ISS

21st International Seating Symposium

Seating & Mobility for People with Disabilities

January 20 – 22, 2005

Wyndham Palace Resort & Spa • Orlando/Lake Buena Vista, FL, U.S.A.

Featuring the Fifth Annual Chris Bar Research Forum

Sponsored by the ROHO Group, Inc.

Sponsored by:

- University of Pittsburgh
  - *Department of Rehabilitation Science and Technology*
  - *School of Health and Rehabilitation Sciences*
  - *RERC on Wheelchair Transportation Safety*
- Pittsburgh VA Rehabilitation Research and Development Center of Excellence - Human Engineering Research Laboratories
- Sunny Hill Health Centre for Children
- University of British Columbia
- RESNA

Course Director:

Elaine Trefler, MEd, OTR/L, FAOTA, ATP

Assistant Professor

University of Pittsburgh

School of Health and Rehabilitation Sciences

Department of Rehabilitation Science and Technology

RST Department of Rehabilitation Science and Technology

School of Health and Rehabilitation Sciences • University of Pittsburgh

Contents

Schedule

General Information

Audience
- Assistive Technology Practitioners (ATP)
- Occupational Therapists
- Physical Therapists
- Assistive Technology Suppliers (ATS)
- Educators
- Manufacturers
- People with disabilities
- Physicians
- Rehabilitation Engineers
- Vocational Rehabilitation Counselors

Introduction
Presentations will cover evaluation, provision, research, funding, and evidence-based practice issues in seating and mobility for people with physical disabilities. The symposium will include scientific and clinical papers, in-depth workshops, special topic sessions, a poster session, and an extensive exhibit hall.

Program Objectives
- Identify seating and mobility interventions for people with physical disabilities
- Understand current funding and policy issues
- Discuss service delivery practices
- Know current research
- Understand features and clinical impact of seating and mobility technologies
- Materials available in alternate formats upon request.

Continuing Education Credit
The University of Pittsburgh, School of Health and Rehabilitation Sciences awards Continuing Education Units to individuals who enroll in certain educational activities. The CEU is designated to give recognition to individuals who continue their education in order to keep up-to-date in their profession. (One CEU is equivalent to 10 hours of participation in an organized continuing education activity). Each person should claim only those hours of credit that he or she actually spent in the educational activity.

The University of Pittsburgh is certifying the educational contact hours of this program and by doing so is in no way endorsing fiany specic content, company, or product. The information presented in this program may represent only a sample of appropriate interventions.

1.75 Continuing Education Units (CEUs) will be awarded to individuals for attending 17.5 hours of instruction.

Exhibits
The exhibit hall will be filled with commercial products from North America and abroad. There will be ample opportunity to explore technical seating and mobility options.

The public is invited to visit the Exhibit Hall "free of charge" on Friday afternoon from 1:00 to 3:00 PM. You must register at the ISS Registration Desk to receive an "Exhibit Hall Pass". Admission at all other times is for Symposium participants only.

This year, for the first time, experts will be available to assist in the evaluating of products in the Exhibit Hall.

▲ Indicates presentation by a representative of a product manufacturer

Seating Symposium

Wednesday, January 19, 2005

7:00 AM
Registration Desk Opens (Great Hall Foyer)

6:00 PM
Registration Desk Closes (Great Hall Foyer)

Thursday, January 20, 2005

7:30 AM
Registration Desk Opens (Great Hall Foyer)

8:30 AM
Opening (Great Hall)

Elaine Trefler, MEd, OTR/L, FAOTA, ATP
Assistant Professor
Department of Rehabilitation Science and Technology
School of Health and Rehabilitation Sciences
University of Pittsburgh

Rory A. Cooper, PhD
Distinguished Professor and Federation of Independent School Alumni & Paralyzed Veterans of America Chair
Department of Rehabilitation Science and Technology
School of Health and Rehabilitation Sciences
University of Pittsburgh
Director, Human Engineering Research Laboratories
VA Rehabilitation Research & Development Center of Excellence
VA Pittsburgh Healthcare System
Professor of Bioengineering, Physical Medicine & Rehabilitation, and Orthopaedic Surgery
Professor McGowan Institute for Regenerative Medicine
VA Senior Career Scientist
Pittsburgh, PA

8:45 AM

Sunrise Medical Keynote Address

What Is Important?

Bengt Engström, PT
Bengt Engström Seating
Värmdö, Sweden

9:45 AM

General Session - Papers - Great Hall

A. Sensory Systems and Seating for Function: The Need for Both Active Postural Control (Use of the Vestibular System) and Passive Postural Management (Use of the Tactile System)

Karen M. Kangas, OTR/L
Shamokin, PA

B. Prevalence of Shoulder Pain in Adult Versus Childhood Onset Wheelchair Use

Bonita Sawatzky, PhD
British Columbia's Children's Hospital, Vancouver, BC, Canada

C. Braking and Swerving of Large Transit Buses Related to Wheelchair and Occupant Safety

Linda van Roosmalen, PhD
University of Pittsburgh, Pittsburgh, PA

D. The Power of Success Sits in the Future

Faye Warren, BA
Consultant for Assistive Technology, Orlando, FL

11:00 AM

Walk-about Lunch (Included in tuition)
Exhibit Hall

1:00 PM

Instructional Courses

Four-Hour Sessions (1:00-5:00 PM)

1. Review of Principles and Practices of Automotive Safety for WheelchairSeated Passengers

Douglas Hobson, PhD
Linda van Roosmalen, PhD
Mary Ellen Bunning, OTR/L, PhD
University of Pittsburgh, Department of Rehabilitation Science and Technology, Pittsburgh, PA

Over the past decade significant advances have been made in the provision of safer transportation for persons that must remain seated in their wheelchairs while being transported in private or public vehicles. All persons responsible for the selection or provision of wheelchairs should be aware of these developments. The workshop will indicate how the principles of automotive passenger safety have been successfully applied to wheelchair seated passengers. It will briefly review both the published and developing industry standards that are now resulting in transport-tested products in the market place. Practical problem-solving scenarios will be discussed, future developments presented, and sources of additional information will be shared with the participants.

2. The Dilemma of Assistive Technology Justification

Laura Cohen, PhD, PT, ATP
The Shepherd Center, Atlanta, GA

When durable medical equipment such as wheelchairs and seating systems, positioning devices (i.e. standers, feeding chairs, car seats, etc.) are being supplied, most insurance carriers (public and private) require that a document indicating the medical necessity for the device accompany any request for prior approval. Herein lays the dilemma. Who is responsible for writing the letter of medical necessity? What information is important to include? Who reviews these letters and what are they looking for? This course will cover the in's and out's of writing a letter of medical necessity. Participants will be invited to adopt a reviewer's perspective. Case studies and discussion will be included.

3. Considerations for the Selection and Fitting of Manual Wheelchairs for Optimal Mobility

Rory Cooper, PhD
Michael Boninger, MD
Rosemarie Cooper, MPT, ATP
Alicia Koontz, PhD
University of Pittsburgh, Department of Rehabilitation Science and Technology, Pittsburgh, PA
VA Pittsburgh Healthcare System, Pittsburgh, PA
Herfried Eisler, KT
Rehabilitations Zentrum, Tobelbad, Austria

Proper selection and fitting of the manual wheelchair has critical implications to mobility, injury prevention, and long term health. This workshop will cover injury mechanisms associated with manual wheelchair usage, basic propulsion biomechanics (including the use of the SMARTWheel), seating ergonomics, preparation of the certificate of medical necessity and wheelchair standards.

Two-Hour Sessions (1:00-3:00 PM)

4. Welded for Wheeling: Custom Ultralights Prescribed with Confidence

Kendra Betz, MSPT
VA Puget Sound Health Care System, Seattle division, Bellevue, WA

A wheelchair should "fit like a glove" with a highly customized configuration that provides optimized comfort, function and performance. The ultralight custom welded frames, when properly prescribed, are the lightest chairs available that best meet individual postural support and mobility needs. Participants will learn to identify chair pushers that would be best served with a custom frame and will gain increased skill and confidence for prescribing custom ultralights that are welded for wheeling.

5. Pressure Mapping: Bench Testing of Cushions and Clinical Applications

David Brienza, PhD
University of Pittsburgh, Department of Rehabilitation Science and Technology, Pittsburgh, PA
Sharon Pratt, PT
▲ *Sunrise Medical, Longmont, CO*
Stephen Sprigle, PhD, PT
Georgia Institute of Technology, Atlanta, GA

6. Matching Client Function with Specialized Manual Mobility Options

Jane Fontein, OT
Phil Mundy, PEng
▲ *PDG Product Design Group Inc., Vancouver, BC, Canada*

This seminar provides practical instruction in assessing and dispensing manual mobility devices for people with complex needs. Using case histories this presentation will emphasize manual tilt wheelchairs, manually operated bariatric wheelchairs and wheelchairs for persons with high agitation.

7. Early Interventions for Positioning the Infant and Small Child

Sheena Schoger, Dip. OT, OT Reg (Ont.)
Children's Rehabilitation Centre of Essex County, Windsor, ON, Canada

Assessment of the pediatric client, for the prescription of seating and mobility products, is more than measurements, range of motion and alignment. This presentation will help you identify strategies with which to incorporate the seating and mobility products with other functional needs such as switch access, oral motor control and other functions

3:00 PM

Break - Exhibit Hall

3:30 PM

Instructional Courses

Two-Hour Sessions (3:30-5:30 PM)

8. Client Evaluation Demonstration

Adrienne F. Bergen, PT, ATP/S
Boca Raton, FL

Clients from the Orlando area with complex seating and mobility challenges will be evaluated as part of a learning experience. They will be accompanied by their local practitioners, so that evaluation information will be complete and follow-up is possible.

9. International Standard for Postural Measures of a Wheelchair Seated Person

Barbara Crane, PhD, PT, ATP
Consultant, Wethersfield, CT
Kelly Waugh, MS, PT
Assistive Technology Partners, University of Colorado Health Sciences Center, Denver, CO

The technical content of an international standard defining measures used in wheelchair seating and seated postural assessment is now complete. This session will discuss clinical guidelines and strategies for performing postural assessments consistent with the international standard. Attendees will hear about documentation available including a clinical guidelines document and a companion document containing common terminology associated with seated postural assessment and defining postural support devices.

10. Development and Use of a Standard Clinical Tool for the Assessment of Manual Wheelchair Propulsion Biomechanics

Carmen DiGiovine, PhD, ATP, RET
University of Illinois at Chicago, Chicago, IL
Alicia Koontz, PhD
University of Pittsburgh, Department of Rehabilitation Science and Technology, Pittsburgh, PA;
VA Pittsburgh Healthcare System, Pittsburgh, PA

This session will highlight the importance of the development and use of a standard clinical tool to assess manual wheelchair propulsion biomechanics, including propulsion strength, style, and efficiency. A step-by-step description of the clinical protocol and the way in which outcome variables are calculated will be provided. We will also review the ways in which propulsion data gathered through the clinical protocol is presently being used, and we will suggest additional future applications.

11. Clinical Protocol for the Administration and Interpretation of Interface Pressure Mapping for Sitting

Jillian Swaine, OT
Swaine & Associates, Calgary, AB, Canada
Stephen Sprigle, PhD, PT
Georgia Institute of Technology, Atlanta, GA
Linda Janzen, PT
Foothills Medical Center, Calgary, AB, Canada
Cherly Oga, OT
Foothills Medical Center, Calgary, AB, Canada

Interface pressure mapping (IPM) is used as a clinical assessment and educational tool for clients who are at high risk for developing sitting acquired pressure ulcers (SAPUS). This interactive workshop will present an evidenced based clinical protocol that was developed and piloted by a group of occupational and physical therapists working in community and acute care hospital settings.

5:30 PM

Adjournment

5:30 PM

Welcome Reception (Exhibit Hall)

Friday, January 21, 2005

7:00 AM

Continental Breakfast (Exhibit Hall)

8:00 AM

Instructional Courses

Four-Hour Sessions (8:00 AM - Noon)

12. Power Wheelchair Access Evaluation and Programming

Michelle Lange, OTR, ABDA, ATP
The Children's Hospital of Denver, Denver, CO

This course will present assessment strategies for determining the optimal access method for independent and funcitonal control of a power wheelchair. A variety of power wheelchairs and access methods will be available for a hands-on lab. Finally, programming strategies to optimize use of various access methods will also be covered.

13. Making It My Choice: Beyond the Theory of Seating And Mobility - A Review of Equipment Prescriptions Based on Client Needs for Function

Sheila Buck, BSc (OT), Reg (Ont.), ATP
Therapy Now, Inc., Milton, ON, Canada

This workshop will review the basic elements of a full seating/mobility service. The presentation will begin with the MAT assessment, go on to positioning of essential body segments, the simulation of the seated position and technology placement and conclude with the final evaluation of the system as it is to be used to accomplish functional activities. Case studies as well as hands on simulation will be used throughout the session to assist in the learning process.

14. Positioning 24/7 - Using Seating and Alternative Positioning for All Populations

Ann Eubank, OTR/L, ATP
Bryan Malone, PT
Deborah Poirier, ATP
Clover Bottom Developmental Center, Nashville, TN

This course will offer intermediate to advanced simulation techniques and seating and alternative positioning methodology. A hands-on, experiential learning environment, providing the latest simulation equipment and techniques, along with lecture, will be included. Advanced case studies, using video and slides, will address the following: molded simulation including foam sculpting techniques, custom incline supine (bed positioner), quadruped on forearms, planar simulation, and custom modification techniques and methodology.

Two-Hour Sessions (8:00 - 10:00 AM)

15. Special Session on Medicare Legislation

Facilitators:
Barbara Crane, PhD, PT, ATP
Consultant, Wethersfield, CT
Laura Cohen, PhD, PT, ATP
The Shepherd Center, Atlanta, GA

16. Wheelchair Sports/Recreation at the Rehabilitations Zentrum

Herfried Eisler, KT
Rehabilitations Zentrum, Tobelbad, Austria

17. Transportation Integration--Thinking Beyond the Wheelchair

Kevin Phillips
Ability Center, San Diego, CA
Kathryn Fisher, BSc, OT Reg (Ont.)
Therapy Supplies f Rentals, Toronto, ON, Canada
Jan Miller Polgar, PhD, OT Reg (Ont.)
The University of Western Ontario, London, ON, Canada

Mobility demands of an active lifestyle require that the personal mobility equipment of a person with a disability integrates seamlessly with their personal transportation. Participants will learn how to assess transportation needs and recommend integration compatible wheelchairs. The in-vehicle consideration of visual, cognitive and mobility abilities of the user as well as vehicle types, entry/exit modes and lift options will be covered in the presentations.

10:00 AM

Break - Exhibit Hall

10:30 AM

Instructional Courses

One-Hour Sessions (10:30 - 11:30 AM)

18. Assessing A Seating System For The Long Haul

Trudie Read OTR/L
▲ *Varilite(tm), Seattle, WA*

This presentation discusses the issue of how to assess a seating/mobility system to meet the needs of persons who are aging. They live longer, have more chronic problems and require an ongoing change to their performance needs including pressure management and the prevention of over-use syndrome.

19. Pain: Defining, Categorizing, and Determining Seating Involvement

Jessica Pedersen, MBA, OTR/L, ATP
Rehabilitation Institute of Chicago, Chicago, IL

Everyone experiences pain at some point in their lives and seeks relief. This requires one to know the cause of the pain so intervention can be focused. Participants will learn categorizations of pain followed by a discussion on how to determine if client described pain is caused by the seating system. Methods of specific intervention to decrease or alleviate the pain using seating products will be discussed.

20. ***Session Cancelled***

Paper Session - Pressure

E. Under Pressure - Strategies for Reducing the Likelihood of Skin Breakdown While in the ER

Ian Denison, PT, ATP
Kathy Norton, MSc, OT
GF Strong Rehab Centre, Vancouver, BC, Canada

F. Objective Insight in Loading Characteristics in Sitting

Joke H. Grady, OT, MSc
▲ *Grady Onderzoek en Advies BV, Haaksbergen, Netherlands*

G. A Marriage Made in Heaven - Join Two Old Technologies for a Customized Cushion

Eva K. Ma, OTR, ATP, PC
Portland, OR

H. Sitting Acquired Pressure Ulcers: Collecting Incidence Data in Tasmania, Australia

Jillian Swaine, BSc (OT)
Swaine & Associates, Calgary, AB, Canada

I. Spectroscopic Assessment of the Blanch Response in Elderly Nursing Home Residents at Risk for Pressure Ulcers

Jeanne Zanca, MPT
University of Pittsburgh, Pittsburgh, PA

11:30 AM

Lunch - Exhibit Hall

12:00 PM

Interactive Poster Session

Note: Posters will be available for viewing from Thursday, 11:00 AM through, Friday 3:00 PM.

P1. Approach to Prevention of Pressure Ulcers in National Rehabilitation Center

Hideyuki Hirose, PT, Mech. Eng.
National Rehabilitation Center for Persons with Disabilities, Tokorozawa, Saitama, Japan

P2. The Effect of Wheelchair Tilt and Recline on Seated Pressure Distribution

Kathryn Wilson, OT
Jan Miller Polgar, PhD, OT Reg (Ont.)
The University of Western Ontario, London, ON, Canada

P3. Evaluation of Newly Designed Water Cushion for Wheelchair Users

Junichi Kubo, BS
Graduate School of Science and Technology, Niigata University,Niigata, Japan
Hisaichi Ohnabe, PhD
University of Pittsburgh, Dept. of Rehabilitation Science and Technology, Pittsburgh, PA
VA Pittsburgh Healthcare System, Pittsburgh, PA

P4. Local Tissue Perfusion Recovery Using an Automated Seating System Featuring Dynamic Ischial Unloading

Mohsen Makhsous, PhD
Northwestern University f Rehabilitation Institute of Chicago, Chicago, IL

P5. The Clinical Assessment and How It Relates to Technology

Sharon Pratt, PT
▲ *Sunrise Medical, Longmont, CO*

1:00 PM

Instructional Courses

Three and 1/2 Hour Sessions (1:00 - 4:30 PM)

21. Review of Medical, Technology, and Psychosocial Issues for Persons With MS

Michael L. Boninger, MD
Rosemarie Cooper, MPT, ATP
University of Pittsburgh, Department of Rehabilitation Science and Technology, Pittsburgh, PA
VA Pittsburgh Healthcare System, Pittsburgh, PA
Jean Minkel, MA, PT
Minkel Consulting, New Windsor, NY

22. Interfacing Assistive Technology and Power Wheelchairs

Michelle Lange, OTR, ABDA, ATP
The Children's Hospital of Denver, Denver, CO

This course will present clinical indicators for appropriate and successful interfacing of a variety of assistive technology devices through power wheelchair electronics. Interfacing will be demonstrated on Invacare, Quickie, and Permobil power wheelchairs with hands-on opportunities for the participants. Interfaced technology will include power actuators, communication devices, computers and Electronic Aids to Daily Living.

Two-Hour Sessions (1:00 - 3:00 PM)

23. Wheelchair. Is a Compound Word

Ian Denison, PT, ATP
GF Strong Rehab Centre, Vancouver, BC, Canada
Bonita Sawatzky, PhD
British Columbia's Children's Hospital, Vancouver, BC, Canada

Wheelchair is a compound word. All too frequently the first part of a word, "wheel" is overlooked. This presentation will provide information on wheel and tire selection that will help optimize the performance of the "chair" you have so careful to prescribed.

24. Custom Contoured Seating: A Pediatric Lightweight System and an Adjustable Contoured Back

Delia "Dee Dee" Freney-Bailey, OTR/L, ATS
Private Therapy Consultant, Castro Valley, CA

25. Application of the ZAS in Diagnostics: a Clinical View

J. de Vries, MD, PhD
Revalidatie Centrum Kastenjehof, Apeldoorn, Netherlands

The ZAS, a pressure measurement analysis program developed to provide input data for custom designed seating system, was used in a study performed between two groups of wheelchair users who received custom made seating systems. The ZAS was applied to the experimental group and standard procedures were applied to the control group. The experimental group showed better performance.

26. Functioning Everyday with a Wheelchair (FEW): Applications for Assessing Wheelchair Function in Clinic, Home, and Community Environments

Tamara Mills, PhD, OTR/L
Kessler Medical Rehabilitation Research and Education Corp., West Orange, NJ
Mark Schmeler, MS, OTR/L, ATP
University of Pittsburgh, Department of Rehabilitation Science and Technology; UPMC Center for Assistive Technology, Pittsburgh, PA

The Functioning Everyday with a Wheelchair (FEW) performance-based observation tools were developed to assess seating-mobility functioning of consumers in a clinic setting and their home or community environment. The objectives of this course are to demonstrate the applicability of these instruments in measuring consumer independence, safety, and quality of performance with seating-mobility technology in a clinic and non-clinic environment. Participants will have the opportunity to administer the tool and become familiar with its scoring system.

27. Seating Under the Influence

Thomas Hetzel, PT, ATP
Joan Padgitt, PT, ATP
▲ *Ride Designs, Denver, CO*

Faced with pressure sores that will not heal, postural deformities, chronic pain, shoulder/elbow/wrist joint dysfunction, wheelchair users aging with their disability tend to be the most complex and challenging for assistive technology practicioners and suppliers. Using case studies, pressure mapping, and interactive dialog, this presentation will discuss the option of Orthotic and Prosthetic influenced contoured seating where the person's shape does not dictate but instead influences the shape of their seating system while meeting both the skin AND postural outcomes.

3:00 PM

Break (Exhibit Hall)

3:30 PM

Instructional Courses

One-Hour Sessions (3:30 - 4:30 PM)

28. Impact of Long Term Sitting in the Spinal Cord Injury Population: Effects on Posture, Pulmonary Function, and Skin Integrity

Amy Bjornson, PT, ATP
▲ *Sunrise Medical, Longmont, CO*

Persons with a spinal cord injury are experiencing near normal life expectancies due to advances in health care and SCI management. This course will utilize case studies to illustrate how clients age with spinal cord injuries and will demonstrate the impact a seating system on the pulmonary system, posture, skin integrity, function and quality of life.

29. Modification of a Seat Digitizer to Accommodate Significant Musculoskeletal Deviations

Linda Elsaesser, PT, ATP
Elsaesser Consulting, Saylorsburg, PA

This workshop will review various technologies that have attempted to provide custom seating technology. Specifically it will use case studies to illustrate a shape sensor seat digitizer designed to provide effective custom contoured seat cushions for clients with significant pelvic obliquity.

30. The Trouble With the Shoulder...

Patrick Meeker, MS, PT
▲ *The ROHO Group, Inc., Belleville, IL*

There is research and clinical information regarding the correlation between upper extremity overuse injuries and the manual wheelchair user. How do we answer our clients questions regarding how to manage their functional limitations and/or relieve their pain. This session will provide current information about conservative and surgical approaches for managing shoulder and upper extremity injuries in manual wheelchair users.

31. Empower and Assist!

Brenlee Mogul-Rotman, BSc, OT, OTR, ATP, OT Reg (Ont.)
Toward Independence, Richmond Hill, ON, Canada

Not all clients that would benefit from a powered mobility device require a powered wheelchair. How about a "middle of the road" option of a Powered Assist unit. This session will discuss the concept of power assist, appropriate client selection and justification guidelines.

32. External Stabilization Systems Used in Sitting and Standing

Catherine Mulholland, OTR/L
Pacific Rehab Inc., Scottsdale, AZ

Orthotic undergarments and strapping systems are currently being used internationally as aides to provide dynamic postural stability. Case histories will be reviewed to show the positive affects that this type of intervention can have in sitting, standing and dynamic movement.

4:30 PM

Chris Bar Research Forum

Sponsored by
The ROHO Group, Inc.

Chairman:
Geoff Bardsley, PhD
TORT Centre, Ninewells Hospital, Dundee, Scotland

The 2005 Chris Bar Research Forum is a British Parliamentary style debate focusing on current research or service delivery issues.

The motion to be debated is as follows:

This house believes that the gathering of clinical evidence to support Assistive Technology practice is a waste of time!

Saturday, Januarry 22, 2005

8:00 AM

Continental Breakfast

8:30 AM

Instructional Courses

Three-Hour Sessions (8:30 - 11:30 AM)

33. CPT Coding and Reimbursement for AT Service Providers

Barbara Levy, PT, ATP
Thoms Rehabilitation Hospital, Asheville, NC

This course will provide background information on Common Procedural Terminology (CPT) Codes and how to utilize them for billing of health care professional services in AT Practice. Included will be a review of how codes are edited and changed and the role RESNA, AOTA, and APTA, took in obtaining the recent revisions. Documentation requirements and reimbursement issues for various practice settings and disciplines will be reviewed. Participants will be encouraged to share their experiences of what has been reimbursed and what has been denied in their particular practice setting or region.

Two-Hour Sessions (8:30 - 10:30 AM)

34. Man's Best Friend: The Benefits of Service Dogs

Shirley G. Fitzgerald, PhD
Diane Collins, PhD, OTR/L
VA Pittsburgh Healthcare System, Department of Rehabilitation Sciences and Technology, University of Pittsburgh, Pittsburgh, PA
Natalie Sachs-Ericcson, PhD
Florida State University, Tallahassee, FL

Service dogs are trained to help individuals with disabilities in a variety of ways, such as retrieving items, opening doors and repositioning people in their wheelchairs. This session will provide information on service dogs including how the dogs are trained, how clients can obtain a service dogs as well as an overview on what research has been conducted to validate the efficacy of service dogs. A demonstration, showing different tasks that the service dogs can perform, will be given.

35. Impact of a Progressive Seating Program on the Spinal Cord Injury Patient

Vicki Bunton, PTA
Charlotte Institute of Rehabilitation, Charlotte, NC
Paul Wilkie, RTS
Chesapeake Rehab Equipment Company, Charlotte, NC

Progressively seating the spinal cord injured patient in the rehabilitation phase of recovery promotes a healthy client / interdisciplinary team interaction. This contributes to the patient achieving the maximum potential for functioning at home and in the community. Using a comprehensive team approach to assess the various needs of persons with a spinal cord injury, a customized provision of seating and mobility components will promote maximum functional outcomes and interaction with their environment.

36. THyperextension, obligatory Reflexes, or the Opisthotonic Reaction? Facing the seating challenges of children whose seating systems do not recognize this body posture

Karen M. Kangas, OTR/L
Shamokin, PA

When a child is diagnosed with cerebral palsy, brain injury, and/or clinical rigidity, often an opisthotonic reaction is present. We will explore how seating can be provided that does not activate this reaction as well as strategies that will assist the children gain increased control of their bodies.

37. Under Pressure: Managing Pressure Outside The Bed

Linda Norton, OT Reg (Ont.)
Shoppers Home Health Care, Etobicoke, ON, Canada

Managing the pressure throughout a client's normal routine begins with an assessment of pressure and shearing during all activities, and in relation to all surfaces with which the client comes in contact. Strategies can then be developed to manage pressure in each domain that may include transfers, bathroom fixtures, transportation, and seating and mobility devices. This interactive workshop will highlight seating practices in relation to pressure ulcers as well as sharing solutions to high pressure and shear during all activities of daily living.

38. Creative Molding or Why Everything We've Learned Doesn't Always Work!

Jill Sparacio, OTR/L, ATP, ABA
Sparacio Consulting Services, Downers Grove, IL

The use of custom molded seating components can be an effective means of providing support and alignment for individuals with skeletal deformities. Creative molding and non-traditional techniques and orientations can result in providing individuals a position of comfort and balance. The evaluation process will be examined using case studies. Specific client goals including areas of function such as respiration, oral motor skills, upper extremity function and pressure management will be presented.

39. Therapeutic Positioning During Sleep

Kelly G. Waugh, MA, PT
Assistive Technology Partners, University of Colorado Health Sciences Center, Denver, CO

Many individuals with physical disabilities have a difficult time sleeping due to movement dysfunction, pain, or because of difficulties with breathing, swallowing or digestion. This leads to poor sleep quality and duration - both for the disabled individual and their caregiver. Additionally, many children with severe motor impairments sleep in asymmetrical postures that promote the development of orthopedic deformities. A specific therapeutic position program will be presented including goals of sleep positioning, interventions strategies and equipment options.

Paper Session-Outcomes

J. Comparison of Telerehabilitation f In Person Assessments in the Determination of Wheelchair Accessories Recommendations

Ana Allegretti, MS, OT
University of Pittsburgh, Pittsburgh, PA

K. Custom Body Support Using the 2nd Generation Matrf System

Steven J, Cousins, PhD, SRCS
Royal Hospital for Neuro-disability, London, England

L. Client Satisfaction with a Wheelchair and Seating Program: An Evaluation of Alternative Service Delivery Methods

Erica Dowdell, OT
Laura Titus, OT
Jan Miller Polgar, PhD, OT Reg (Ont.)
The University of Western Ontario, London, ON, Canada

M. Living With the iBOT: a Functional and Vocational Profile of iBOT Users in the First 6 Months

Martin Ferguson-Pell, PhD
University College of London, Stanmore, UK

N. Sharing Research Results - What Is the Scoring System of the F.I.M. Really Measuring?

Jean Minkel, MA, PT
Minkel Consulting, New Windsor, NY

O. A RCT to Compare the Effectiveness of an Individualized Seating Intervention With Conventional Seating System

Anna Wu, MS
Caritas Medical Centre, Hospital Authority, Hong Kong

10:30 AM

Break

10:45 AM

Instructional Courses

One-Hour Sessions (10:45 - 11:45 AM)

40. Challenges and Solutions to Providing Assistive Technology for the Bariatric Client

Elizabeth Cole, MSPT
▲ *Sunrise Medical, Longmont, CO*

The needs of bariatric clients encompass more than increasing seat width and depth and equipment weight limits. In addition to the effects of disability, injury and secondary medical complications and aging, our bariatric clients present with a special set of challenges. This course will discuss the challenges of performing an evaluation, addressing skin issues, accommodating variable body shapes and types and addressing environmental issues.

41. The Henry Ford Approach to Custom Made Seats and Backs

Steven Cousins, PhD, SRCS
Royal Hospital for Neuro-disability, London, England
Richard Hannah, MSc
▲ *Symmetric Designs, Salt Spring Island, BC, Canada*

In this course we will explore the structural matrix concept, the opposite of the Henry Ford approach that you can have any color car as long as it is black, in which we use mass-produced components for one-of, custom shaped, non-identical products. We will cover the transformation of the 'off the shelf' mass produced technology in to a shapeable/lockable, and clinically acceptable structure that can be fitted and delivered to clients. We will discuss the biomechanical, clinical and workshop implications of this technique as well as future applications.

42. Measuring Wheelchair Seat Comfort: Research Methodology and Application to Clinical Practice

Barbara Crane, PhD, PT, ATP
Consultant, Wethersfield, CT

The Tool for Assessing Wheelchair Comfort (TAWC) was designed to measure one clinical outcome of seating intervention in a seating practice, comfort. Results from a 3 year development and testing process will be discussed as well as potential application of the tool in future research or clinical practice.

43. Non-Traditional Roles for Clinicians

Kay Koch, OT, ATP
Children's Healthcare of Atlanta, Mobility Designs, Atlanta, GA

44. Who Needs Power?

Gloria Leibel, OT (C)
Bloorview Macmillan Children's Centre, Toronto, ON, Canada
Kathryn Fisher, BSc, OT Reg (Ont.)
Therapy Supplies f Rentals, Toronto, ON, Canada

By discussing three diagnostic groups (Spina Bifida, Cerebral Palsy and Muscular Dystrophy) in case history format, strategies that assist in making appropriate recommendations for powered mobility based on evidence-based practice will be presented. For each group we will present trends related to effective choice, medical conditions and implications and finally technical options.

45. Getting it Right the First Time!

Tina Roesler, MSPT, ABDA
▲ *The ROHO Group, Belleville, IL*
Josh Anderson
▲ *TiLite, Kennewick, WA*

When fitting a client for a manual mobility device, the first chair can be the most important chair! Size, configuration of components and the selection of a seating system will have a significant impact on a client's ability to maximize function and mobility while limiting the risk for upper extremity injury. This course will present up to date clinical research and demonstrate how this information can help us to make good equipment recommendations.

46. Impossibility or Probability? EADLs in a Long-Term Care Facility

Faith Saftler Savage, PT, ATP
The Boston Home, Natick, MA

The Boston Home is a 96 bed long-term care facility with many residents having a diagnosis of Multiple Sclerosis. Residents are struggling with maintaining independence an all activities of their life including using a phone, television, bathing, dressing and mobility. There is technology to assist but they are costly. This workshop will report on a two-year effort by the facility to maximize residents independence using alternative funding sources.

11:45 AM

Special Session

Dream On !

Service Delivery Challenges Around the Globe

Funding?
Location?
Unique population?
Payment?
Technology Limits?
Government Directives?

What is it that is giving you a headache?

This panel of experts from many parts of the world will set the scene for an interesting discussion on what can be done to overcome some of the problems we have in providing service delivery.

Share your own perspective in the discussion period.

Then go back home and make it work!

Geoff Bardsley, PhD
TORT Centre, Ninewells Hospital, Dundee, Scotland
Martin Ferguson-Pell, PhD
University College of London, Stanmore, UK
Ray Fulford, P.Eng, MSc
Society for Manitobian's with Disabilities, Winnipeg, MB, Canada
Jean Minkel, MA, PT
Minkel Consulting, New Windsor, NY, USA
Sheila Buck, BSc (OT), Reg (Ont.), ATP
Therapy Now, Inc., Milton, ON, Canada

1:00 PM

Adjournment

Faculty

A

Ana Allegretti
University of Pittsburgh
Department of Occupational Therapy
5014 Forbes Tower
Pittsburgh, PA 15260
ala15@pitt.edu

Comparison of Telerehabilitation & In Person Assessments in the Determination of Wheelchair Accessories Recomendations
Paper - Saturday - 8:30 AM

Josh Anderson
TiLite
20191 E. Country Club Drive #2602
Aventura, FL 33180
janderson@tilite.com

Getting it Right the First TIme!
IC 45 - Saturday - 10:45 AM

B

Geoff Bardsley
TORT Centre, Ninewells Hospital
Dundee, Scotland DD1 9SY
geoff@tortc.tuht.scot.nhs.uk

Chris Bar Research Forum
Chairman – Friday – 4:30 PM

Dream On ! Service Delivery Challenges Around the Globe
Closing Session - Saturday - 11:45 AM

Adrienne Bergen
13727 Plaza Mayor Drive
Delray Beach, FL 33446
adriennebergen@aol.com

Client Evaluation Demonstration
IC 8 - Thursday - 3:30 PM

Kendra Betz
VA Puget Sound Health Care System, Seattle Division
17400 NE 19th Place
Bellevue, WA 98008
Kendra@betzfamily.com

Welded for Wheeling - Custom Ultralights Prescribed with Confidence
IC 4 - Thursday - 1:00 PM

Amy Bjornson
Sunrise Medical
7477 East Dry Creek Parkway
Longmont, CO 80503
Elizabeth.Cole@sunmed.com

Impact of Long Term Sitting in the Spinal Cord Injury Population: Effects on Posture, Pulmonary Function and Skin Integrity
IC 28 - Friday - 3:30 PM

Michael Boninger
University of Pittsburgh, Department of Rehabilitation Science and Technology
VA Pittsburgh Healthcare System
5044 Forbes Tower
Pittsburgh, PA 15260
mlboning@pitt.edu

Considerations for the Selection and Fitting of Manual Wheelchairs for Optimal Mobility
IC 3 - Thursday – 1:00 PM

Review of Medical and Technology and Psychosocial Issus for Persons with MS
IC 21 - Friday - 1:00 PM

David Brienza
University of Pittsburgh, Department of Rehabilitation Science & Technology
5044 Forbes Tower
Pittsburgh, PA 15260
dbrienza@pitt.edu

Pressure Mapping: Bench testing of Cushions and Clinical Applications
IC 5 - Thursday - 1:00 PM

Sheila Buck
Therapy NOW
811 Graham Bell Crt.
Milton, Ontario L9T 3T1
therapynow@cogeco.ca

Making it My Choice: Beyond The Theory of Seating and Mobility - A Review of Equipment Prescriptions Based on Client Needs for Function
IC 13 - Friday - 8:00 AM

Dream On !   Service Delivery ChallengesAround the Globe
Closing Session - Saturday - 11:45 AM

Mary Ellen Buning
University of Pittsburgh, Department of Rehabilitation Science & Technology
5044 Forbes Tower
Pittsburgh, Pa 15260
mbuning@pitt.edu

Review of Principles and Practices of Automotive Safety for Wheelchir Seated Passengers
IC 1 - Thursday - 1:00 PM

Vicki Bunton
Charlotte Institute of Rehabilitation
1100 Blythe Blvd
Charlotte, N.C. 28203
cirseatingclinic@carolinashealthcare.org

Impact of a Progressive Seating Program on the Spinal Cord Injury Patient
IC 35 - Saturday - 8:30 AM

C

Laura Cohen
Crawford Research Institute
The Shepherd Center
2020 Peachtree Rd, NW
Atlanta, GA 30309
Laura_Cohen@Shepherd.org

The Dilemma of Assistive Technology Justification
IC 2 - Thursday - 1:00 PM

Special Session on Medicare Legislation
IC 15 - Friday - 8:00 AM

Elizabeth Cole
Sunrise Medical
7477 East dry Creek Parkway
Longmont, CO 80503
Elizabeth.Cole@sunmed.com

Challenges and Solutions to Providing Assistive Technology for the Bariatric Client
IC 40 - Saturday - 10:45 AM

Diane Collins
University of Pittsburgh, Department of Rehabilitation Science and Technology
VA Pittsburgh Healthcare System
5044 Forbes Tower
Pittsburgh, PA 15260

Man’s Best Friend: The Benefits of Service Dogs
IC 34 - Saturday – 8:30 AM

Rory Cooper
University of Pittsburgh, Department of Rehabilitation Science and Technology
VA Pittsburgh Healthcare System
5044 Forbes Tower
Pittsburgh, PA 15260

Considerations for the Selection and Fitting of Manual Wheelchairs for Optimal Mobility
IC 3 - Thursday – 1:00 PM

Rosemarie Cooper
University of Pittsburgh, Department of Rehabilitation Science and Technology
VA Pittsburgh Healthcare System
5044 Forbes Tower
Pittsburgh, PA 15260

Considerations for the Selection and Fitting of Manual Wheelchairs for Optimal Mobility IC 2 - IC 3 - Thursday – 1:00 PM

Steven Cousins
Royal Hospital for Neuro-disabiltiy,
West Hill, Putney
London, England SW15 3SW
scousins@rhn.org.uk

Custom Body Support Using the 2nd Generation Matrix System
Paper - Saturday - 8:30 AM

The Henry Ford Approach to Custom Made Seating and Back Support
IC 41 - Saturday - 10:45 AM

Barbara Crane
180 Middletown Avenue
Wethersfield, CT 06109
barb.crane@cox.net

International Standard for Postural Measures of a Wheelchair Seated Person
IC 9 - Thursday - 3:30 PM

Special Session on Medicare Legislation
IC 15 - Friday - 8:00 AM

Measuring Wheelchair Seat Comfort: Research Methodology and Application to Clinical Practice
IC 42 - Saturday - 10:45 AM

D

J. de Vries
Revalidatie Centrum Kastanjehof
Arnhemseweg 11
7301 BB Apeldoorn
Netherlands
jaap.de.vries.planet.nl

Place and Meaning of Sit Load Analysis Software (SLAS) in Diagnostics and Treatment of Sit Complaints /Impairments
IC 25 - Friday - 1:00 PM

Ian Denison
G F Strong Rehab Centre (VHHSC)
4255 Laurel St
Vancouver, BC V5Z 2G9
idenison@vanhosp.bc.ca

Under Pressure - Strategies for reducing the likelihood of skin breakdown while in ER
Paper - Friday - 10:30 AM

Wheelchair is a Compound Word
IC 23 - Friday - 1:00 PM

Carmen DiGiovine
University of Illinois at Chicago
1640 West Roosevelt Road,
Suite 436 IIDD
Chicago, Illinois 60608-6904
cpdigiov@uic.edu

Development and Use of a Standard Clinical Tool for the Assessment of Manual Wheelchair Propulsion Biomechanics
IC 10 - Thursday - 3:30 PM

Erica Dowdell
The University of Western Ontario
Parkwood Hospital
1201 Western Road
London, ON N6G 1H1

Client Satisfaction with a Wheelchair and Seating Program: An Evaluation of Alternative Service Delivery Methods
Paper - Saturday - 8:30 AM

E

Herfried Eisler
Rehabilitations Zentrum
A-8144 Tobelbad, AUSTRIA

Considerations for the Selection and Fitting of Manual Wheelchairs for Optimal Mobility
IC 3 - Thursday – 1:00 PM

Wheelchair Sports/Recreation at the Rehabilitations Zentrum
IC 16 - Friiday – 8:00 AM

Linda Elsaesser
RR 7 Box 7744
Saylorsburg, PA 18353
elsaesser@enter.net

Modification of a Seat Digitizer to Accommodate Significant Musculoskeletal Deviations.
IC 29 - Friday - 3:30 PM

Bengt Engström
Bengt Engström Seating
Jagarvagen 14
Värmdö, S-139 40 Sweden
engstrom@posturalis.com

What is Important?
Keynote Address - Thursday - 8:30 AM

Ann Eubank
Clover Bottom Developmental Center
Assistive Technology Clinic
275 Stewarts Ferry Pike
Nashville, TN 37214
Ann.Eubank@state.tn.us

Positioning 24/7 – Using Seating and Alternative Positioning for All Populations
IC 14 - Friday - 8:00 AM

F

Martin Ferguson-Pell
University College of London
Center for Disability Research & Innovation
Stanmore HA7 4LP England
m.ferguson-pell@ucl.ac.uk

Living With the iBOT: a Functional and Vocational Profile of iBOT Users in the First 6 Months
Paper - Saturday - 10:45 AM

Dream On ! Service Delivery Challenges Around the Globe
Closing Session - Saturday - 11:45 AM

Kathryn Fisher
Therapy Supplies and Rentals, Ltd.
104 Bartley Drive
Toronto, ON M4A 1C5 Canada
kfish@sympatico.com

Transportation Integration--Thinking Beyond the Wheelchair
IC 17 - Friday - 8:00 AM

Who Needs Power?
IC 44 - Saturday - 10:45 AM

Shirley Fitzgerald
University of Pittsburgh, Department of Rehabilitation Science and Technology
VA Pittsburgh Healthcare System
5044 Forbes Tower
Pittsburgh, PA 15260
Sgf9@pitt.edu

Man's Best Friend: The Benefits of Service Dogs
IC 34 - Saturday - 8:30 AM

Jane Fontein
PDG Product Design Group Inc.
Unit 102, 366 East Kent Avenue South
Vancouver, BC V5X 4N6
jane_fontein@prodgroup.com

Matching Client Function with Specialized Manual Mobility Options
IC 6 - Thursday - 1:00 PM

Delia "Dee Dee" Freney-Bailey
19356 Darcrest Ct.
Castro Valley, CA 94546
DDFreney@aol.com

Custom Contoured Seating: A Pediatric Lightweight System and an Adjustable Contoured Back
IC 24 - Friday - 1:00 PM

Ray Fulford
Society for Manitobian's with Disabilities
Wheelchair Services
1111 Winnipeg Ave.
Winnipeg, MB R3E 0S2 Canada

Dream On ! Service Delivery ChallengesAround the Globe
Closing - Saturday - 11:45 AM

G

Joke Grady
Grady Onderzoek en Advies BV
Lansinkstraat 38
7481 JP Haaksbergen Netherlands
J.Grady@goa-bv.nl

Objective Insight in Loading Characteristics in Sitting
Paper - Friday - 10:30 AM

H

Richard Hannah
Symmetric Designs
125 Knott Place
Salt Spring Island, BC V8K 2M4 Canada

The Henry Ford Approach to Custom Made Seating and Back Support
IC 41 - Saturday - 10:45 AM

Thomas R. Hetzel
Ride Designs
4251-K South Natches Court
Sheridan, CO 80110
tom@ridedesigns.com

Seating Under the Influence
IC 27 - Friday - 1:00 PM

Hideyuki Hirose
National Rehabilitation Center for Persons with Disabilities
4-1, Namiki
Tokorozawa, Saitama, Japan 359－8555
hirose@rehab.go.jp

Approach to Prevention of Pressure Ulcer in National Rehabilitation Center
Poster Session - Friday - 12:00 Noon

Douglas Hobson
University of Pittsburgh, Department of Rehabilitation Science and Technology
5044 Forbes Tower
Pittsburgh, PA 15260
dhobson@pitt.edu

Review of Principles and Practices of Automotive Safety for Wheelchir Seated Passengers
IC 1 - Thursday - 1:00 PM

J

Linda Janzen
7103 Christie Briar Manor SW
Calgary, Alberta T3H 2G5
info@jillianswaineots.com

Clinical Protocol for the Administration and Interpretation of Interface Pressure Mapping for Sitting
IC 11 - Thursday - 3:30 PM

K

Karen M. Kangas
private practice
R.R. 1, Box 70
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kmkangas@ptd.net

Sensory Systems and Seating for Function: The Need for Both Active Postural Control (Use of the Vestibular System) and Passive Postural Management (Use of the Tactile System)
Paper - Thursday - 8:30 AM

Too Much “Hyperextension,” and “Obligatory Reflex,” or the Opisthotonic Reaction?
IC 36 - Saturday - 8:30 AM

Kay Koch
Children’s Healthcare of Atlanta
Mobility Designs
296 Hascall Road NW
Atlanta, GA 30309
kkhotr@yahoo.com

The Road Not Taken- Options and Alternatives Outside the Clinic
IC 43 - Saturday - 10:45 AM

Alicia Koontz
University of Pittsburgh, Department of Rehabilitation Science and Technology
VA Pittsburgh Healthcare System
5044 Forbes Tower
Pittsburgh, PA 15260
akoontz@pitt.edu

Considerations for the Selection and Fitting of Manual Wheelchairs for Optimal Mobility
IC 3 - Thursday – 1:00 PM

Development and Use of a Standard Clinical Tool for the Assessment of Manual Wheelchair Propulsion Biomechanics
IC 10 - Thursday - 3:30 PM

Junichi Kubo
Niigata University
8050, Ikarashi 2 no-cho
Niigata, Japan 950-2181
jun-kb@qb4.so-net.ne.jp

Evaluation of Newly Designed Water Cushion for Wheelchair Users
Poster Session - Friday – 12:00 Noon

L

Michelle Lange
Assistive Technology Partners
The Children’s Hosital
11785 W. 56th Drive
Arvada,, CO 80002
lange.michelle@tchden.org

Power Wheelchair Access Evaluation and Programming
IC 12 - Friday - 8:00 AM

Interfacing Assistive Technology and Power Wheelchairs
IC 22 - Friday - 1:00 PM

Gloria Leibel
Bloorview MacMillan Childrens' Centre
150 Kilgour Rd.
Toronto, Ontario M4G 1R8
gleibel@bloorviewmacmillan.on.ca

Who Needs Power?
IC 44 - Saturday - 10:45 AM

Barbara Levy
Thoms Rehabilitation Hospital
Seating & Mobility Clinic
68 Sweeten Creek Road
Asheville, NC 28804
blevy@carepartners.org

CPT Coding and Reimbursement for AT Service Providers
IC 33 - Saturday - 8:30 AM

M

Eva K. Ma
1616 S.W. Harbor Way
A305
Portland, OR 97201
evama@aol.com

A Marriage Made in Heaven - Join Two Old Techonologiesc for a Customized Cushion
Paper - Friday - 10:30 AM

Mohsen Makhsous
Northwestern University & Rehabilitation Institute of Chicago
645 N Michigan Ave., Suite 1100
Chicago, IL 60611
m-makhsous2@northwestern.edu

Local Tissue Perfusion Recovery using an Automated Seating System Featuring Dynamic Ischial Unloading
Poster Session - Friday – 12:00 NOON

Bryan Malone
Clover Bottom Developmental Center
Assistive Technology Clinic
275 Stewarts Ferry Pike
Nashville, TN 37214
Positioning 24/7 – Using Seating and Alternative Positioning for All Populations
IC 14 - Friday - 8:00 AM

Patrick Meeker
The ROHO Group, Inc.
3424 Laredo Drive
Lexington, KY 40517
PatM@therohogroup.com

The trouble with the shoulder...
IC 30 - Friday - 3:30 PM

Jan Miller Polgar
The University of Western Ontario
School of Occupational Therapy, Elborn College
1201 Western Road
London, ON N6G 1H1

Transportation Integration--Thinking Beyond the Wheelchair
IC 17 - Friday - 8:00 AM

The Effect of Wheelchair Tilt and Recline on Seated Pressure Distribution
Poster Session - Friday – 12:00 Noon

Client Satisfaction with a Wheelchair and Seating Program: An Evaluation of Alternative Service Delivery Methods
Paper - Saturday - 8:30 AM

Tamara Mills
Kessler Medical Rehabilitation Research and Education Corporation
1199 Pleasant Valley Way
West Orange, New Jersey 07052
tmills@kmrrec.org

Functioning Everyday with a Wheelchair (FEW): Applications for Assessing Wheelchair Function in Clinic, Home and Community Environments
IC 26 - Friday - 1:00 PM

Jean Minkel
Minkel Consulting
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New Windsor, NY 12553
jminkel@aol.com

Review of Medical and Technology and Psychosocial Issus for Persons with MS
IC 20 - Friday - 1:00 PM

Sharing Research Results - What is the FIM Scoring System Really Measuring?
Paper - Saturday - 10:45 AM

Dream On ! Service Delivery Challenges Around the Globe
Closing Session - Saturday - 11:45 AM

Brenlee Mogul-Rotman
Toward Independence
34 Squire Drive
Richmond Hill, Ontario L4S 1C6
brenleemogul@sympatico.ca

Empower and Assist!
IC 31 - Friday - 3:30 PM

Catherine Mulholland
Pacific Rehab Inc
7426 E Quien Sabe Way
Scottsdale, AZ 85262
Cathyotr@aol.com

External Stabilization Systems Used in Sitting and Standing
IC 32 - Friday - 3:30 PM

Phil Mundy
PDG Product Design Group Inc.
Unit 102, 366 East Kent Avenue South
Vancouver, BC V5X 4N6
phil_mundy@prodgroup.com

Matching Client Function with Specialized Manual Mobility Options
IC 6 - Thursday - 1:00 PM

N

Linda Norton
Shoppers Home Health Care
5230 Dundas St. West
Etobicoke, Ontario M9B 1A8 Canada
lnorton@shoppershomehealthcare.ca

Under Pressure: Managing Pressure Outside The Bed
IC 37 - Saturday - 8:30 AM

O

Cherly Oga
7103 Christie Briar Manor SW
Calgary, Alberta T3H 2G5
info@jillianswaineots.com

Clinical Protocol for the Administration and Interpretation of Interface Pressure Mapping for Sitting
IC 11 - Thursday - 3:30 PM

P

Joan Padgitt
Ride Designs
4251-K South Natches Court
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joan@ridedesigns.com

Seating Under the Influence
IC 27 - Friday - 1:00 PM

Jessica Pedersen
Rehabilitation Institute of Chicago
345 E. Superior St., 15th floor
Chicago, IL 60611
jpedersen@ric.org

Pain: Defining, Categorizing, and Determining Seating Involvement
IC 18 - Friday - 10:30 AM

Kevin Phillips
Ability Center
9390 Alta Laguna Way
San Diego, CA 92126
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Transportation Integration--Thinking Beyond the Wheelchair
IC 17 - Friday - 8:00 AM

Deborah Poirier
Clover Bottom Developmental Center
Assistive Technology Clinic
275 Stewarts Ferry Pike
Nashville, TN 37214

Positioning 24/7 – Using Seating and Alternative Positioning for All Populations
IC 14 - Friday - 8:00 AM

Sharon Pratt
Sunrise Medical
7477 East dry Creek Parkway
Longmont, CO 80503
sharon.pratt@sunmed.com

Pressure Mapping: Bench Testing of Cushions and Clinical Applications
IC 5 - Thursday - 1:00 PM

The Clinical Assessment and How It Relates to Technology
Poster Session - Friday – 12:00 Noon

R

Trudie Read
Varilite
4000 First Ave South
Seattle, WA 98134
trudie.read@varilite.com

Assessing A Seating System For The Long Haul
IC 18 - Friday - 10:30 AM

Tina Roesler
The ROHO Group
100 N FLorida Ave
Belleville, IL 62221
tinar@therohogroup.com

Getting it Right the First TIme!
IC 45 - Saturday - 10:45 AM

S

Natalie Sachs-Ericsson, Ph.D.
Florida State University, Department of Psychology
Tallahassee, Florida 32306
sachs@psy.fsu.edu

Man's Best Friend: The Benefits of Service Dogs
IC 34 - Saturday - 8:30 AM

Faith Saftler Savage
The Boston Home
74 Cottage Street
Nantick, MA 01760
fsaftlersavage@rcn.com

Impossibility or Probability? EADLs in a Long-Term Care Facility
IC 46 - Saturday - 10:45 AM

Bonita Sawatzky
Department of Orthopaedics, UBC
4480 Oak St.
Vancouver, BC V6H 3V4
bsawatzky@cw.bc.ca

Prevalence of Shoulder Pain in Adult Vs Childhood Onset Wheelchair Use
Paper - Thursday - 8:30 AM

Wheelchair is a Compound Word
IC 23 - Friday - 1:00 PM

Mark Schmeler
University of Pittsburgh, Department of Rehabilitation Science and Technology
UPMC Health System, Center for Assistive Technology
3010 Forbes Tower
Pittsburgh, PA 15260
schmelermr@upmc.edu

Functioning Everyday with a Wheelchair (FEW): Applications for Assessing Wheelchair Function in Clinic, Home and Community Environments
IC 26 - Friday - 1:00 PM

Sheena Schoger
Children's Rehabilitation Centre of Essex County
3945 Matchette Rd
Windsor, ON N8M 2X5
sschoger@childrensrehab.com

Assessment and Therapeutic Basis fpr Prescription of Seating and Mobility equipment for the Paediatric Client
IC 7 - Thursday - 1:00 PM

Jill Sparacio
Sparacio Consulting Services
4600 Roslyn Road
Downers Grove, IL 60515
OTSpar@aol.com

Creative Molding or Why Everything We've Learned Doesn't Always Work!
IC 38 - Saturday - 8:30 AM

Steve Sprigle
Georgia Institute of Technology
Center for Assistive Technology & Environmental Access
490 Tenth Street
Atlanta, GA 30332
sprigle@arch.gatech.edu
Pressure Mapping: Bench Testing of Cushions and Clinical Applications
IC 5 - Thursday - 1:00 PM

Clinical Protocol for the Administration and Interpretation of Interface Pressure Mapping for Sitting
IC 11 - Thursday - 3:30 PM

Jillian Swaine
Swaine & Associates
Rehabilitation Services
2309 6th Avenue N.W.
Calgary, Alberta T2N 0X3 Canada
info@jillianswaineots.com

Clinical Protocol for the Administration and Interpretation of Interface Pressure Mapping for Sitting
IC 11 - Thursday - 3:30 PM

Sitting Acquired Preasure Ulsers: Collecting Incidence Data in Tasmania, Australia
Paper - Friday - 10:30 AM

T

Laura Titus
The University of Western Ontario
Parkwood Hospital
1201 Western Road
London, ON N6G 1H1

Client Satisfaction with a Wheelchair and Seating Program: An Evaluation of Alternative Service Delivery Methods
Paper - Saturday - 8:30 AM

Elaine Trefler
University of Pittsburgh, Department of Rehabilitation Science and Technology
5044 Forbes Tower
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etrefler@pitt.edu

V

Linda van Roosmalen
University of Pittsburgh, Department of Rehabilitation Science and Technology
5044 Forbes Tower
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lvanroos@pitt.edu

Braking and Swerving of Large Transit Buses Related to Wheelchair and Occupant Safety
Paper - Thursday - 8:30 AM

Review of Principles and Practices of Automotive Safety for Wheelchir Seated Passengers
IC 1 - Thursday - 1:00 PM

W

Faye E. Warren
Consultant
953 Chauncey Ct.
Ocoee, FL 34761
warrenfaye@yahoo.com

The Power of Success Sits in the Future
Paper - Thursday - 8:30 AM

Kelly Waugh
University of Colorado Health Sciences Center
Department of Rehabilitation Medicine, Assistive Technology Partners
1245 E.Colfax Ave, Suite 200
Denver,, CO 80218
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Kelly.Waugh@uchsc.edu

International Standard for Postural Measures of a Wheelchair Seated Person
IC 9 - Thursday - 3:30 PM

Therapeutic Positioning During Sleep
IC 39 - Saturday - 10:45 AM

Paul Wilkie
Chesapeake Rehab Equipment
7016 Albemarle Road
Charlotte, NC 28227

Impact of a Progressive Seating Program on the Spinal Cord Injury Patient
IC 35 - Saturday - 8:30 AM

Kathryn Wilson
The University of Western Ontario
School of Occupational Therapy, Elborn College
1201 Western Road
London, ON N6G 1H1

The Effect of Wheelchair Tilt and Recline on Seated Pressure Distribution
Poster Session - Friday – 12:00 Noon

Anna Wu
Caritas Medical Centre
Occupational Therapy Dept.
111 Wing Hong Street,
Shamshuipo, Kowloon, Hong Kong
awu7808@hotmail.com

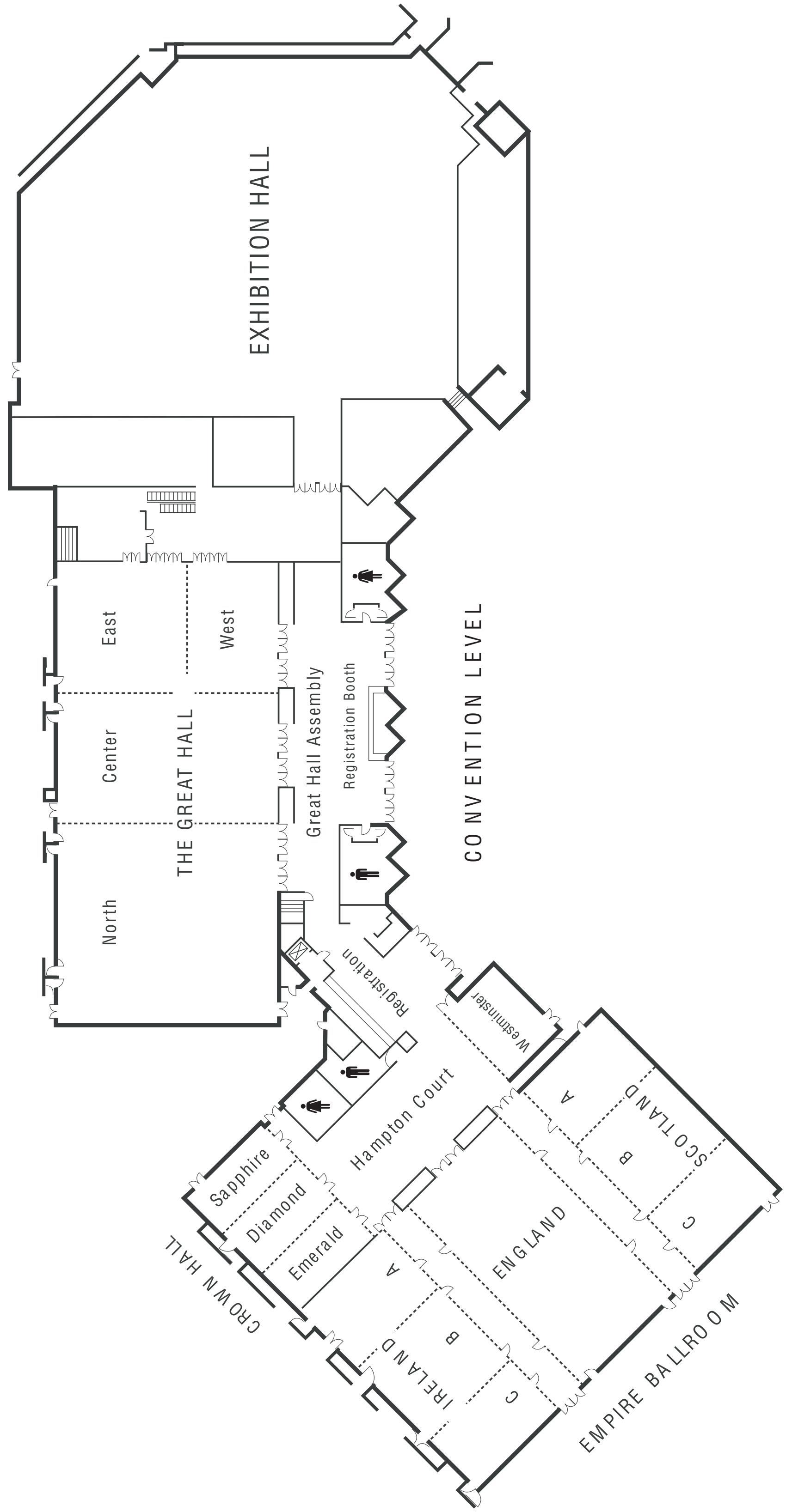
A RCT to compare the effectiveness of an individualized seating intervention with conventional seating system
Paper - Saturday - 8:30 AM

Z

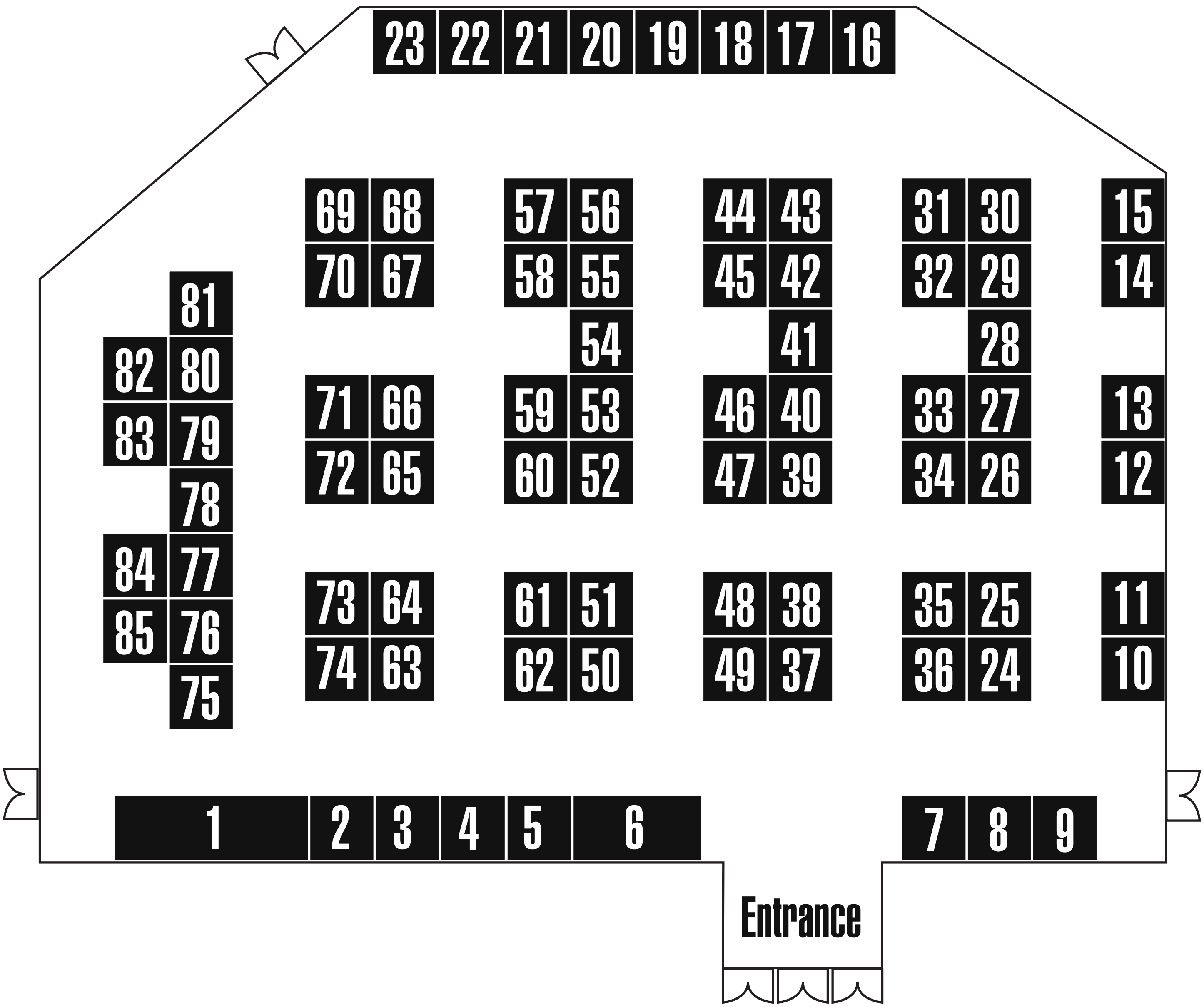
Jeanne Zanca
University of Pittsburgh, Rehabilitation Science and Technology
5044 Forbes Tower
Pittsburgh, PA 15260
jmzst19@pitt.edu

Spectroscopic Assessment of the Blanch Response in Elderly Nursing Home Residents at Risk for Pressure Ulcers
Paper - Friday - 10:30 AM

Hotel floor plans



Exhibitor Hall Floor Plan



Exhibitor list

A

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Adaptive Equipment Systems
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Adaptive Engineering Lab, Inc.
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Aquila Corp. manufactures the Airpulse PK automatic pressure relief cushion and the Custom-Air 2-zone manually inflated pressure relief cushion. The Airpulse PK inflates/deflates alternate cells to automatically change pressure distribution. The Custom-Air is the smart passive air cushion with lower inflated pressure at the boney areas of the posterior, an LED style pressure gauge and low pressure alert system.

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ARTSCO, Inc.

Booth number: 46

Mark Malagodi

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Irwin, PA 15642

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ARTSCO's Rehab Anywhere® is a portable documentation assistant system that greatly reduces the time necessary to complete medical justification paperwork. Rehab Anywhere's "Documentation Assistant" software contains computerized versions of over 250 wheelchair specification sheets. The "Assistant" automatically matches the wheelchair a clinician recommended with current HCPCS codes including the Medicare allowables, and organizes all the information gathered during an evaluation into price quotations, costing, and a medical justification report individualized to each client.

www.artscoinc.com

B

Bodypoint Designs, Inc.
Booth number: 10 and 11

Ryan Malane

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Bodypoint manufactures the highest quality postural support devices and wheelchair seating accessories. Bodypoint is also the exclusive U.S. distributor of the the Jenx line of pediatric positioning products.

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R

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Thursday, January 20, 2005

What is important?

Bengt Engström, P.T.

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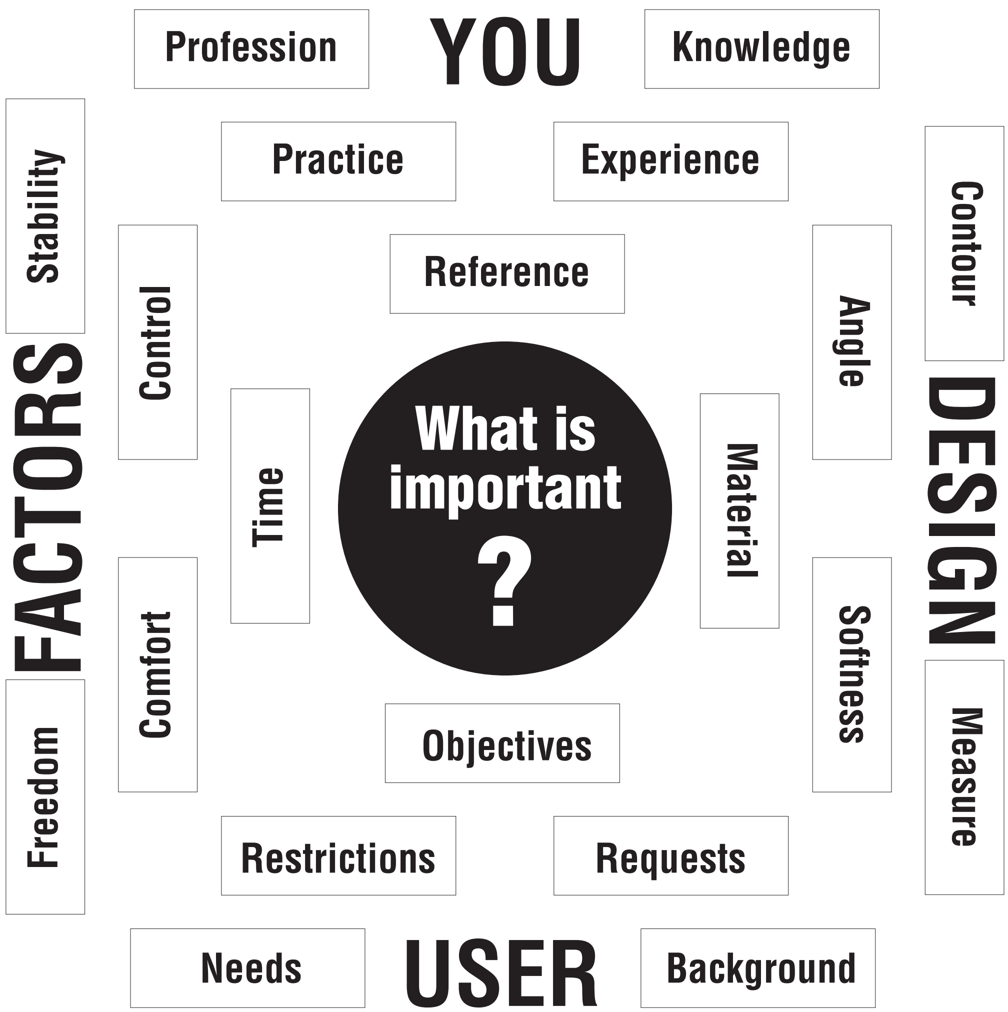
The answer to ”What is important?” depends on, of course, what we talk about. In the field of seating and mobility for the physically callenged population, in which I have been involved soon twenty years, I find that the answer is rather simple – YOU are important!

There are many factors involved and several dimensions to think of in the process of adapting wheelchairs for functional seating and mobility. Your knowledge level and practical skill decide the outcome. Your know-how level is the difference between good results for the user or very dangerous situations. It is about - what to do, how to do and why to do!



Sensory Systems and Seating for Function: The Need for Both Active Postural Control (Use of the Vestibular System) and Passive Postural Management (Use of the Tactile System)

Karen M. Kangas, OTR/L

Seating for function for children and adults with complex tone requires an understanding of the sensory processing systems and their support of body postures. Providing seating for management of the individual is as important as providing seating for the individual to perform tasks. Yet, today, we are not providing seating for task performance. Understanding the rudiments of sensory processing can help.

This approach, (creating seating from a neurophysiological perspective) can often seem to look like it is an "opposing" point of view or the "opposite" of what has been taught. However, since physiology is not physics, we need to understand its critical importance in seating.

To be human is to move. Control and use of our bodies is based on our ability to move. Moving and movement is inherently related to our on-going relationship with gravity. Movement is what also gives purpose to our bodies, and allows us to participate and perform tasks of all kinds. The vestibular system is the foundation and structure (in the central nervous system, and more specifically the brain) of all movement.

The vestibular system activates and provides the musculo-skeletal system with power, control, and coordinated movement. The vestibular system is always on. (As the body is always on, it does not turn off, nor is it stimulated, nor activated, nor facilitated. All these terms are terms from physics and from a stimulus-response mode of understanding, a paradigm, far too simple to describe accurately the functioning of the body). For the body to utilize power (muscle strength used in a specific task), the body must be weight bearing. This weight bearing requires that the pelvis and lower extremities actively hold the body. For head control to be utilized, the pelvis and trunk must be weight bearing. For weight bearing to occur, the body cannot be still, nor stay still. The body must move. Even in body "stillness" there is movement most of the time. This movement can be small weight shifts in the feet, and/or buttocks, or trunk or head, or hands.

For individuals who have bodies which exhibit more muscle tone than is most frequently observed, (whether hypotonic or hypertonic), seating has been believed to be needed which CONTROLLED tone, or caused the tone to not be demonstrated. (The wedged seat with or without contours, an adductor pommel, the high back, the strapped feet and ankles, the chest harness, the trunk lateral supports, and a very tight pelvic positioning belt, with a fully supportive headrest, and, often a laptray, and, a tilt-in-space. Also, symmetry reigns supreme.).

We are providing children with "standard" seating systems, systems from which they can be safely passively transported, and for many, can be safely fed liquids. However, this seating is not conducive to any postural control on the part of the children. It does not support any postural control they already have, nor does it assist them in learning more control.

For the body to be weight bearing, it must be in an asymmetrical position. The body must be able to move, and the movement it needs must not be in any singular linear plane. Instead, the body must be able to move in rotation, utilizing principles of pelvic/shoulder girdle rotation, proximal stability for distal control, and bring anticipation and readiness to tasks. This amount of movement must allow for a very particular range and freedom of movement.

The type of seating required for supporting postural control must first: allow the feet to be on the floor, the pelvis to be weight bearing, the trunk to be engaged, and the shoulder girdle a reflection of the pelvis's position. This then allows the upper extremities to gain power, the eyes to visually converge, the mind to pay attention, and the body anticipate the task, providing power, strength, and use to its extremities.

To provide seating which will allow for task performance, it is important to provide children with a different seating system than the one they are transported in, or from which they are fed. When children are under the age of 5 years old, these many systems are still evident in their environments. However, when children become school age, they are placed in a single wheeled system from which they are to participate in all daily activities.

We must begin to take on the challenge of understanding seating throughout the day. We need to understand the critical importance of movement, and how to provide it within seating systems. We need to understand that a single seating system, made to control the body, or allow the body to be managed by adults or caregivers, cannot be the seating from which any individual can learn to control her own movements.

I am including some references, not because they will talk at all about how to make a seating system, but rather because they will assist any of you more interested in how the body works, especially in movement and sensory processing. These are my favorites.

1. Clinical Assessment and Training Strategies for the Child's Mastery of Independent Powered Mobility By Karen M. Kangas OTR/L, 2000, booklet can be purchased directly from author (by check or money order to Karen M. Kangas OTR/L, for $15.00 includes S& H)
2. Sensory Integration, Theory and Practice by Anne G. Fisher ScD, OTR, Elizabeth A. Murray, ScD, OTR and Anita C. Bundy, ScD, OTR copyright 1991; published by F. A. Davis Company, Philadelphia OR (I think this has replaced it)
Sensory Integration, Theory and Practice, 2nd edition, By Bundy, Anita; Lane, Shelly; Murray, Elizabeth, ISBN ; 0545-5 from F.A. David Company, 1-800-323-3555; www.fadavis.com
3. Understanding the Nature of Sensory Integraiton with Diverse Populations by Susanne Smith Roley, Erna Blanche, and Roeann Sc. Schaaf from Harcourt Publishing (previously Therapy Skill Builders); www.psychcorp.com
4. Sensory Integration and the Child by A. Jean Ayres from Harcourt

Publishing (previously Therapy Skill Builders); www.psychcorp.com (Dr. Ayres wrote this book for parents, but I think it is so readable, it helps all of us in our busy lives to remember the issues and concepts we need. Then, we can go back and re-read her textbooks.)
5. Sensory Integration and learning disorders by A. Jean Ayres, copyright 1972, Los Angeles: Western Psychological Services (can be obtained at www.amazon.com too)

Prevalence of Shoulder Pain in Adult vs Childhood Onset Wheelchair Users: A Pilot Study

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Slobogean GP, BSc
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Chambers CT, PhD
Hol AT, BSc

Introduction

Shoulder pain and the resultant dysfunction is an expected problem in individuals with spinal cord injury (SCI) [1-4]. Researchers have associated shoulder pain in the SCI population with overuse related to weight bearing. More than two-thirds of SCI manual wheelchair users report suffering or having suffered shoulder pain [2], the frequency and duration of the attacks increase with the time since the onset of disability. By 20 years post-injury all patients had complaints of shoulder pain and/or parasthesias [3]. Currently, there is no reported incidence of shoulder pain in individuals with a spinal cord injury (either congenital or traumatic) who have used wheelchairs since early childhood.

The purpose of this pilot study was to compare the prevalence of shoulder pain in adult wheelchair users who began using their wheelchair during their childhood (immature skeleton) to those who began using their wheelchair as adults (mature skeleton).

Methods

This was a cross-sectional study of childhood and adult spinal cord injured populations (traumatic or congenital) investigating variables associated with shoulder pain. The primary variable was age of onset of wheelchair use. Co-variates included length of wheelchair use, frequency and duration of activity, and other activities of daily living.

Subjects were older than 18 years of age and had a spinal cord injury (traumatic, congenital, or tumor). The childhood onset (CH-O) user group was defined as those who began wheelchair use (>50% time) at 16 years of age or earlier. The adult onset (AD-O) users were those who began using a wheelchair after 16 years of age. All subjects had been wheelchair users for a minimum of one year.

Upon obtaining informed consent, an interview was conducted with all subjects, during which, information was recorded on general demographics and their disability (shunt, scoliosis surgery, etc.). Three questionnaires were administered: the Brief Pain Inventory (BPI) [5], The Wheelchair Users Shoulder Pain Index (WUSPI) [6], and self-report questions taken from the nation-wide Canada Fitness Survey [7].

Results

Fifty-three subjects participated in this study, 22 in the AD-O wheelchair user group, and 31 in the CH-O wheelchair user group. There was no difference in number of years of wheelchair use between groups; although, the two groups were significantly different for age. Both shoulder pain (as measured by the WUSPI) and overall pain (as measured by the BPI) were greater in AD-O wheelchair users than CH-O wheelchair users ($p<0.05$). The shoulder pain was a limitation to sports participation in more AD-O than CH-O wheelchair users ($p<0.05$).

There was a modest correlation between WUSPI and BPI ($r=0.35$) for all subjects collectively. This translates to shoulder pain accounting for 12% of the variance of average whole body pain. There was no correlation between shoulder pain and the number of years of wheelchair use, or shoulder pain and age.

No differences were found between AD-O and CH-O wheelchair users in either their activity duration per day, or the distance wheeled per day. More CH-O wheelchair users than AD-O wheelchair users received assistance when wheeling for long distances or uphill.

When combining all wheelchair users (AD-O and CH-O) together into a single group, there was no relationship between shoulder pain and the daily wheeling distance, transportation method used, duration of sporting activities (as measured by the Canada Fitness Survey), or whether or not individuals independently lift their wheelchair into their car. Individuals who wheel independently up hills or over long distances have more average pain (measured by the BPI) and more shoulder pain (measured by the WUSPI) ($p<0.05$) than those who receive help.

Discussion

The main results of this study demonstrate that individual's who began using a wheelchair as an adult experience greater pain, both overall, and more specifically, shoulder pain, than those who began using a wheelchair as a child. Age was not correlated to either overall pain or shoulder pain. Age explained only 16% of the variance of overall pain, and 9% of the variance of shoulder pain. CH-O wheelchair users, who began using their wheelchair while their skeletal structure was still immature, have fewer limitations due to shoulder pain than those who began using their wheelchairs as adults. Several possible inferences can be theorized from this:

1. There is a possible difference in pain perception between the two groups, or it is possible that children develop desensitization strategies towards pain over time, which continues with them throughout adulthood.
2. The childhood onset group may have a different wheeling strategy, which preserves the shoulder. This can be tested in a biomechanics lab.
3. The childhood onset group has articular cartilage and soft tissue adaptation, which reduces the pain. This can be explored further via MRI study. (This is in progress in another study).

Long term goals of this research are to identify strategies used by the CH-O group that may prevent shoulder pain, and use these strategies to make recommendations for all wheelchair users.

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Braking and Swerving of Large Transit Buses Related to Wheelchair and Occupant Safety

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ABSTRACT
Wheelchair tiedown and occupant restraint systems (WTORS) are commonly used to secure wheelchairs and restrain occupants in large transit buses. This research study explored the potential risks of WTORS misuse to wheelchair seated individuals riding in large transit buses. Preliminary results demonstrate that improper WTORS usage can place wheelchair occupants at a greater risk of injury than other passengers in transit buses.

BACKGROUND
Four-point strap-type tiedown systems installed in most large transit buses secure wheelchairs to the vehicle by S-hooks or strap loops. Many transit providers find existing securement systems difficult to use and time-consuming [1-4] which results in non use or wrong use of the system. Occupant restraints such as lap belts and shoulder belts are often overlooked entirely.
Do we need a four point securement system to safely secure wheelchairs in transit buses? Shaw et al. found that there were no documented injuries associated with high impact crashes in large transit buses. Most injury events among wheelchair passengers were associated with normal driving and emergency maneuvers (braking and swerving) [5] combined with "improper securement methods and devices" [1].

OBJECTIVES
By using computer simulation techniques, the potential risks of securement system misuse to wheelchair seated individuals in public buses will be investigated.

Figure 1 (left): 20mph/0.7g braking at 1200ms
Figure 2(right): 20mph/0.6g turning at 1200ms

METHOD
A computer simulation model of a manual wheelchair was used to evaluate various emergency driving conditions of a transit bus (44 passenger bus) such as braking and swerving. The following securement/restraint scenarios were evaluated in the study:
1- four point wheelchair securement and no occupant restraint
2- two point wheelchair securement and no occupant restraint
3- two point wheelchair securement and pelvic restraint
A previously developed and validated Dynaman computer model was used in the study [6]. The computer model was adapted to represent a 15 kg (34 lb) manual wheelchair with armrests. A Hybrid III Anthropomorphic Test Device was used to represent a 50th percentile male occupant.
Table 1 shows the variables and environmental test conditions used in the computer simulation model. The acceleration/deceleration pulse data for braking and turning used in simulation models were obtained from various studies conducted by the Cleveland Clinic Foundation and a study conducted by Mercer and Billing in which accelerations were measured in a 44-passenger transit bus [7-10]. A parametric analysis was conducted to evaluate the effects of wheelchair CG and seat friction on wheelchair and occupant kinematics. Wheelchair P-point, occupant head and occupant lower torso excursions were measured throughout each simulation condition.

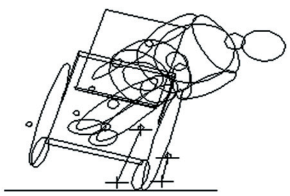
RESULTS
1- The wheelchair is secured with all four tiedowns and the occupant is unrestrained:
The occupant was ejected forward from the wheelchair during vehicle braking and beyond 1000 milliseconds, the SAE J2249 head excursion (25.6 cm (10 in.)) was exceeded [11].
During turning, the occupant contacts the wheelchair armrest and the upper torso and head rotate laterally beyond the wheelchair footprint.
2- The wheelchair is secured with only two tiedowns and the occupant is unrestrained:
The occupant was ejected from the wheelchair during vehicle braking, with exceeding head excursions. Turning in the direction opposite of the two tiedowns (e.g. a right turn while only the left-side tiedowns were used), led to the wheelchair tipping over (Fig. 1). When the turn was in the direction of the tiedowns the wheelchair did not tip, but the occupant rotated over the armrest and could fall and/or hit the interior.

Table 1: Wheelchair and environment parameters

Wheelchair CG Variable[1]	Seat Friction Variable:	
High CG:(x,y) = (6.5"; 17.5")	High= 0.99	
Driving Condition	**Characteristic**	**Peak Acceleration on Bus**
Turning: 20mph during 50ft radius turn	20 mph – max (32 km/h)	0.35-0.6g
Braking	20 to 0 mph (32 km/h)	0.5-0.71g

[1] Wheelchair CG position: x is relative to the rear hub and y is relative to the ground

3- The wheelchair is secured with 2 tiedowns and the occupant is restrained by a PELVIC restraint only: During turning the occupants' upper torso rotates over the armrest (Fig. 3 middle).With a wheelchair mounted pelvic belt, the occupant did not slide out of the wheelchair during breaking (Fig. 3 right). This scenario, with the added pelvic restraint, is especially interesting to study since ANSI/RESNA WC19 certified wheelchairs are now required to make crashworthy pelvic restraints available on board these wheelchairs [12]. When evaluating the dynamic response of a belted occupant turning away from the tiedowns, the occupant's upper torso rotates over the armrest and the wheelchair tips over (as in Fig.2)



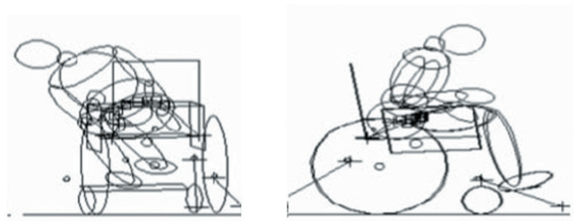


Fig.2(left): Wheelchair tipping during turning when secured with 2 same side securement straps.
Fig.3(middle/right): Wheelchair and occupant position during turning (middle) and braking (right).

DISCUSSION AND CONCLUSION

Partially or fully secured forward-facing wheelchairs and unbelted occupants may not be safe even in non-crash conditions when riding public transit vehicles. Using a pelvic restraint seems to prevent ejection of wheelchair occupants from their wheelchair during braking, and to a lesser extent, during turning. Additionally, using fewer than 4 tiedown points can result in tipping of the wheelchair into the isle of the transit vehicle. Our findings support anecdotal reports of wheelchair accidents occurring during normal or emergency driving. These findings also suggest that alternative, easier to use wheelchair securement methods need to be explored for use in large transit bus environments. Limitations include that the computer model used in the study was not validated for non-crash type load conditions.

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The Power of Success Sits In The Future

Faye Warren, BA

am honored to be here to speak about how customized seating has had a significant impact on my life. Presently I live independently in my own home. I finally graduated last May from St. Andrews Presbyterian College in North Carolina with a Bachelor of Fine Arts Degree in Creative Writing. However, I was born in Palm Springs, California and then we moved to Memphis, Tennessee, when I was three years old. Customized seating in some form has been significant in the development my ability to sit for long periods of time, and yet, still move around comfortably. My mother and I went to University of Tennessee to find out what kind of wheelchair and seating I needed. That is where I met Elaine Trefler, Doug Hobson and Susan Taylor who assisted with getting my customized seating for my first power wheelchair, an Invacare, at the age of four. They found a power wheelchair to fit my ambitious, crazy, adventuresome personality. Due to my condition of athetoid, spastic cerebral palsy, a specialized bead seat was contoured for me at the Rehabilitation Engineering Center at U T. Further, a plain tray was made for me and later, one that accommodated my communication aid.

As a little four year old girl, I was very naive like most children are at that age and thought I could go anywhere without getting hurt. Basically, I thought I was invincible and boy, I was wrong! I was a little dare devil as a kid. I would try anything and thanks to my little power wheelchair with comfy seating, I was as mischievous and normal as any other kid without disabilities. One day, I decided to drive my wheelchair down the street to a friend's house. Well, my friend's house was on a big hill and I thought it was no big deal that I went on my own without informing my parents first as to where I was going. My friend, Jamie's house was three long blocks away. There were no sidewalks, so I raced up the middle of the street. Jamie's house had a huge, grassy bump with a deep ditch beyond it for water retention wrapping around the entire corner lot. Guess what happened? As I drove over the bump, into the ditch, and tried to go up the hill to her house, my power chair flipped onto its back. I was looking up at the sky, laughing my head off because I thought it was so funny. My parents were called to come and get me. Man, did I get it, when I went home. My butt was actually smoking that night. I learned my first lesson on my own that night: Listen to my parents or else! However, when I was older, my parents told me that they were actually proud of me that day for being independent and thought the sight of me in that ditch was funny. Do you remember the terrible two's? Well, I was the terrible four's. My power chair and seating gave me a license to be wild. A wild child! Fear is not in my vocabulary and it never was. I was encouraged to live life as closely as possible to that of my peers without disabilities. That was why my parents wanted me to get a power wheelchair with special seating, to allow me to experience life to the fullest at a very early age. Thank God they did because I learned how to become as independent as possible at the very beginning of my life. The wheelchair and my customized seating became my new body with a pair of legs, which were the wheels.

It is extremely crucial that the physical therapists and rehab engineers fit the customized seating to their clients' bodies to keep them safe and well supported. This is because you never know how dangerous of a driver they are or what they will choose to do in their wheelchairs. Driving a wheelchair is just like driving a vehicle, or in my case, driving a fast sport car. The difference is that you can get out of the car, we can't! Therefore, it is extremely important that the seating be exceptionally comfortable and supportive, but be flexible enough to move around in and do whatever is possible independently. We, as wheelchairs users, need to be able to tolerate sitting in our wheelchairs for at least eight hours straight, or in my case, twelve hours straight a day. Furthermore, my supportive seating definitely positions me to access my assistive computer device for communication with people, driving my wheelchair, working on my computer and doing other daily things like those without disabilities.

Throughout my life, I've enjoyed doing and saying things that people have not expected of me because of their preconceived ideas about those who have physical disabilities. Some call my degree of disability significant due to my supportive seating system and my use of a personal communication device accessed by a head stick mounted on my powered wheelchair. My disabilities do not control my life. The reason why I can success at achieving my life experiences and goals is my determination, my power wheelchair with my customized seating and my assistive communication devices. I lead a very active life. Let me give you some examples of goals I was able to achieve because of my seating system and communication tools. One of the most challenging goals was to get receive regular education and then proceed to college. As I entered seventh grade, I was transferred to a new middle school called Southwest middle school. There was this remarkable teacher, Ms. Hackett, who realized that I was as smart as anybody else without a disability. Therefore, she gave me a chance and integrated me in two classes to see if I could handle those classes with an aide to assist me in the classroom.

Then after a month or more, I met some friends who were very willing to assist in taking notes, getting books out of my books bag and so on. If I needed to read a book in class, a friend took off my communication device from my metal stand attached to put my tray and put the book the in its place. My head-stick that I use to type with was left on me head. Therefore, I could turn the pages of the book. Worksheets were put into the plastic swivel paper holder attached to the right side of my communication device, called the Liberator. Therefore, all of my friends took the place of an aide.

Now I had the confidence to succeed in the classroom with the help of my peers and the teachers. Also, I had more determination and more confidence to pursue my dreams as well as my goals in my life. So, Ms. Hackett realized that I did not need an aide and pushed her out. During the same year I was included in regular classes, I developed scoliosis and had to have an operation. Before I had an operation to place rods in my back to correct scoliosis, the custom seating that I had saved me from having the back operation much earlier in life. Because it fit so well to my body, I was thirteen years old before I developed severe Scoliosis due to the excellent support from my seating. Most of children who have severe Cerebral Palsy usually develop Scoliosis due to the spasticity in their extremities and Scoliosis in the middle of the spine. My back muscles were loose on one side and the other side was extremely tight. Therefore, my abnormal muscle tone contorted my body. The operation was a success. I had my power wheelchair customized again at this time by Jody Whitmeyer. This was necessary because the scoliosis operation changed the way I sat in my chair and how I needed to access my communication device. I returned to the classroom just three months after the operation, part time. A couple of months after this, my teacher and I decided that I could be fully mainstreamed the next year, eighth grade. My new seating and new energy levels made me more productive. By the end of the next year, I was fully integrated educationally and socially. I had an active extra curricular life with wheelchair sports, student council, mall shopping and movies with peers. I moved on to my local high school, Dr. Phillips, the following year without the assistance of an academic or personal aid. Positioning and seating was critical in being the foundation of all I was accomplishing.

After I had gotten a feel for what high school was all about, I began to adventure out and get involved with my school activities there by signing up for all different kinds of clubs such as: the Beta Club, Honor's Society, Christian Activities, and Student Council. All of these clubs consisted of a lot of activity outside of school as well as in school and hard work in which I had to keep my grades up and still achieve a certain number of points for each month to remain in these clubs. Every other week, I went to different nursing homes and group homes throughout Orlando with a group of my friends to cheer up the elderly people by telling my sick jokes to them on my communication device, playing around with them, or even talking with them about anything that they wanted and getting anything that they needed. We also went to Head Start Programs to give kids presents, serve them pizza or cookies, little snacks and be their buddy for a day. By the end of High School, I was fully participating in Homecoming, Proms, Honor Society and so forth

Ahhh, what wonders seating can do for a student. One day, in Honors Biology, we were dissecting a frog and nobody in my group wanted to cut the frog open. I did. Everyone thought I was out of my mind for actually wanting to cut up a dead frog, especially since I cannot use my hands. I told them, "Don't worry, I am not going to cut you open. Come on, do you want an A or not?" They nodded and taped the scalpel to my head pointer. That day, I did it with the assistance of my friends. I started my illustrious surgical career. Proper seating prevented my slicing up my friends in the process.

With the assistance of all my technology, I went away to college five hundred miles from home. My parents made sure that I had two good power chairs: an old Quickie P 300 and a new Invacare Arrow. I now used Jay Cushions with gel seating. They had some specialized pieces.

Just to let you know that my technology enabled me to behave like any other college student, I'll let you in on a couple of my stories. During my senior year of college, I became a regular at the local sports bar and resteraunt near the college called, Champs. Thursday nights were college night. Nearly every week, the management had karaoke contests. The beer and strawberry margaritas were good there. I always volunteered to sing. One night, I was able to get my friend, Andrew, to join me and we drove our wheelchairs down the street through darkness and crossed a highway to get there. It was worth it. We won $100 and split it between us. When I told my mother about this over the phone, she asked me if anyone could understand the words that I sang. Did she mean my slurred speech from having Cerebral Palsy or was she asking if I had some drinks? I replied, "No!" She asked if that bothered me. I told her it didn't, and no one else cared either. She laughed. Then there was that time Andrew and I won the Halloween costume contest at Champs. I was a cow. He was a Viking warrior. Imagine us driving to Champs with our costumes on, we stopped traffic! It was that hilarious.
It is so satisfying to entertain and challenge myself and others with the unexpected. The point of my sharing with you my life experiences is, as I look back at all of the wonderful things I did throughout the years due to my dependable, power wheelchair and other assistance technology, I have led a very normal, exciting, fulfilling life. Basically, my wheelchair along with the supportive seating and my other assistive technology, are like a team. They make it as easier and more pleasant for me to handle my life experiences, my expectations for myself and whatever challenges I may have. I would not be able to achieve my goals and have life experiences if it was not for the proper seating which the physical therapists and the rehab engineers recommended, designed and implemented. Since I need a new power wheelchair every five to six years, the services of these professionals will always be a part of my life.

Specialized seating is the key to positioning the significantly physically challenged to succeed in school or life. The professionals in this room can enable people with physical disabilities to take back control of their lives and become successful in the future. Basically, you are a part of their success like Susan, Elaine and Doug are a big portion of my success because they were the ones who assisted me with getting my life started by helping me to get a power wheelchair. Because of the interventions of professionals such as those in this room, I have become independent and am definitely my own boss. Every child or adult who has Cerebral Palsy or other kinds of physical disabilities is unique in every way and have different degrees of disability. Therefore, it is very challenging and intriguing to create customized seating for that child with special needs who requires positioning to reach his or her potential.

Review of standards, principles and best practices of automotive safety for wheelchair seated passengers

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BACKGROUND

Over the past thirty years, there have been significant improvements in motor-vehicle transportation safety for able-bodied travelers. Much of this is due to federal motor vehicle safety standards (FMVSS) that require manufacturers of motor vehicles to comply with minimum crashworthiness design and performance requirements. However, there has also been a significant increase in consumer ratings testing, such as the National Highway Traffic Safety Administration's (NHTSA) New Car Assessment Program (NCAP) and the Insurance Institute for Highway Safety (IIHS) tests and published ratings that impose higher test and performance requirements than federal safety standards. With the exception of a 1992 modification to FMVSS 222 School Bus Crashworthiness that requires bus manufacturers to install statically tested four-point strap-type tiedowns and 3-point belt restraint systems for use by forward-facing wheelchair occupants, these federal standards and consumer tests do not address occupant protection systems used by most wheelchair-seated travelers(National Highway Traffic Safety Administration (NHTSA), 1976).

To fill this void and improve the transportation safety for wheelchair-seated travelers, the Adaptive Devices Subcommittee (ADSC) was established in the mid 1980s as a Society of Automotive Engineers Technical Subcommittee for the purpose of developing SAE Recommended Practices for after-market motor-vehicle adaptive equipment. Within this Subcommittee, the Restraint Systems Task Group was charged with the task of developing design and performance requirements for wheelchair tiedown and occupant restraint systems (WTORS). The result of more than ten years of effort, which involved significant coordination and harmonization with International Standards Organization (ISO) and Canadian Standards Association (CSA) efforts to development similar standards, is SAE J2249 Wheelchair Tiedown and Occupant Restraint Systems for Use in Motor Vehicles(SAE, 1999).

A new Working Group, called the Subcommittee on Wheelchairs and Transportation (SOWHAT), was formed within the ANSI/RESNA Wheelchair Standards Subcommittee, with the charge of developing a new ANSI/RESNA wheelchair standard that established design and performance requirements for wheelchairs relative to their foreseeable use as seats in motor vehicles. With the financial support of numerous private and public agencies, including school transportation groups and the NHTSA, the first transit wheelchair standard, officially known as Section 19 ANSI/RESNA WC/19 WC/Volume 1 Wheelchairs Used as Seats in Motor Vehicles, or simply WC/19, was developed in less than five years and became effective in May 2002(ANSI/RESNA, 2000). As with SAE J2249, comparable ISO and CSA standards (CSA Z604 Transportable Mobility Aids and ISO 7176/19 Mobility Devices for Use in Motor Vehicles) have also been developed with very similar requirements(CSA, 2003-rev; ISO, 2001).

PRINCIPLES AND RATIONALE FOR THE STANDARDS DEVELOPMENT

In developing these initial voluntary standards for WTORS and transit wheelchairs, the guiding principles have been the same in SAE, ISO, and CSA arenas. One of the primary goals has been to establish requirements that are appropriate for the worst-case motor-vehicle environment, which, for both public and private transportation is the van or minivan. This principle was based on the assumption that WTORS manufacturers do not generally limit or control the types of vehicles where their products are installed and used, and that most wheelchair users will not limit their travel to one type of vehicle or transit mode. A second principle behind the initial standards has been to establish requirements that will offer wheelchair users the opportunity to use belt-type occupant restraints and seats that are comparable in frontal-crash performance to equipment available to able-bodied travelers that must comply with federal safety standards. A third objective has been to improve occupant protection for the highest priority in occupant protection, namely to provide forward-facing wheelchair occupants with improved protection in frontal crashes which account for more than half of all serious and fatal injuries to motor-vehicle occupants.

Although the provisions of these initial standards contain numerous design and performance requirements related to improving the ease and effectiveness of wheelchair securement and occupant restraint, the most significant requirement of these standards is that compliant products must perform successfully in a 30-mph, 20-g sled-generated frontal crash pulse similar to that specified in FMVSS 213 for child restraint testing, and similar to the change in vehicle speed, or delta V, that results from FMVSS 208 rigid-barrier testing of vehicles. The design requirements for WTORS emphasize the need for a device or system to provide for wheelchair securement that functions independently of a belt-type occupant restraint that provides both upper (i.e., shoulder and chest) and lower (i.e., pelvic) restraint for the wheelchair occupant.

For sled-impact testing of WTORS, the wheelchair tiedown and belt restraints are dynamically loaded during this impact test by an 85 kg (187 lb) surrogate wheelchair and a 170-lb adult crash dummy, respectively. WTORS that comply with SAE J2249 and related ISO and CSA standards can secure the wheelchair by any and all types of wheelchair securement methods, including four-point strap tiedowns or docking-type securement devices. Whereas, wheelchairs that comply with WC/19 or the related ISO and CSA standards must provide four easily accessible hook-on type securement points and be dynamically tested when secured by a four-point strap-type tiedown system. The basis for this design requirement on wheelchair securement for transit wheelchairs is the need for compatibility between the method of wheelchair securement provided on the wheelchair and the method of wheelchair securement provided in public vehicles (4-point straps). Although four-point strap-type securement of wheelchairs requires considerable effort by a vehicle driver or attendant, four-point securement using strap assemblies is currently the most commonly used securement method in public and school transportation. This is because of its relatively low cost, its ability to be used with a wide range of wheelchair types, and its ability to comply with the 30-mph, 20-g test requirements.

APPLICATION OF STANDARDS AND RELATED BEST PRACTICE PRINCIPLES

The WC-19 standard is voluntary for wheelchair manufacturers. That is, manufacturers are not required to crash test products, provide attachment points to improve securement, or label their wheelchairs as "transit tested." The more consumers and prescribers understand the value of transit wheelchairs and increase their demands for such products, the more manufacturers will be encouraged to provide transit wheelchairs. As of December 2004, 12 manufacturers list 48 makes and models of WC-19 compliant wheelchairs (for the latest information see: http://www.rercwts.pitt.edu/RERC_WTS_WC19/RERC_WTS_chart.html).

Main advantages to using transit-tested wheelchair:
Increased Occupant Protection in Motor Vehicle Crashes

- Four crash-tested securement points for effective wheelchair tiedown
- Tested to a nominal 30-mph frontal crash.
- Crash-tested anchor points on the wheelchair frame to which a crash-tested pelvic belt can be added.

Improved Usability

- Securement points are clearly marked and easily accessed for one-hand attachment of tiedown strap hooks
- Increased compatibility with vehicle-anchored occupant restraints.
- Seatbelt fit ratings are measured and reported in the presale literature.

The Rehabilitation Engineering Research Center (RERC) on Wheelchair Transportation Safety at the University of Pittsburgh and the University of Michigan Transportation Research Institute (UMTRI) has created a website at http://www.rercwts.pitt.edu/WC19.html. At this site you will find information in easy to understand language that answers frequently asked questions (FAQs), shows crash tests, and provides information about currently transit tested mobility devices. You can also connect to a website where a 'Ride Safe' brochure (http://www.travelsafer.org/) can be viewed and downloaded for broader distribution. You can also contact the RERC by e-mail at: rercwts@shrs.pitt.edu.

FUTURE DIRECTIONS

The initial efforts toward developing voluntary standards for WTORS and transit wheelchairs have been appropriately targeted to design and performance requirements that follow basic principles and crash conditions for protecting forward-facing occupants traveling in van-sized vehicles in frontal crashes that have been established for government safety standards. For WTORS, the assumption was made that this equipment may be installed in a wide range of vehicles, and for transit wheelchairs it is was assumed that most wheelchair users will occupy their wheelchair while seated in different types and sizes of vehicles. Therefore, the 30-mph, 20-g frontal crash pulse is the appropriate level since it is comparable to the level of frontal crash testing required by federal safety standards.

Now that these initial standards are in place and the numbers of products that comply with their requirements is increasing, standard-development efforts have begun to address some of the remaining important safety and utility issues, such as occupant protection for wheelchair riders in rear and side impacts and seeking alternate solutions to the four-point strap securement system. In addition, it is becoming increasingly clear that a different set of design and performance requirements for WTORS that are intended exclusively for use in the large accessible transit vehicle (LATV) environment, where high-speed frontal crashes are extremely rare, are needed. Thus, development of a lower-level crash pulse for WTORS that are more suitable to the operational needs of large fixed-route transit buses is becoming a higher priority. One wheelchair securement approach that is based on the assumption of low level forces, termed 'passive wheelchair securement' has met widespread acceptance in Europe and more recently, Canada. The wheelchair user rides rear-facing in the vehicle without any physical attachment of securement devices to the wheelchair(TCRP-50, 2003).

Finally, docking technology offers longer-term promise to semi automate the wheelchair securement process, particularly in transit environments where the crash loads are likely to exceed those in fixed-route LATVs (>1g). An industry standard that specifies how the wheelchair and docking device will interface (engage) is now nearing final completion as an international standard. Wide-spread adoption of docking technology by the wheelchair and wheelchair securement industries would resolve many of today's wheelchair securement dilemmas, potentially on a world-wide scale.

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The Dilemma of Assistive Technology Justification

Laura Cohen, PhD, PT, ATP

When durable medical equipment such as wheelchairs and seating systems, positioning devices (i.e. standers, feeding chairs, car seats, etc.) are being supplied, most insurance carriers (public and private) require that a document indicating the medical necessity for the device accompany any request for prior approval. Herein lays the dilemma. Who is responsible for writing the letter of medical necessity? What information is important to include? Who reviews these letters and what are they looking for?

The Process of Obtaining an Assistive Technology Device (Ideal World)
- Someone identifies a need
- Consumer meets with someone for an evaluation
- Devices are tried out to see what will work
- A report is prepared (results of the assessment, trial, recommendation)
- Funder reviews request
- Request approved
- Device supplied

Roles of AT team members in the documentation process
Who should prepare the documentation? The doctor? The therapist? The supplier? Some funders (i.e. Medicare) specify who is allowed to complete the Certificate of Medical Necessity (CMN). In most cases there is no regulation specifying who is to write the letter of medical necessity (LMN) and there is no clear requirements specifying what information is included in the LMN.

Whose job is the paperwork anyway? Since it is a statement of medical necessity must it be written by a “medical professional”? (MD, therapist, nurse)? What if the professional involved with the consumer is not familiar with the technology? What if the professional has no time to prepare additional reports?

At the 2003 International Seating Symposium there was a panel discussion entitled “Damned if we do, damned if we don’t”. The panel was comprised of a therapist, rehabilitation technology supplier, consumer, and funder/reviewer. It was a lively discussion raising many important issues about what is actually happening out there in the world of practice. It is worthwhile to review panelists’ perceptions.

In summary, the therapist on the panel felt that the seating and mobility evaluation is a therapy evaluation and forms the basis for a treatment plan. Documentation of the evaluation and treatment is part of the job and is therefore the responsibility of the therapist. The RTS, was of the opinion that suppliers have no more “time” than the therapist; justification can often be beyond the ability of some therapists and most physicians; and yet an ethical conflict exists to write a compelling/fundable LMN since the suppliers’ profit is dependent on the equipment being provided? It was the opinion of the consumer that the physician is most knowledgeable concerning medical needs, the therapist is most knowledgeable about the physical and functional needs, the supplier is most knowledgeable concerning the equipment and the consumer is the only constant and has the “obligation” to run the process. Finally, the reviewer reported that the number of qualified experts varies region to region; most LMN’s are authored by the supplier - ranging in quality from poor to expert, the level of expertise evident by the documentation provided. Furthermore, suppliers are the ones typically visiting the home, performing the home environmental survey and trialing equipment; a service that the supplier is not being reimbursed to provide yet one that has become an “expected” practice in the service delivery process. The supplier, caught between customers (the consumer and the funder) is often faced with the decision of consumer satisfaction or most cost effective solution.

Is it therefore surprising that based on these dilemmas and daily practice realities there exists confusion and blurry lines defining professional responsibilities for completing the evaluation, documenting the findings and making definitive recommendations? As a result, it is no surprise that in practice “the system” of review and authorization is sketchy and built largely on mistrust.

The seating and mobility evaluation

Physical Evaluation can be described as the determination and documentation of the history, pathology, prognosis, and physiological, functional and environmental factors that impact the selection of appropriate mobility equipment or mobility system for a specific consumer.

Technology Assessment can be described as the process and documentation of matching the consumer with the appropriate assistive device or system.

Together this information serves as the comprehensive LMN when signed by the clinician and the physician. A team effort (clinician, supplier, consumer, and physician) is needed to gather the necessary information.

Components of the Physical Evaluation

Goals
- Reason for request
- Why equipment is needed and medically necessary

Medical Diagnosis
- Static, progressive, secondary conditions

Skin Issues
- History
- Risk factors
- Capacity for weight relief

Size & Weight
- Physical measurements

Functional Status
- Cognitive status
- Sensory status
- Endurance
- Safety/Falls
- Pain

Physical Motor Abilities (Mat evaluation)
- Sitting posture in wheelchair
- Sitting posture out of wheelchair
- Influence of tone
- UE function
- Transfers
- Assistance or AT needed to perform ADL's or IADL's

Equipment
- Current Equipment
- Status and condition
- What is needed in a new system? What is currently working in existing system? What is not working? Why? What needs to be changed?
- Other Technologies
- Computer, ECU, AAC
- Compatibility/interfacing

Functional
- Activities of Daily Living (Basic & Instrumental)
- Transfers
- Assistance
- Activity Endurance
- Work
- Leisure

Living Situation
- Roles and Routines
- Assistance Available
- Environmental
- Access in/out of home
- Accessibility within home
- Other accessibility (work/school, community)
- Terrain
- Distances

Transportation
- Personal Vehicle
- Passenger or driver
- Accessibility
- Public Transportation and Paratransit
- Ride in WC vs. Transfer out
- Restraint System or Airlines Stowing

Components of the Technology Assessment

What specifically is being recommended?

What was tried?

How did it work?
- In the home?
- Outside the home?
- Transportation?

Rationale for equipment recommended
Why did/would lower level equipment not work?
Have future anticipated needs been considered?

The Letter of Medical Necessity
The purpose of the LMN is to present relevant information for the purpose of making a value judgment regarding the "best" intervention for a particular individual.

The Reviewer: What are they looking for?
Why is the AT device being requested?
Evidence of need based on coverage policy (medical, educational, or vocational)
Specific recommendation, price and coding
Rationale for why recommendation is the most appropriate and cost effective solution

Take Home Message – Consider Your Audience
Understand the funding sources coverage policy and limitations
Know your reviewers qualifications and knowledge base
- Build a relationship with reviewers and funders
- Use language that is understandable by all
- Write legibly
- Avoid abbreviations
- Anticipate reviewer questions and address them in your LMN
- Include the name and telephone number of the person authoring the LMN

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Considerations for the Selection and Fitting of Manual Wheelchairs for Optimal Mobility

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Herfried Eisler, KT

I. Basic Classes of Manual Wheelchairs
All manual wheelchairs are not alike. There is substantial variation due to performance, mass, features, and the ability to match the needs of users. Manual wheelchairs can be classified by some of their common features. The most common classes are depot wheelchairs, light weight wheelchairs, ultralight weight wheelchairs, and specialty wheelchairs. Depot wheelchairs are typically non-adjustable or have minimal adjustability, and they are intended to be used by multiple users (eg, hospital, shopping mall). Depot wheelchairs are often made of steel, have a low initial purchase price, and weigh in excess of 35 pounds. Lightweight wheelchairs allow some adjustability for fitting to the user. Removable armrests and leg-rests are common. The frame may be made from steel or aluminum. Their weight is often between 25 to 35 pounds. Ultralight wheelchairs are either custom fitted to the user or they are designed to be maximally adjustable to the user. These wheelchairs are generally made of aircraft quality steel or aluminum. These wheelchairs weigh less than 25 pounds and are made to meet the mobility needs of an individual. Recently, there have been advances in manual wheelchairs that allow factory customization, as well as greater use of advanced materials. For example, titanium is rapidly becoming more popular among designers of high performance manual wheelchairs. It is very light weight, strong, corrosion resistant, and abrasion resistant. Titanium can also act as suspension to reduce ride shock and vibration. However, titanium is expensive and difficult to work with; hence titanium wheelchairs cost more. Composite materials like carbon fiber, kevlar, and fiberglass are also used with manual wheelchairs, but mostly in the manufacture of components. Use of these more advance materials has resulted in an emerging class of wheelchairs that weigh less than 20 pounds.
There is also a class of manual wheelchairs for persons who weigh over 250 pounds. These wheelchairs are heavier than the wheelchairs in the other classes in order to support more body weight. As the numbers of persons with disabilities who are overweight or obese has increased over the years, an additional class of wheelchairs has emerged. This class of wheelchairs referred to as baratric wheelchairs are designed to support individuals who weigh between 300 and 1000 pounds.
Pediatric and children manual wheelchairs are similar to the adult manual wheelchairs only smaller (seat width or depth < 14”) and some have adjustable frames or kits for accommodating growth of the child.

II. Wheelchair Selection and Fitting
Published studies suggest that ultralight wheelchairs are preferable, especially for individuals who are going to be living in the community and use a wheelchair for more than a few months. Ultralight wheelchairs provide the highest degree of adjustability making it possible to optimize the fit of the wheelchair to the user which is likely to have a positive impact on propulsion mechanics. Possible wheelchair adjustments that are only available on ultralight wheelchairs include: combination seat and back angles, rear wheel camber, and rear axle position.
A. Seat and back angle adjustments: Increasing the seat angle or dump can assist persons who have limited trunk control with stabilizing their pelvis and spine making it easier to propel the wheelchair. However, too much dump may cause the pelvis to rotate backwards and cause the lumbar spine to flatten. Increased dump also increases pressure on the sacrum increasing the risk for skin breakdown and can make it more difficult to transfer into and out of the wheelchair. Using a combination of seat and back angle adjustments increases the number of possible postural accommodations that can be made to optimize fit.
B. Rear wheel camber: Camber is the angle of rear wheel tilt. Every day wheelchairs generally have up to 8° of camber. While more is usually possible, it can impede the ability to enter and exit doors and openings. Camber has certain advantages which include: bringing the wheels inward and closer to the body enabling the arms to access more of the pushrim, reducing shoulder abduction because the wheels are closer to the body, increasing lateral stability, reducing rolling resistance because less of the tire in contact with the ground, and protecting the hand when pushing in tight areas since the wheels make contact first with walls and doorframes.
C. Rear axle position: Ultralight wheelchairs allow for customizability of rear axle position both vertically and horizontally. Adjusting the rear axle allows for optimal positioning of the rear wheels relative to the body and arms. Raising the axle, lowers the seat and lowering the axle, raises the seat. Moving the axle forward brings the seat back relative to the wheels and moving the axle rearward, brings the seat forward. Both kinds of adjustment can have a dramatic influence on propulsion biomechanics. For example, a more forward axle position results in lower peak forces, less rapid loading of the pushrim, fewer strokes to go the same speed, and greater hand contact with the pushrim. Two of these parameters, stroke frequency and rate of loading the pushrim, have been associated with the development of carpal tunnel syndrome, a highly prevalent repetitive strain disorder affecting manual wheelchair users. Moving the axle reduces rolling resistance because more weight is distributed over the larger rear wheels as opposed to the casters. A more forward axle makes it easier to pop a wheelie and ascend curbs; however, it can make the wheelchair ‘tippy’ and difficult to push up a ramp. Research studies have shown that a lower seat position improves propulsion biomechanics through increased hand contact with the pushrim, lower stroke frequency and higher mechanical efficiency. Lowering the seat height also increases stability of the wheelchair. If the seat height is too low however, the patient will be forced to push with the arm abducted, which could increase the risk for shoulder impingement, another commonly reported upper limb injury among manual wheelchair users. Two studies agreed that the ideal seat height is the point at which the angle between the upper arm and forearm is between 100 and 120 degrees when the hand is resting on the top dead center of the pushrim. It’s important to keep in mind that adjusting the axle position can affect wheel alignment and seat angle. Other adjustments, such as caster alignment and height may be needed to keep the chair in good alignment.

III. Selecting Seat Dimensions

A. Seat Height. The height of the seat will depend on the person's body stature, surface heights in living environments, and the type of cushion used. The seat should be just high enough to accommodate leg length while leaving enough space under the foot rests (about 2" or so) to clear obstacles. Persons with longer legs in order to fit under tables may need to consider angled or elevating legs rests which extend the legs outward instead of straight down (knee angle of 90 degrees). When possible, the height of the seat should be adjusted so that the person has enough knee clearance to fit under tables, counters, sinks at home, work, school, and the community (ADA mandates at least 27" high knee clearance under surfaces).

B. Seat Depth. The depth of the seat provides support for the thighs. A seat that is too shallow causes higher sitting pressures because less of the seat is in contact with the thighs. A seat that is too deep, causes excess pressure behind the knees and calves. There may also be a tendency for the pelvis to slide into a posterior tilt so that the back can be adequately supported by the backrest. A 1" gap between the back of the knees and front edge of the cushion is recommended but may need to be more if the person propels with their feet.

C. Seat Width. When sitting on the seat, the individual's hips should be at or close to the edge of the cushion. If the seat is too narrow, the individual may develop a pressure sores on the pelvic bony prominences. If the seat is too wide, the individual will be forced to abduct their arms more making it more difficult to push the chair.

D. Back Height: The height of the back will depend on the amount of postural support the person needs and feels comfortable with. The backrest should be low enough to provide adequate support but still enable for the arms to access as much of the pushrim as possible. Many practitioners use the inferior angle of the scapula as a basis for determining backrest height. The backrest height should be below the inferior angle so that the backrest doesn't impede arm movements. There are various kinds of back supports and some have a cut-out section for the scapula. Only high-strength lightweight and ultralight wheelchairs allow for attaching rigid and custom back supports.

IV. Using Wheelchair Standards in the Selection of Manual Wheelchairs

All manual wheelchairs are not alike. Even within a particular class there is variation in durability, reliability and overall performance. Wheelchair standards can help to sort out the highest quality wheelchairs between and within the classes. The International Standards Organization (ISO) wheelchair test methods are divided into four basic components: measurement, stability, strength, and information disclosure. The intent of the standards is to allow comparison between products and improve quality. By exposing manual wheelchairs to a common battery of tests, the results can be compared providing information to consumers, clinicians, and regulators as to the safety, performance, and features of various wheelchairs. Quality has been improved by the application of wheelchair standards through identifying products that do not meet minimal specifications and by disseminating comparison data.

Despite the nearly fifteen year existence of the wheelchair strength standards, an appalling number of wheelchairs do not pass these tests. There have been several studies that have used wheelchair standards to compare and contrast manual wheelchairs. Only about 20% of depot wheelchairs pass the fatigue tests, 30% of lightweight wheelchairs, and about 80% of ultralight wheelchairs. Hence, it is critical to ask manufacturers and/or suppliers if their wheelchairs are compliant with ISO standards. It would be prudent to ask to see a copy of the test results, especially for products that may be unfamiliar. Studies have also shown that ultralight wheelchairs are more than ten times less costly to operate than depot chairs and four times less costly than lightweight wheelchairs over their life-time. Ultralight wheelchairs tend to perform much better on the strength tests than the other common classes of manual wheelchairs. Emerging data also shows that the sub-20 pound class of ultralights also performs quite well. One plausible explanation is that the lighter wheelchairs are simply better engineered. Interestingly, suspension manual wheelchairs have been shown to perform about as well as lightweight wheelchairs on the fatigue strength tests, with a correspondingly high life-cycle cost.

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Welded for Wheeling: Custom Ultralights Prescribed with Confidence

Kendra Betz, MSPT

Objectives: Participants will gain knowledge and skills that will allow them to . . .

1) Understand & discuss key features and benefits of custom ultralight manual wheelchairs
2) Gather client information and coordinate details to design a custom ultralight chair
3) Clearly communicate the desired configuration for a custom welded ultralight frame

THE ULTRALIGHT MANUAL CHAIRS

Key features of the Ultralights
- Lightweight: K0005 (less than 30#)
- Durable (Cooper, 1999)
- Customized configuration via adjustability or specific frame design for:
  - Comfort (DiGiovine, 2000)
  - Postural support (Hastings, 2003)
  - Skin protection (Cook, 2002)
  - Efficient propulsion (Brubaker, 1986; Beekman 1999)
  - Injury prevention/reduced forces (Boninger, 2000; Richter, 2001)

Ultralights vary widely
- Folding designs
- Rigid options
- Suspension options
- Materials
- Degree of adjustability
- Customization available
- Ask for RESNA/ANSI test data

The Custom Ultralights
- Most dimensions welded; minimal adjustability
- Custom designed & welded frames are:
  - Lightest
  - Most durable
  - Most comfortable
  - Best performance
  - Lowest maintenance
  - Utilized as an ORTHOTIC device to provide postural stability, substitute for impaired trunk (Hastings, 2003)

Concerns with the custom Ultralights
- Not much room for mistakes – gotta get it right
- Most expensive due to materials and manufacturing processes (but think long term)
- Variances in specifications of each chair creates a challenge (read the directions)

Examples of Custom Ultralights

Figure 1: TiLite TRC

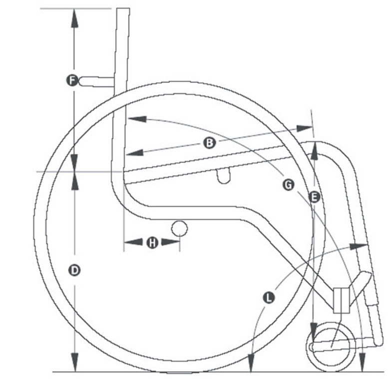
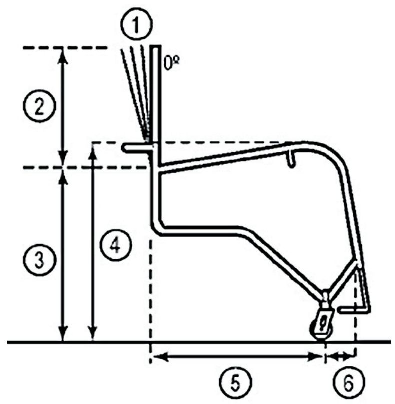


Figure 2: Invacare Top End Terminator



The Role of the Seating & Mobility Specialist
- Knows technology options available
- Matches the technology to the individual
- Understands the process for obtaining & providing the technology
- Provides comprehensive education

"It is imperative that consumers be knowledgable and seek expert advice when selecting a new chair"
(Cooper, 2003)

CUSTOM ULTRALIGHTS FAQ's

Which wheelchair users should be considered for a custom ultralight chair?
- Those who know where they want to sit
- Those who will benefit from a manual chair that is very lightweight, supportive, comfortable, responsive, and durable
- Those whose condition is not likely to significantly change in the near future

Who are the key players in prescribing the custom welded ultralight chair?
- The client (and family/caregivers)
- The clinician
- The DME dealer/vendor
- The funding source
- The manufacturer

How do I figure this out?
- Interview the client
  a. Past medical history, current issues
  b. Preferences, habits, skills, life necessities
  c. Intended environments and uses
  d. Review equipment history for "gotta haves"
  e. Transportation and stow techniques

- Complete a comprehensive evaluation
  a. The client:
     postural presentation, ROM, tone, strength, functional skills. Evaluate the client in chair, sitting on firm mat, supine on mat
  b. Current equipment:
     seating system configuration, patterns of wear, components. Examine the equipment with the client in and out of chair.

- Utilize equipment trials and simulation.
  a. Identify features that provide benefit
  b. Use "assessment chairs" to trial various configurations (i.e. TNT, A4, R2, others)
  c. Use extra parts/pieces for "mock ups" in whatever chair is available
  d. Evaluate support, comfort, performance
  e. Assess functional skills in proposed system (Cook, 2002)
  f. Must identify cushion and back supports
  g. Identify what modifications necessary to optimize the system

PRESCRIBING CUSTOM ULTRALIGHTS

The Dimensions
- Refer to Appendix A of this document
- Communicating dimensions
  a. Each company requests different measurements
  b. For the specifications that are similar, reference points for measures vary
  c. Once you know what you want, clear communication becomes

CRITICAL

The Rear Wheel Big Deal
In addition to location, must consider:
- Size (diameter)
- Materials
- Tire Tread
- Weight
- Camber
- Handrim Selection
- Education

How to get the frame you want
- Know what you want in the frame design
- Know what specifications to provide
- Clearly understand reference points
- Read every detail and footnote
- Communicate with the company (ideally the design engineers)
- Be able and willing to give specs that may not have been requested; give justification
- Confirm frame design by schematic drawing
- Submit the agreed upon frame design (drawing) with the final order

Fine-tuning features for a great fit
- Adjustable rear wheel in horizontal plane
- Adjustable tension back upholstery
- Adjustable height footrest

Options &Accessories – What's the goal?
- Lighten up!
  a. material selection
  b. lightweight rear wheels and casters
  c. non-folding backrest
  d. fixed angle footplate
  e. single camber selection
  f. minimize unneeded accessories & brackets
  g. factor in cushion and backrest selections
  h. education (back-packs, tie downs, body wt.)

- Completely Custom
  a. Consider unique designs that may benefit the user – don't be afraid to ask
  b. Consider the cushion & back supports as part of the custom fit

- Cause and Effect . . . Think ahead
  a. Solid seats position the user higher than nylon upholstery
  b. After-market backs often alter seat depth
  c. Cushion impacts seat, back and footrest heights

When the CUSTOM Ultralight is NOT the best choice . . . several great options exist

- Some Ultralights offer both fixed & adjustable features (i.e. Kuschall series, TiLite ZRA, Quickie ST/DT, Ti & R2, Invacare A4, others)

- Some Ultralights offer a great degree of adjustability (i.e. Quickie box frames, Colours box frames, various folders, others)

FITTING THE CUSTOM ULTRALIGHT

Fit the chair to the client
- Review the final product– measure every specification. Don't settle for less.
- Get in the chair and push it to rule out any problems (i.e. pull to one side)
- Adjustments and fine-tuning make all the difference in the world (not much to do)
  1. Check basic fit with cushion in place
  2. Adjust backpost angle

3.Adjust backrest height
4.Adjust footrest height
5.Adjust rear wheel position (don't forget to adjust the wheel locks)
6.Check chair skills, maneuverability in varied environments and terrain
7.Further adjust as needed
8.Provide comprehensive education

Education – last but certainly not least
• Safety and basic operations
• Maintenance & adjustments
• Push mechanics for efficiency and injury prevention
• Wheelchair skills progression
• Transfers review to/from chair to varied surfaces
• Stow techniques
• Weight of the "system" (Boninger, 1999)

CONCLUSIONS
• Consider the custom Ultralights as a viable option
• Every chair order is an opportunity to improve
• A well configured chair provides improved quality of life – we CAN make a difference

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Appendix A: "Welded for Wheeling" Custom Ultralight Specifications (Kendra Betz, MS.PT)

A. SEAT WIDTH:
Typically measured outside of seat tubes.
• Recommend snug fit without causing adverse effects; rigid clothing guards help with positional control and protection near rear wheels.
• Consider clothing bulk relative to usual wear and seasonal differences. Avoid prescription of width that fits the winter coat, not the body.
• Tapered seat is an option (front more narrow than back). Must determine if measured outside of front seat tubes or referenced to inside of front seat tubes.

B. SEAT SLOPE: aka dump, squeeze, seat angle. Generally specified as difference front seat to floor height relative to rear seat to floor height. Most commonly measured linearly (inches or cm) vs. angles (degrees).
• Information from the mat eval and empirical trials is CRITICAL for determining where the client is optimally positioned in seat angle.
• General rule: the greater the degree of trunk compromise, the greater the degree of seat slope to substitute for trunk instability (i.e. extensive trunk paralysis best with 3-4" slope vs intact trunk 1-2" slope) although highly variable. Seat slope has significant impact on postural alignment. (Hastings, 2003)

C. REAR SEAT HEIGHT:
Measured from floor to top of seat tube at back post.
• Consider seat position relative to rear wheel. 100-120 degrees of elbow flexion with hand at top dead center of handrim recommended (van der Woulde, 1989). Center of finger at center of axle is a strong clinical correlation with that elbow angle. Seat position affects torque output of upper extremity joints during chair propulsion; hub to shoulder length should be considered (Richter, 2001).
• Consider height in space relative to front and seat slope as discussed above.
• For suspension chairs, consider the impact of suspension on rear seat height when the suspension is loaded (loss of seat height with suspension). Some companies account for loss of height in chair build, others don't. Weight of user impacts seat height.

D. FRONT SEAT HEIGHT:
Measures vary between companies. Need to know if measured distance from floor is to a) top of seat rail at front of upholstery b) to beginning of top frame bend c) to apex of top frame bend or other (measure is not always the height at front of upholstery).
• Impacts clearance for tables/ desks, floor access, height in space.
• Incorporate cushion height, lower leg length, footrest clearance.

E. FRONT FRAME ANGLE:
Reference angles vary between companies. Understand if the angle is relative to a) the ground to inside of front frame bend or b) frame bend from seat plane. Measure is not always requested so specify if it is a critical measure.
- Consider ROM, tone, overall chair length, front stability of chair, caster clearance.

F. FOOTPLATE POSITION:
Vertical position relative to seat height and/or ground clearance.
- Impacted by front frame angle. Incorporate cushion heights.
- Also need to understand position relative to front casters for front chair stability and foot clearance

G. SEAT DEPTH:
Usually measured front of backpost to front of upholstery. Sometimes there is a gap between the backpost and rear aspect of seat upholstery.
- Selection of seat depth impacts the overall frame length. Can specify depth and frame lengths separately when appropriate.
- Determined from evaluation, identified needs, front frame angle and knee flexion position. Common mistake is seat depths TOO LONG – impact seated posture.

H. BACK ANGLE:
References vary between companies so know if vertical is referenced as zero or 90 degrees. Measure is usually relative to vertical, not relative to seat.
- Can be fixed angle or adjustable posterior (recline) & anterior (squeeze); adjustable tension upholstery or after market backs give flexibility. In conjunction with seat slope, backrest position strongly influences posture; reclined encourages posterior pelvic tilt (not good).
- Consider influence of rear suspension on back angle (do the backposts assume a more reclined position when suspension loaded?)

I. BACK HEIGHT:
Typically from top of seat post to top of back post, without upholstery.
- Fixed or adjustable. Must be high enough that pelvis and trunk are well supported, low enough to allow available full upper body function and optimized postural alignment (i.e. thoracic flexion over lumbar extension).

J. REAR WHEEL (COG):
See Rear Seat Height section above for vertical position.
- For position in horizontal (fore/aft) dimension, often designated as front of backpost to center of rear wheel axle.
- Want wheel as far forward as possible without compromising rearward stability (Bonninger, 2000; Koontz 2003).

K. CASTER POSITION:
References vary between companies. Not always requested. Specify when measure is critical. Impacts chair maneuverability & stability. Must consider in 3 planes:
1. Sagital plane (from the side): caster position relative to the rear & front of the frame. Short wheelbase (center of rear wheel to center of front caster) gives compact frame. Recommend preserving a long enough wheel base to allow safe mobility with obstacles and uneven terrain. With front suspension, consider extending front caster placement forward for stability).
2. Frontal plane (from the front): distance between the 2 casters (usually center to center). Changes lateral stability and clearance of casters with feet, front hanger. Factor in caster size, fork lengths.
3. Transverse plane (from above): caster swivel impacted by position as well as fork lengths and caster size selections.

L. FRAME LENGTHS:
Considering all of above, determine frame length needs. Not always requested by manufacturer, so be sure to designate when critical. References vary.
Consider:
1) chair “footprint” which includes the rear wheel which extending beyond the frame
2) overall frame length
   (most posterior aspect of frame to most anterior aspect of frame)
3) break it down to component lengths
   a. rear frame to center rear wheel (COG)
   b. rear frame to center caster
   c. center rear wheel to center front caster
   d. center caster to front frame angle

M. FOOTREST WIDTH:
Typically measured as “inside width” at designated position on front hanger.
- Consider desired foot and lower leg position which will impact upper leg position. Feet at midline will encourage femurs toward abduction and external rotation.
- Assess potential pressures at lateral lower leg.
- Shoe widths vary by season and activity
- Recognize impact of footrest width on overall frame configuration. Wider footrest usually requires wider caster position.
- Be careful when a specific measure is not requested as you may get an odd configuration (i.e. 14” wide seat with (-6) footrest width is 8” which is very tight)

Measurement of Interface Pressure- Research Versus Clinical Applications

David Brienza, PhD
Sharon Pratt, PT
Stephen Sprigle, PhD, PT

Interface pressure measurement systems or pressure mapping devices have developed into useful tools to study the buttock-cushion interface. Because these systems have been used in research and clinical applications, an understanding of the technology is needed to be able to interpret the results of pressure measurements. Research and clinical applications have different goals and, therefore, produce different types of results. This session will explain the basic features of pressure mapping devices and describe methods used for clinical and research applications.

Pressure measurement technology
Several commercial systems are available for this purpose. Mattress-sized and/or seat-sized systems are available from Vista Medical, Inc, ErgoCheck, X-Sensor, Tekscan, Oxford and Novel. Simple, hand held sensors are made by Cleveland Medical Devices and The Roho Group. These systems use capacitance, resistance or pneumatic transducers to determine the pressure between the body and support surfaces and have varying levels of cost and complexity.

All these devices report normal pressure or loading and are unable to measure shear forces on the body. Moreover, the interpretation of an array of numbers is not trivial, as one must consider pressure magnitudes, pressure gradients, and the relative location of applied pressure on the body. Finally, all sensors have the potential for artifacts (errors) in measurement due to curvature, hysteresis and creep.

Research Applications

Human versus bench testing
Research has used pressure measurement within projects using human subjects as well as bench tests that utilize buttock models and jigs to represent the human body. Each approach has benefits and drawbacks. The greatest challenge in using humans centers on incorporating a large enough number of subjects to represent the vast diversity of wheelchair users. Some studies recruit subjects with specific diagnoses or with specific equipment needs in order to reduce inter-subject variability. This approach has merit but then limits the generalizability of the results. Bench tests that use buttock models and jigs have the benefit of a repeatable loading indenter that is well-suited to reliable measurements. However, the challenge of this approach is determining how well the measurements of forces and pressures reflect those experienced by actual wheelchair users. In summary, and in research jargon, the challenge of both approaches centers on the ability to control risks to both internal and external validity.

Categorization of cushions
One goal of some research projects and standards development is the development of test methods that can categorize a cushion's ability to distribute load over the supporting tissues of the body. These projects are focused on assisting clinicians and users to identify a class or category of cushions that will meet an important medical need, adequate pressure distribution. By identifying a client's relative risk for ulcer development, a clinician can select cushions for trial that have the appropriate level of pressure distribution capability. Test methods that categorize cushions according to their ability to distribute pressure would facilitate this process. Certainly, the results of test methods that reflect cushion performance cannot be used to prescribe cushions for an individual; but they can be used to categorize cushions in a manner that facilitates the matching of a cushion to a person's needs.

Assessing PU risk
Research has used interface pressure measurement in an attempt to determine the relative pressure ulcer risk of an individual. As an example, Brienza et. al. (Brienza, 2001) studied the relationship between buttock-wheelchair seat cushion interface pressure measurements and pressure ulcer incidence in a Skilled nursing facility. Interface pressure measured on wheelchair seat cushions was higher ($p \leq 0.01$ for both peak pressure, and average of highest four pressures) for patients who developed sitting-induced pressure ulcers compared to those patients who did not develop pressure ulcers. The mean peak pressure was 114 mmHg with a standard deviation of 46 mmHg for subjects with PUs and 77 mmHg with a standard deviation of 22 mmHg for subjects remaining PU-free. But was a relatively small study (n= 32) and not generalizable. Conine et al. (Conine, 1993) studied the effectiveness of a cushion in preventing pressure ulcers in a group of 163 elderly wheelchair users. They found that "the incidence of pressure ulcers was significantly higher among those patients who experienced peak interface pressure recorded at 60 mmHg or higher…." However, since the pressure measurement devices used in these two studies were difference, the results are not comparable.

Clinical use of pressure measurement
Pressure mapping can be a useful tool to assist clinicians in a field that is often rather vague and practiced with an element of trial and error (seating) – What a concept!!!!

Pressure mapping devices are not intended to replace or substitute for our most valuable tools, our hands and eyes, but when used appropriately, may be used as an adjunct to information gathered during a seating assessment in support of deciding on seating interventions. As mentioned above, all pressure measurement technologies have certain limitations is what and how they measure and record interface pressures. These technical issues must be incorporated into clinical decision-making in order to get the most benefit from these systems.

Some of the clinical challenges of clinical pressure measurement include: 1) the acceptance and understanding that pressure mapping devices only measure normal loading on the mat; 2) measurement and interpretation of a static seated posture at one point in time versus the measurement and interpretation of longer term measurements; and 3) the understanding that no 'safe' interface pressure threshold has ever been determined for all people. Tissue tolerance varies across people and across body sites.

Because of these challenges, interface pressure measurements are best used to identify inappropriate support surfaces rather than determining efficacy. In other words, clinicians should use pressure measurements to exclude certain supports from consideration due to high loading, but should not be used as a singular measure during assessment. The basis for this reasoning is the fact that appropriate wheelchair cushion selection reflects several factors with normal pressure being just one. For example, a wheelchair cushion must be chosen with respect to its effect on transfers, posture, propulsion, comfort, and stability as well as pressure. Finally, the maintenance and service requirements must also be taken into consideration. If a user cannot properly maintain the product, it should not be a consideration. Clinicians should consider all these factors rather than elevating interface pressure measurement to supreme status.

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Matching Client Function with Specialized Manual Mobility Options

Jane Fontein, OT
Phil Mundy, PEng.

Instructional Session Outline
The presentation draws on clinical experiences of prescribing therapists, Home Medical Equipment dealers and PDG staff during their work developing various mobility related products with an emphasis on manual wheelchair positioning, bariatrics and individuals exhibiting high agitation. In developing 'special application' mobility devices, PDG staff gathers input from all sources to facilitate development of equipment that meets the clients needs for the best function and independence

The presentation will discuss several factors as they relate to each case history and product application. The following list provides an introduction.
- Physical problems - This is often the first issue that comes to mind when identifying aspects contributing to specialized manual mobility.
- Functional limitations - The balance between function, physical limitations and therapeutic goals often requires a compromise.
- Environmental Barriers - In cases where the environment limits options, the team may have to compromise in their efforts to find a workable mobility solution.
- Care Giver issues - Issues for caregivers may conflict with client issues and need to be addressed.
- Funding issues - Relatively uncomplicated cases can become difficult to address if funding issues limit options available to the team.

Case Presentations
Case histories will be used to demonstrate a variety of unique solutions. Each case will be done with emphasis on the process used to work through delivery of sophisticated equipment. Information will be presented in a way that delineates the relationship between physical need, functional goals, and equipment design.

Client Presentations – The following are only a few of the many case histories that will be presented with a small synopsis about each client.

Frail / Marginal Mobility Client

Clients who are frail and have general weakness and some postural deformities often have difficulty mobilizing a wheelchair.

Prior to having a chair that she could hand and foot propel in tilt, Ruth was only able to be up for 3 hours per day and she was unable to mobilize independently. Because of the configuration of the Bentley wheelchair she is now up all day and is independent for her mobility.

High-Agitation Client

Clients with high agitation often require products with many specialized features. PDG presents several clients requiring unique solutions. These wheelchairs feature extra-high stability, shock absorbing materials and components that stand-up to heavy use.

Margaret is a client who is constantly moving within her mobility device. She had some pressure problems in her previous chair that did not allow her to mobilize in tilt. She is now safe and independent.

Manual Tilt-in-Space

Sam had a pressure sore that was not healing and he had refused to get a tilt chair unless he could independently propel it and tilt it. The Stellar allowed Sam to live at home with maximum independence since he can 'wheel' and change his seat tilt independently.

Physical deformity

Darwin is a client with a severe fixed kyphosis and scoliosis. He requires the 45 tilt for his postural deformity. Despite being in a fully tilted position most for the time Darwin is able to see his environment and we are able to see him and he can be at the table for his meals.

Bariatric Client

Pauline was unable to get out of her bed until an extra wide chair was provided for her. She has limited strength and her centre of gravity is quite far forward. The Eclipse with its forward wheelbase enables Pauline to push the chair independently because she can access the wheels and her weight remains on the rear wheels.

Early Interventions for Positioning the Infant and Small Child

Sheena A. Schoger Dip.OT, OTReg.(Ont.)

Babies, newly diagnosed with a medical condition or disability, often have parents who are overwhelmed; unable to comprehend a future that involves medical interventions such as surgeries, therapy appointments, wheelchairs, walkers, etc.. Complex early intervention rehabilitation equipment can be totally rejected by parents, although well made, very adjustable, and esthetically pleasing (to those of us in the rehabilitation field). If parents think this equipment is their only option, they may comply with the "experts" and agree to the purchase of the equipment but not use it, or they may refuse, possibly because of financial reasons and as a result, not have the equipment they and their child may desperately need.

Modifications can be made to commercial baby and toddler equipment, to enhance the child's alignment, positioning, and function and to make their care easier. This can be as simple as demonstrating to a parent how to roll towels and/or receiving blankets and place them strategically in strollers, car seats etc., to custom fabricated equipment from such materials as foam and ethafoam. With a little foresight and ingenuity, these materials can be used in the NICU, ICU, the home, or paediatric ward and are often more easily accepted by the parent.

The NICU

The primary consideration is:
- Keeping the baby alive
- Obtaining the best outcome possible, regardless of diagnosis
  Prematurity:
- Less than 37 weeks gestation
- Have not developed fetal flexion

Low birth weight:
- Below 2.5 kg or 5.5 lbs

Traumatic birth:
- Asphyxiation
- Meconium aspiration
- Shoulder Dystocia
- Etc.

Congenital/chromosomal condition or anomaly:
- Spinal muscular atrophy
- Osteogenesis imperfecta
- Dandy Walker syndrome
- Down syndrome
- Heart conditions
- Etc.

Babies in the NICU often have many and varied complications which affect their outcome. Examples of these are:
- Anemia
- Apnea
- Bradycardia
- Bronchopulmonary Dysplasia (BPD)
- Chronic Lung Disease (CLD)
- Feeding Intolerance
- Growth Restriction
- Hyaline Membrane Disease (HMD)
- Intrauterine Growth Restriction (IURG)
- Intraventricular Hemorrhage (IV)
- Narcotizing Enterocolitis (NEC)
- Patent Ductus Arteriosus (PDA)
- Pneumothorax
- Respiratory Distress Syndrome (RDS)
- Retinopathy Of Prematurity (ROP)
- Seizure disorder
- Sepsis/Infection
- Weight Gain/Loss

These complications will often preclude positioning interventions. Any of the above conditions, plus many others, will determine the intervention allowed for positioning, as well as the previously listed reasons for the baby being in the NICU initially. It is vitally important to obtain the neonatologist's permission, prior to attempting to change the baby's posture and positioning.

Positioning, as previously stated, can be in the form of rolled receiving blankets, arranged to achieve the required results. How one rolls and applies these however, will determine how effective the intervention is and also whether or not the nursing staff and parents will actually use the intervention. If it is seen as being easy and beneficial to the infant, it is much more likely that it will be carried out, not only in the NICU, but also by the parents, once the infant is discharged and goes home. Other types of intervention for positioning in the NICU include the use of:

- Foam wedges and bolsters
- Soft stuffed toys
- Baby "bowls"
- Infant car seats
- Commercial strollers

When the infant is ready for discharge, the most pressing need is for modification of an infant car seat, to allow for safe transport home. Depending on the size of the infant, tone (high or low/floppy), reflexive postures, respiratory status, etc., this can be difficult to achieve. Methods of modification will be discussed during the presentation as well as interventions that should not be done, as they can compromise the integrity of the car seat.

Once the infant arrives home, a whole new set of circumstances has to be adjusted for and parents often have limited ability to cope after weeks and months of wondering if they will ever take their child home. If the infant is irritable on arriving home, the parent, usually the mother, becomes the primary caregiver. She finds it difficult to trust the care of the infant to another, even to the father, and soon becomes the only person able to feed, soothe, bathe, and change the infant. She finds that she cannot go shopping with or without the baby, as he becomes distressed in the vehicle and he cannot be left with another caregiver, as he cannot be separated from his mother. Soon the mother feels trapped at home, with a demanding baby, and with little energy for day-to-day activities.

On discharge from the NICU, therapy is often provided in the home but is limited by the reluctance of the child to tolerate handling by the therapist. When the baby is ready to attend a therapy facility, he is often found to be extremely irritable and cannot be transported without extreme agitation. If a baby cries going to and from therapy appointments, the value of the therapy will be lost and the parent will be more likely to avoid outings that could provide much needed social contact and support from other parents and professionals. Our work then is to provide techniques to allow the baby to separate from the parent and to tolerate the car seat and vehicle. This requires diligence but will be eventually be successful, although for some babies this takes months to achieve.

This can be achieved by the use of a baby "bowl", car seat, wagon, stroller and vehicle as well as a co-operative husband or friend. When the baby can be placed in the baby "bowl" and carried without getting upset and without the mother holding him, the baby "bowl" is placed in a wagon or stroller and is moved slowly within the home. Often it is movement the baby cannot tolerate, possibly because of the influence of the tonic labyrinthine reflex. Once this is successful, the baby should have a car seat adapted to fit him snuggly and when he is able to tolerate sitting in the car seat in the home, it is then placed in the wagon or stroller and moved within the home. The next step is to place the baby in the car seat, to carry him while still in the car seat, and place him and the seat in the car. If it is cold weather, blankets should be used to bundle him, rather than extra clothing, which would change the experience. Initially, the vehicle should be started but not moved and gradually short trips added, first only a few feet, then around the block and gradually for longer and longer distances. During this time, the mother should sit with the infant, reassuring him as needed until gradually she can move away and eventually drive the vehicle herself. This technique has been successful for several very "difficult" babies.

I have mentioned the baby "bowl" several times. This is a piece of equipment I designed and have made for many years from 4" foam slabs, individually fabricated for every child. It can be used in the NICU, ICU, pediatric ward, or home. Primarily, it positions the child in symmetry, with trunk and hip flexion, the arms/shoulders in slight flexion, and the head in midline. Care is taken to maintain the head in the desired position. The head posture is very important, as too much capital extension does not inhibit extension and too much capital flexion can impede respiration and swallowing. The 'bowl" allows the parent to hold the baby without actually holding him in her arms and it can serve to assist in removing an irritable baby from the constant shelter of the mother's arms. The end result is usually tolerance, inhibition of abnormal posturing and reflex activity, and good maintenance of midline orientation. Most babies settle down when placed in the "bowl" and often fall asleep, a good indication of your success. Feeding often improves due to the improved head and body posture. An irritable baby is often comforted if an article of clothing, used by the mother, is placed in the crib, car seat, etc.. The scent of the parent comforts the child when the parent is not actually present and consistent use of one perfume by the mother makes this easier to maintain.

For high chair modification, I have found that Ethafoam, a closed-cell foam that is heat bondable, can be relatively easily configured to meet the custom requirements of our clients and is easily modified as the infant grows. I usually provide positioning in long leg sitting, as this is the easiest method of safely adjusting a high chair for a small child, while also providing passive stretching and inhibition of flexor and adductor tone in the lower extremities. The insert can be as simple or as complex as required, and if more complex support is required initially, this can be cut down or removed as the infant grows and matures.

A wedge seat, also constructed from Ethafoam, is often provided as a therapy intervention, providing elongation of the muscles of the lower extremities while also providing a play table and seat. The wedge seat utilizes a seat that is wedged anteriorly, so that the child sits with an open or greater then 90° hip angle. This is provided to allow the pelvis to assume an upright orientation, despite tight hamstrings. Initially we were concerned that the hamstrings, no longer on stretch, would actually shorten and tighten, however the exact opposite was found to occur. When the pelvis is upright, the hamstrings and other muscles do not have to work as hard to maintain the upright posture, and we find that with regular use, the hamstrings actually relax and gain length, despite the open hip angle.

There are many commercial products available, which provide excellent positioning for the neonate as well as older children. These products, some of which are sold under the name of Snuglbuds, are convenient and reasonably priced. Custom made products or customized commercial products generally provide the best interventions, however not all babies require this degree of intervention. Non-slip products or such items as the inflatable highchair inserts from Ikea, can be used for babies who need some support but who do not have high positioning needs. Sometimes parents only have to be shown why and how to use every day products, to provide the intervention their child requires.

As the baby gets older, wheeled mobility becomes an issue. If funding is available, I have found that parents have been very positive when offered the Quickie Kid Kart Xpress, made by Sunrise Medical. Families report that parents of "normal" children will ask where such a stroller can be purchased, as they would like one for their child. It is very important that, in the early years, the parents are able to feel positively about their child and this type of interaction is very important. Even with this type of stroller, I have found that it is possible, and often necessary, to customize it, without compromising the crash test rating, while providing the child with the support required. This system can also be integrated with the Zippie P500 to provide power mobility. For older children, whose needs are related more to size rather than maximal positioning, the Kimba TRS is readily accepted. There are many other systems that can be prescribed and each system has its pros and cons. No system is perfect for all children.

I do not believe that an older child should use a stroller, as he may be regarded and treated by peers and adults as a baby, very dependent and cognitively and developmentally immature. Children should be assisted to function at an age appropriate level whenever possible. This includes sitting in highchairs, strollers, and wheelchairs. The "normal" child learns to walk between the ages of 8 to 15 months; this then is the ideal time to provide mobility equipment.

When therapy is provided in the home, it is more difficult for a therapist to provide some of the higher levels of equipment interventions, as these are more easily constructed within the rehabilitation facility, where specialized equipment and facilities are available. However, the therapist should not be deterred from fabrication within the home. The end result may not look quite as professionally made, but if successful in its function, the equipment will be used by the family.

This presentation will address the early equipment and positioning needs of our clients and families and hopefully most participants will feel ready to go into the NICU or out into the community with confidence, knowing we can make a difference.

Information Gathering Through Simulation

Adrienne Falk Bergen, PT, ATP/S, CRTS

Simulation is an invaluable tool when making decisions regarding seating interventions. I rarely do any decision making or measuring without the use of a simulator. During the past few years the use of a simulator as a pure assessment tool has become confused with other tools we use to assess consumers in sitting. Many seating professionals use the Invacare Shape Sensor to position clients during the assessment process. Still others use frames with bead evacuation bags in place. The word simulation has been used loosely to describe all of these assessment tools. We need to be careful not to confuse the issue.

Simulation needs to be a generic process, which occurs after the mat assessment and prior to making seating decisions. Once a consumer is seated on a soft, flexible surface a surface decision has been made. Once a consumer is seated on a surface, which creates contours to support their body, a seating decision has been made. Simulation should be done at the first step in the decision making process, it should be planar in most cases, so that a clear view of the client can be had from all angles. During this stage the observer(s) need to make changes, observe the result of the intervention and when necessary take photographs to document the observations. At a minimum, the simulator "tool" must:

- allow for changes of seat depth and seat pitch,
- have a thin profile at the front of the seat to allow for accommodation of tight knee angles
- allow for seat/back and seat/calf angle changes
- accommodate windblown leg postures
- allow for clear viewing of spinal contours and alignment from both sides.

The following assessment story will help you to understand the value of planar simulation in the decision making process.

Asher

Asher presented at the clinic in his new manual wheelchair. He obtained this chair through an outside clinic and his school therapists were not satisfied with his posture. They had tried to discuss this with the clinic that provided the chair, but were concerned that they were not being heard. Two of my clients had canceled for the day, so I offered to go through an assessment process with Asher and take photos for them to share with the outside clinic.

Our usual procedure during an assessment is to carefully observe the client in his existing seating system after he is positioned as optimally as possible. We removed Asher's tray and observed him in his existing wheelchair and seating system. From the front it is obvious that he is sitting with a slumped posture (see photo 1). His pelvis is slightly posteriorly tilted, his trunk appears collapsed and his low tone is reflected in the broad abduction of both legs. He is having difficulty holding up his head. A side view confirms the poor posture (see photo 2).

Our next step is to remove some of his clothing and further observe his seated posture. Shirtless it is obvious that his trunk is very collapsed, with a protruding abdomen(see photos 3 and 4). He also slumps over to his right. Lower rib flare is seen, along with the continued broad abduction. Asher had been provided with an antithrust seat and a biangular back. When the therapists working with him first expressed concern to the seating clinic they removed the influence of the biangular back, since his supine range of motion showed some limitation in mobility, and he was simply pulling forward of the biangular surface at the pelvis. We were concerned to see that the antithurst seat was very thick at the front, and had not been beveled back to accommodate for his calf muscle or his AFO (see photos 5 and 6). At this point we had not done a supine mat evaluation, so we did not know if he had tight hamstrings, which would have required a closed seat/calf angle. We later learned that he actually would have benefited from an 85-degree seat/calf angle, which is not possible without a beveled front on the seat. With the wheelchair's footplates in place we were disturbed to note that the heel cup pulled his foot forward of the front edge of the seat, pulling his knee out to a 95 degree seat/calf angle (see photo 7).

Asher was removed from his wheelchair and a supine mat assessment performed. In supine we found that he had limited pelvic mobility, and some hamstring tightness. In general, all ranges were within functional limits for neutral sitting.

The clinic's simulator has both planar surfaces and replacement frames with bead evacuation bags. We always do a planar simulation first, using our hands and the supports that accessorize the simulator to provide a way to assess the client's response to support. The simulator was set up for Asher based on the information gleaned from the mat assessment(see photo 8).

We placed lateral hip/thigh supports to try to control Asher's tendency to abduct his legs(see photo 9). These did not adequately control his position until we moved them forward to provide control to the end of his knees. (see photo 10). We then moved up to his trunk and attempted to provide adequate lateral trunk control. Although he responded fairly well, he required extensive controls and we quickly began to realize that in order to provide control as high in the trunk as he required it he might be candidate for a molded back cushion. In addition, we noted that wherever a lateral support ended he tended to flare out around it, both above and below(see photo 11).

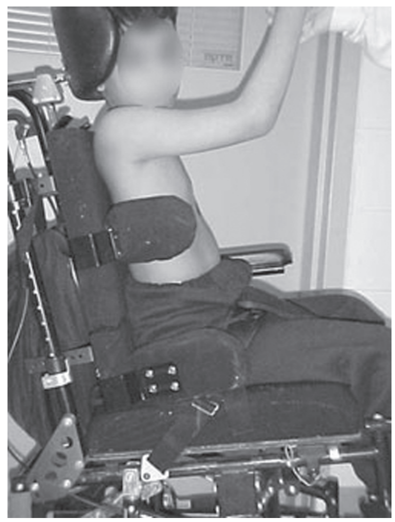
Side views showed the lower abdominal collapse we had seen in his wheelchair. Here, however, with a clear, unobstructed view, we could see that he was actually collapsing in his mid trunk and then hyperextending above it (see photo 12). This made it difficult for him to find a good, functional placement for his shoulders and head. We began to use our hands to try and help him find a better place to center himself and activate his muscle groups for trunk co contraction. Filling in the area behind him to bring his shoulders over his pelvis seemed to solve some of his problems(see photo 13).

Further discussion lead to a conclusion that he would benefit from a simulation with molding bag, but we had run out of time. Recommendations will be sent to the outside clinic regarding the manual chair revisions, to improve his seating in this manual wheelchair. Revisions to his power wheelchair will be done in the near future, and the team will consider a molded back for that chair to improve his opportunities for head control to facilitate easier driving with his head array.

(above: Photo 1) Asher's posture in his new seating system was very poor. He always appeared to be slumped in the seat.

(above: Photo 2) This view shows his posture from the side.

(above: Photo 3) It is almost impossible to assess wheelchair seating problems unless the client's clothing is removed or atleast lifted up to expose the body to view. Notice that he leans to the left, has lower rib flare and sits in broad abduction.



above: Photo 4) The side view shows his "abdominal collapse" symptomatic of low central tone.

(above: Photo 5) Whenever you use a seat with a thick front profile it is important to cut back (undercut) the front so that there is room for the calf muscle, and/or brace segments.

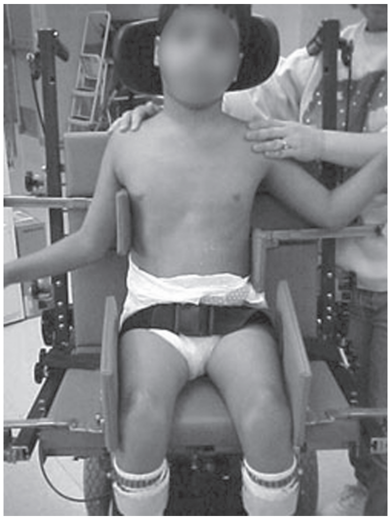
(above: Photo 6) This shows how his his calf would hit the front wooden portion of the seat if his knee was at the proper angle.

(above: Photo 7)It is important to look at the knee angle needed and the relationship of the front of the seat to any calf or heel supports that might pull the person's knee away from the angle determined by the mat assessment and simulation.

(above: Photo 8) A planar simulator has components which are fully adjustable and allow the evaluators to view the client from all angles to determine his response to support.

(above: Photo 9) Asher is placed on the simulator and observed.

(above: Photo 10) It is necessary to extend the lateral knee support pads to the end of the knee for maximum control of excessive abduction.



(above: Photo 11) Lateral supports are moved around to try and find the most optimum key points for control. It became obvious that full contact would be needed for maximum support.

(above: Photo 12) Asher continues to show abdominal sag, with little activation of his flexors or extensors.

(above: Photo 13) A combination of angular adjustments with a pad behind his shoulders to get better alignment of his trunk (shoulders over pelvis for a more “ready” position) creates some activation of his abdominals and tells us more about what we needed to know to plan his seating system.

International Standard for Postural Measures of a Wheelchair Seated Person

Barbara Crane, PhD, PT, ATP
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BACKGROUND

In the field of wheelchair seating, there has been tremendous variation in the use of the terminology and definitions related to the clinical measures of a seated individual. Standard definitions and terms are lacking for communicating critical postural information and support surface parameters in a way that is uniformly useful to service providers, technicians, researchers, manufacturers, wheelchair users and purchasers when selecting and providing wheelchair seating devices. To address this and other needs, work began in 1998 at an international level within the structure of the International Standards Organization (ISO) on the development of wheelchair seating standards. Part 1 of the ISO 16840 series of seating standards is called "Definitions of Body and Seat Measures", and this document should be released for the final draft international standard (FDIS) voting sometime in the fall of 2004. (The FDIS stage is the final voting stage for a standards document.) The purpose of 16840 Part 1: Definitions of Body and Seat Measures is to specify standardized geometric terms and definitions for describing and quantifying a person's anthropometric measures and seated posture, as well as the spatial orientation and dimensions of a person's seating support surfaces. The plan throughout the development of this document was to provide a standard that would be useful not only for scientific research, but also for clinical practice in all areas of the service delivery process. Work has already begun on developing the tools necessary for clinicians to be able to utilize the measures in the Part 1 standard. This work will continue with refinement based on feedback from audiences such as this one. Successful implementation should allow clinicians to improve their clinical practice in the area of wheelchair seating.

PURPOSE/OBJECTIVES

The purpose of this workshop is to present the foundational concepts contained in this ISO standard that relate directly to clinical practice, and to introduce some preliminary tools and techniques that will help to facilitate integration of these measures into current practice settings. It is our long term goal that a standardized method of describing and measuring both the person and their postural support system will not only facilitate clinically useful research in the field of wheelchair seating, but will also improve communication between all members of the seating team, resulting in more efficient service delivery and improved outcomes for consumers. Many of the concepts introduced in this workshop will be quite new to most seating practitioners, therefore time will be allowed for questions and discussion. It is our hope that this workshop will increase RESNA member participation in this important work, and we expect that feedback from participants will be very helpful in planning future developments.

MEASURES DEFINED IN THE STANDARD

The following is a summary of the types of measures defined in this part of the Wheelchair Seating Standard (ISO 16840-1):

Body Measures

1.Angular Measures of the seated person's body

ß Absolute Angles of Body Segments

(eg: Sagittal Thigh Angle, Sagittal Pelvic Angle, Frontal Head Angle)

ß Relative Angles of Body Segments

(eg: Thigh to Trunk Angle, Pelvis to Thigh Angle)

2.Linear Measures of the seated person's body

(eg: Buttock/Thigh Depth, Scapula height, Foot depth)

Support Surface Measures

1.Angular Measures of support surfaces

ß Absolute Angles of Support Surfaces

(eg: Sagittal Seat Angle, Frontal Head Support Angle)

ß Relative Angles of Support Surfaces

(eg: Seat Support to Back Support Angle, Seat Support To Leg Support Angle)

2.Linear Size Measures of support surfaces

(eg: Seat Support Depth, Foot Support Width, Back Support Length)

3.Location Measures of support surfaces

(eg: Lateral Trunk Support Frontal Location, Back Support Sagittal Location)

Note that the measures of a person (either linear or angular) will not necessarily be identical to those of the seating support surfaces, which is why it is critical that measures of the two be differentiated. The prescription of a seating support surface must be determined through clinical interpretation or translation of the measures of a person into those appropriate for support surfaces that will adequately support a person in a desired posture.

FOUNDATIONAL CONCEPTS

The following concepts are elements of the integrated measurement system that, when used together with the proposed terminology, permit the objective description and recording of both the person's seated posture and the dimensions of their postural support system.

1. Global Coordinate System: In order to take a measure of any kind that will have consistency across facilities and over time, agreement must first be reached on what recognized coordinate system, from the many possible, will be used as the standard. After much debate, the following coordinate system was chosen. The direction of the positive X, Y, and Z axes, relative to the seated person and as viewed by the observer, is defined in Figure 1 below. This has been termed the Global Coordinate System because it remains fixed in orientation and thereby serves as the constant reference to which all linear measures can be made - for the person, their support surfaces, and their wheelchair (only the person is shown in Figure 1). Figure 1 also shows the three- dimensional location of the origin (0,0,0p) of the coordinate system for the person.

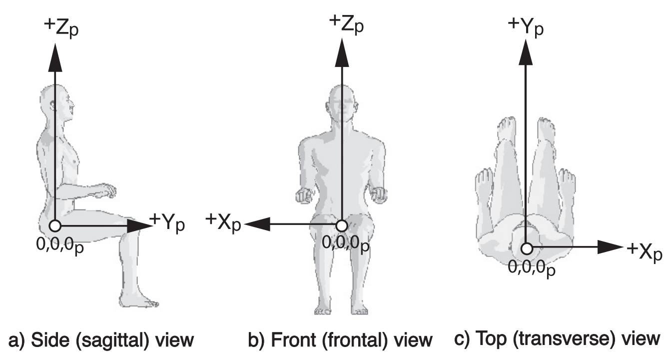
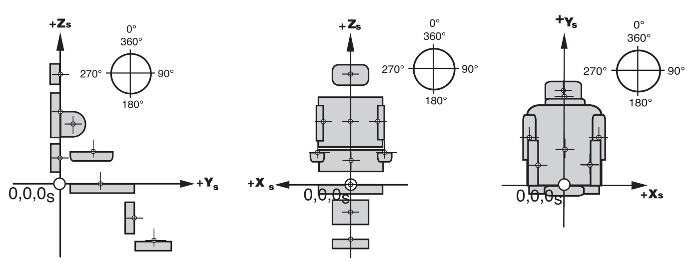


Figure 1-Definition of Global Coordinate System

As seen in figure 1, there are three views in which measures are considered – sagittal (side), frontal (front) and transverse (top), thereby allowing an approximate 3-D representation of posture. This simplification reduces all three-dimensional measures to two measures, which is consistent with current clinical practice. Note that values for linear location measures can be positive or negative depending on the direction they extend from the 0,0,0p center. Separately and/or collectively this coordinate system allows for measurement in the three traditional orthogonal planes of locations, angles and linear dimensions of a seated person's body and their seating support surfaces.

2. Integrated Measurement System – There are really three coordinate axis systems-– one for the person (termed, seated anatomical axis system (SAAS), one for their postural support devices (termed, support surface axis system (SSAS), and one for the wheelchair (termed, wheelchair reference system (WRS). Though described separately, each has been designed to allow for integration with the other two systems. This integrated measurement can then provide a description of the seated posture of the person, the dimensions and placement of their postural support system and the set-up of the wheelchair.



a) Side (sagittal) view b) Front (frontal) view c) Top (transverse) view

Figure 2 – Support Surface Axis System

3. The Compass Rose– In order to describe and measure angular positions of body segments and their support surface components, a zero reference must be established. After much international debate, it was agreed that a 360 degree measurement system, termed the compass rose, seemed to offer the most advantages. As can be seen in Figure 3, this method defines the zero reference position as aligned with the +Z axis and measures degrees continuously to 360 degrees in a clockwise direction. Therefore, angular measures are always positive and can range from 0 degrees to 360 degrees. This method is used for all angular measurements in all positions.

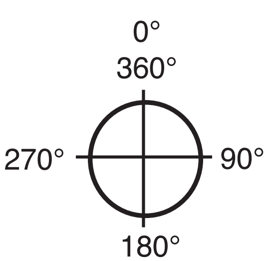


Figure 3: Definition of the angular measurement system

4. Absolute vs. Relative Angular Measures:
The recording of angular measures of body segments in all three planes gives us an objective method for describing and documenting seated posture. This standard defines two types of angular measures, absolute and relative, because it is clinically important to be able to define the orientation of body segments both with respect to other body segments (as this reflects joint position), and with respect to a fixed outside reference (as this reflects orientation in space). Absolute angles define the orientation of a single body segment or support surface relative to the vertical, and relative angles define the angle between two adjacent body segments or support surfaces. Terms for absolute angles are defined in all three views (sagittal, frontal and transverse), while terms for relative angles are defined in the sagittal view only for simplicity.

5. Body Segments, Anatomical Landmarks and Segment Lines:
In order to define absolute and relative angles of the body, it was first necessary to identify the specific body segments of interest, and then be able to specify their orientation. In order to accomplish this, body surface landmarks and lines joining these landmarks (termed segment lines) were defined for those body segments critical for defining seated posture, in each of the three views. The center of rotation (usually joint centers) for each segment line is also defined. Measurements of deviations of body segment lines from the designated reference axis in the compass rose, projected to the three orthogonal planes, permit the measurement and recording of body segment angles.

6. Support Surface Geometric Center and Reference Lines:
Determination of absolute and relative angles of support surfaces required an additional step in this process, because unlike body segments, support surfaces do not have a joint which helps define a natural center of rotation. Additionally, because support surfaces are not universal in their size, shape or configuration there is no way to define them based on an assumed size, shape, or configuration. For this reason, the concept of the support surface geometric center was necessary. This hypothetical point on any support surface has a consistent definition regardless of the size, shape, or configuration of the particular support surface involved. Unlike a body segment line, which has a natural point of rotation, the support surface geometric center is actually at the center of the support surface, so rotation occurs around it in any direction. This necessitates defining a support surface reference line which extends out of the support surface geometric center and which is then used in the determination of absolute and relative angular positions of that support surface. As with body segments, these reference lines are defined within each of the three planes. The SSGC is used not only as the standardized center of rotation for angular measures of support surfaces, it is also used as the standardized point to which linear location measures of support surfaces are taken.

CLINICAL APPLICATION OF THIS STANDARD – "WHY BOTHER?"
Currently, we have very few "scientific" ways of quantifying what we do and why it is important to those we serve, however we are being challenged more and more to demonstrate evidence-based need for both our services and for the specific devices we recommend. It is our belief that the application of this seating standard will elevate the level of clinical practice in our field and will assist in documenting positive seating outcomes, thereby helping to validate the need for our specialty services and the equipment we recommend. , this standard will become essential to both research and clinical practice.

Development and Use of a Standard Clinical Protocol for the Assessment of Wheelchair Propulsion Biomechanics

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I. Background

A. Secondary Injuries among Manual Wheelchair Users and Consequence

Repetitive strain injuries (RSI) of the wrist and shoulder are common among manual wheelchair users 1-3. This is not surprising as persons who use manual wheelchairs rely exclusively on their arms for mobility and other important weight-bearing activities of daily living (e.g., transfers and pressure relief). Carpal tunnel syndrome (CTS), or median nerve compression, is the most prevalent type of wrist-related RSIs reported by wheelchair users. Sie and colleagues studied 103 subjects with paraplegia and found historical or physical examination evidence of CTS in 66% 1. In comparison, about 5% of the general United States population has CTS. At the shoulder, Nichols et al. found over 50% of the survey respondents with SCI reported shoulder pain which was related to wheelchair use and transfers 3. Documented pathologies at the shoulder in manual wheelchair users include impingement syndrome, rotator cuff tears, capsulitis, osteoarthritis, and distal clavicle osteolysis 4. Dalyan et al. investigated the impact of upper limb pain on ten functional activities in persons with varying levels of SCI and found that pain was most closely associated with wheelchair mobility, transfers, pressure relief and upper body dressing5. The personal impact of upper limb (UL) pain and injury can range from curtailing essential activities to near total dependence on others. A manual wheelchair user who used to lead an active lifestyle at work, home, and in the community may need to succumb to a more sedentary lifestyle in the presence of UL pain and injury. Not only is independence reduced but there are financial impacts as well. In the early stages of arm pain, treatment may include medications (e.g., anti-inflammatories). If pain persists or injuries develop, surgery may be indicated further increasing costs. At some point a power wheelchair may be needed. Switching to a power wheelchair requires a substantial lifestyle adjustment and the need for greater home, worksite and vehicle modifications.

B. Development of the SMARTWheel to Examine the Relationship between Wheelchair Propulsion and the Development of Pain and Injury in Manual Wheelchair Users

Ergonomic studies have found a link between high force, highly repetitive tasks and risk of wrist and shoulder RSIs. 6; 7 In order to begin to understand how the task of wheelchair propulsion might be related to the development RSI in manual wheelchair users, instrumentation was developed that could analyze the forces and frequencies involved in pushing a wheelchair. Dr. Rory Cooper and scientists at the Human Engineering Research Laboratories in Pittsburgh, PA developed the SMARTWheel, a wheel capable of determining the forces and torques applied to the pushrim. The system consists of three beams, oriented 120 degrees apart, each containing two sets of strain gages wired in a Wheatstone bride configuration. The general output from the wheel includes time-varying forces and moments in all three planes as well as wheel orientation and velocity. The SMARTWheel has evolved over the years from the original mag-based, hard-wired, 8-bit resolution wheel to a spoked-based, 12-bit resolution wheel that transmits the data wirelessly through WiFi high-speed data transmission or saves the data using on-board memory. The SMARTWheel can be quickly mounted onto any wheelchair with quick-release hubs without changing the person's setup (e.g., camber). The SMARTWheel has been thoroughly tested and validated.8; 9

Research studies using the SMARTWheel have been in progress for more than ten years. With this device researchers have been able to, for the first time, determine the relationship between certain biomechanical aspects of propulsion and the development of shoulder and wrist injuries. 10; 11 For example, Boninger et al. performed a biomechanical analysis of wheelchair propulsion using the SMARTWheel with 34 wheelchair users and found that increased rate of force application and peak weight-normalized propulsion force was associated with wheelchair users having greater median nerve dysfunction (an indicator of CTS). In addition, stroke cadence, or the number of strokes used to go a certain speed, was also correlated with median nerve dysfunction. Another study found a relationship between pushrim forces and the progression of shoulder injuries overtime.11

The SMARTWheel has also been used to show that changes made to the wheelchair impacts propulsion biomechanics and offers the potential for intervention.12; 13 Most importantly this includes changing the set up of the wheelchair with respect to axle position. Individuals who sit low and behind the rear wheels have lower propulsive forces and stroke frequency, both of which have been previously associated with CTS.

In 2002, The SMARTWheel was successfully transferred from the research realm to an industry partner and has become a commercially available product (Three Rivers Holdings (TRH): http://www.3rivers.com/swhome.php). TRH has developed an efficient, user-friendly clinical interface to facilitate data collection, analysis and reporting.

II. Use of a Standard Clinical Protocol

The progression of the SMARTWheel, from a research tool to a fully functional clinical tool, loosely correlates with the progression of pressure mapping systems. The clinical community has begun to incorporate the clinical version of the SMARTWheel into their service delivery models. Consumers, rehabilitation professionals (physical therapists, occupational therapists, rehabilitation engineers), and researchers have begun collaborating in order to rapidly maximize the effectiveness of the clinical SMARTWheel. The purpose of this collaborative effort is to generate the standard protocol and normative data that is necessary to create a general acceptance of the clinical SMARTWheel by all stakeholders (consumers, rehabilitation professionals, researchers, manufacturers and funding sources) in the wheelchair selection process. This collaborative effort was the genesis for the SMARTWheel Users Group. The primary goals of the SMARTWheel Users Group are as follows: provide feedback (pro and con) as to the effectiveness of the SMARTWheel in the clinical setting (both center-based and community-based); develop a standardized protocol for the use of the SMARTWheel so all stakeholders will be comparing apples to apples; and begin to create a database of normative values, which could lead to the development of threshold values required to perform specific activities. This has been a daunting task as the stakeholders cross geographical and funding landscapes (Canada, UK and USA), clinical models (dedicated Assistive Technology programs vs. traditional rehabilitation hospitals) and clinical settings (center-based vs. mobile, community-based). However, the users group has succeeded in

creating a standard protocol that can be applied by all of the stakeholders. Furthermore, the users group has begun the process of creating a database, which will lead into the development of normative standards.
The SMARTWheel Clinical Protocol includes two key components: the tasks that will be performed, and the parameters that will be analyzed (a.k.a. nuggets of information). Unlike other protocols, which define an individual's ability to propel a wheelchair based on the success/failure of a variety of skills (usually subjectively evaluated), this protocol defines an individual's ability based on varying degrees of success, as measured by the clinical SMARTWheel (objective and quantitative evaluation). The goal was to select tasks that the majority of individuals would be able to complete. The four tasks are: 1) Figure 8 on tile, 2) straight line on tile, 3) straight line on carpet, and 4) straight line on an ADA compliant ramp (less than 8% slope).
The protocol is designed for use in clinical settings as opposed to research settings. Therefore, it is recognized that completing the entire protocol may not be feasible. Each task is designed as an individual evaluation, recognizing that all four tasks may not be available at every setting, and that each individual may not be able to complete all four tasks while using a given wheelchair. For example, an ADA compliant ramp may not be available when performing an evaluation at someone's home (i.e. they may use lift or have a zero grade entrance). Also, an individual may not be able to traverse carpeting when using a standard wheelchair, but is able to traverse carpeting when using an ultralight wheelchair.
The second key component is the variables that maximize the informational content and relevance of the clinical SMARTWheel. This includes both data generated by the SMARTWheel and survey data. As a starting point, the parameters which are used for comparative and normative purposes are those defined in the Clinical SMARTWheel reporting system. However, the Clinical SMARTWheel data collection software, not only calculates the relevant parameters, but also saves the raw data for future parameter development. These parameters are as follows: 1) elapsed time; 2) average speed; 3) maximum speed; 4) total distance traveled; 5) stroke frequency; 6) average stroke length; 7) average propulsion (tangential) force; 8) average peak propulsion (a.k.a. tangential) force; 9) stroke smoothness; 10) efficiency; 11) ease of propulsion
Currently, the survey includes the following parameters: age, gender, height, weight, wheelchair manufacturer and model, overall satisfaction with wheelchair, years of wheelchair use, primary diagnosis, secondary diagnoses (if applicable), date of injury/primary diagnoses and number of hours of wheelchair use per day.

III. Examples for Using the SMARTWheel as a Clinical Tool

A. Wheelchair Selection

The three primary categories of wheelchairs are standard wheelchairs (a.k.a. depot), lightweight wheelchairs and ultralight wheelchairs. One specific area that the SMARTWheel has been beneficial is in comparing various styles of manual wheelchairs. For example, an individual with paraplegia may be able to propel a standard wheelchair, a lightweight wheelchair and an ultralight wheelchair. Furthermore, this individual may be able to perform a significant number of activities of daily living using all three wheelchairs. The most appropriate wheelchair may be obvious to the consumer and the rehabilitation professional based on experience and observations. However, biomechanical documentation did not exist prior to the development of the clinical SMARTWheel. The biomechanical documentation provides the quantitative justification for selecting one wheelchair over another. This quantitative justification is currently missing when justifying a selection based on perceived effort and observations.
The weight of the wheelchair will have a significant effect on the efficiency of the wheelchair, but the inclusion/exclusion of an adjustable axle will also have a significant effect. As was discussed previously, the position of the axle will affect the propulsion style. Shifting the axle position forward will increase the efficiency of the wheelchair, as a larger percentage of the individual's weight will reside on the rear wheels (assuming a rear wheel drive manual wheelchair). Of course, shifting the wheel forward may compromise the rearward stability of the wheelchair.
Another area which the Clinical SMARTWheel will have a significant effect is in determining if an individual requires a power wheelchair, or pushrim activated, power-assist wheelchair instead of a manual wheelchair. The SMARTWheel will document the ability (or lack of ability) to propel a manual wheelchair in various situations and environments. These situations and environments may be related to performing activities of daily living in the home environment, performing job related tasks in a vocational setting, performing educational tasks in an academic environment or performing household tasks in a community setting.

B. Funding Justification

The Clinical SMARTWheel can also be used to provide the quantitative information that funding sources prefer. These funding sources range from medical insurance (e.g. Medicare, Medicaid) to vocational (e.g. workers compensation), educational and personal sources. The clinical SMARTWheel allows consumers and rehabilitation professionals to "paint a picture" as to the effect of different wheelchair styles and configurations on individuals' mobility. Rather than relying on published research studies to defend the selection of one type of wheelchair over another, consumers and rehabilitation professionals will be able to substantiate the fact that for this specific individual, an ultralight wheelchair performs better than a lightweight wheelchair, and here is the biomechanical data to prove it.

C. Propulsion Training

The feedback that the Clinical SMARTWheel provides may also assist with propulsion training (e.g., using longer, smoother strokes). Groot and her colleagues assert that if propulsion techniques can be learned that improve the mechanical efficiency of wheelchair propulsion, then it provides an avenue for novice wheelchair users to "optimize wheelchair performance much more effectively from the start of the rehabilitation process onward."14 Research suggests that propulsion skills can be learned relatively quickly. For example, two studies provided evidence that a 3-week wheelchair propulsion training program (3 sessions per week) influenced various aspects of propulsion including stroke frequency, length, and effective force production.15-16 Early learning of wheelchair skills is likely to contribute to more positive rehabilitation outcomes.

D. Database Creation and the Ability to Track Changes over Time

A key component of the Clinical SMARTWheel is the creation of a complementary software package that simplifies the task of collecting data, and displaying relevant parameters in an easy to interpret format. This includes the automatic generation of a MS Word document that can be easily imported into a letter of necessity, and an MS Excel document that allows for comparisons of the key parameters over time. One potential application is for a clinic to implement a program for training individuals how to propel with optimal biomechanics. Documenting the before/after effects of the training program is important for justifying and evaluating the effectiveness of the program. Another application includes documenting the effectiveness of the services provided by a seating and mobility clinic. The progression of an individual as they migrate from an old wheelchair to a new wheelchair can be easily verified.

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Clinical Protocol for the Administration and Interpretation of Interface Pressure Mapping for Sitting

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Abstract
Interface pressure mapping (IPM) is used as a clinical assessment and educational tool for clients who are at high risk for developing sitting acquired pressure ulcers (SAPUs). Despite this technology being used internationally for seating assessments, there has been little published on a standardized administration and interpretation of interface pressure mapping technology. The goals of this instructional course are to present an evidenced based clinical protocol that was developed and piloted by a group of occupational and physical therapists, and b) have participants gain adequate proficiency in applying and interpreting interface pressure mapping so as to be able to teach their colleagues ("train the trainer" emphasis). The protocol is based upon a combination of the available literature and expert opinion. It has been piloted in the community and the acute care hospital settings in Calgary with occupational and physical therapists.

Background
The goal of the presentation is to provide a consistent method of administering and interpreting interface pressure mapping for sitting. Therapists from an acute care and rehabilitation unit were taught the protocols in a four hour training session. Pre and post tests were given to the therapists to assess their level of competency and sense of control for pressure mapping. The Psychosocial Impact of Assistive Devices Scale was an outcome measure.

The therapists were able to practice the administration using actual pressure mapping technology.

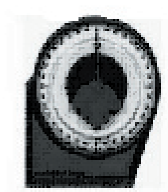
Interpretation of the IPMs was taught in a computer lab environment where the pressure mapping software was loaded onto computers with IPMs from actual clients to interpret (i.e. case studies).

IPM Protocol for Administration.

IPM Protocol [i]

1. The client is pressure mapped on their existing support surface (e.g. wheelchair cushion) while measuring and documenting their present posture.

   Measurement tools such as the Seating and Postural Control Measure[ii] and a standard angle finder for measuring seat to back angle and seat angle are useful. Angle finders are available at local hardware stores in the roofing section.

   IPM 1. Standard roofing angle finder.

2. The client is pressure mapped on a variety of new support surfaces (e.g. cushions).

IPM Protocol in Detail

1. Wash hands and wear disposable gloves for infection control.

2. Encase the IPM pad in a thin plastic bag to ensure that infection control standards are maintained. This also protects the IPM from contamination by urine or feces. Wide rolls of very thin plastic are available from paint supply stores. There are no exceptions to this rule.

3. Place the IPM pad on top of the firm, flat surface. Different orientations of IPM pad placement are recommended each time to decrease the wear and tear on one area of the map by bony prominences.

4. The clinician sits briefly on the firm surface to complete a “clinical” check of the IPM’s calibration and to check the buttocks’ orientation on the computer screen. The clinician determines if the map is working properly. If it is working properly, the assessment proceeds. If it is not working properly, the assessment does not proceed and technical support at the manufacturer is contacted.

5. Place the IPM pad on the client’s existing cushion. This is most safely done by transferring the client off their cushion. Transfer client onto the IPM pad. Ensure that their entire buttocksare on the pressure IPM pad.

6. It is encouraged to have the client participate in the IPM session. Therefore, check with client if the sensor IPM pad’s orientation on the computer screen makes sense to them since the client participates in the interpretation of their IPMs. Orient the client on how to interpret their own IPMs.

   There are situations when viewing the IPM is not conducive to a meeting the seating goal. In these situations, explain why and either turn the computer off or have the computer monitor turned away from the client.

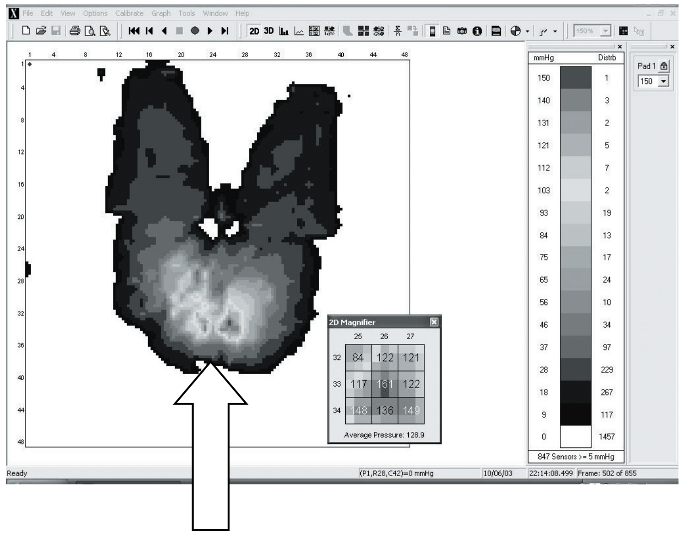
7. Ensure that the client sits on the IPM pad for 15 minutes.

8. At the end of the 15 minutes, record 100 frames while the client is sitting still/quiet with their hands on their lap and looking straight ahead. This is done with the computer screen turned off so the feedback from the screen does not interfere with the client’s posture during this mapping. This ensures that the 100 frames are “clean” with the least amount of movement and no artefacts.

9. Palpate bony prominences to correlate with peak pressures seen on IPM (e.g. ischial tuberosities, greater trochanter). Do not assume that the high pressure observed on the computer screen matches a typical bony prominence, especially if the client has had surgery on their buttocks (e.g. muscle flap with shaving of the ischial tuberosity). In addition, if the client is in an extreme posterior pelvic tilt, they may be weight bearing on their coccyx/sacrum. Below is an example of an IPM where the client is actually weight bearing on their sacrum.

10. It is highly recommended to do a skin assessment of the buttocks, hips and low back for any evidence of pressure ulcers. This needs to be done in a private area with as few professionals as possible. Use a standardized pressure ulcer staging protocol. Use a standardized pressure ulcer assessment and measuring tool to document the wound.

Alternatively, refer the client to a wound care nurse or physician for an assessment.



IPM 1 .The client weight bearing on their sacrum in a severe posterior pelvic tilt.

11. Make notes in the IPM software: clinician name, date, client name, client ID#, age, weight, height, diagnosis, presenting problem, wheelchair model and size, angle of inclination of the seat, cushion, backrest, backrest angle, goals and action plan, etc.

12. Take a digital photographof clients and their posture (front, side, and top views, if applicable). Insert the photos into the IPM frame that corresponds to their posture. These photographs matched with the IPMs are valuable references for later use and future comparisons.

13. Completely offload the client from the cushion and the IPM pad between each cushion assessment. Compare the IPM results for each cushion using the standardized interpretation discussed below.

14. Remove and discard the plastic covering on the IPM pad. Remove gloves and wash hands.

15. If calibration is required by the manufacturer, it is recommended to be done every 3 months regardless of manufacturers' recommendation.

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Power Wheelchair Access: Assessment and Alternative Access Methods

Michelle Lange, OTR, ABDA, ATP

This course will present assessment strategies for determining the optimal access method for independent and functional control of a power wheelchair, including programming to optimize the use of the access method. This paper discusses a variety of access methods and some clinical indications.

Proportional Control

When you think of a power wheelchair, chances are you are also thinking of a joystick. Joysticks are by far the most common means of accessing and controlling a power wheelchair, however, many of our clients are unable to use this effectively. While many other access methods exist, there is a lot you can do with a joystick to make it work for many of your clients. Altering placement of the entire unit, modifying the height of the stem, modifying or changing the terminal end or "handle", or changing electronic parameters can allow success for many clients who otherwise would struggle with joystick access.

Joysticks generally provide 360 degree, proportional control. That means you can move the chair in any direction and that the farther you move the joystick, the faster you move the wheelchair. All other access methods are digital (one speed at a time) and are more limited in directional control. Joysticks require less electronics on the wheelchair, and so are usually less expensive. For these reasons, joysticks are the access method of choice if the client is able to control one. Non-proportional joysticks are also available with switches inside. These are generally sold as "heavy-duty" joysticks for clients who exert a lot of force while driving. This excessive force can actually break a proportional joystick.

The typical joystick has a ball for a handle. This places the forearm in pronation and requires a grasp. Various alternative handles can be used. For example, if a client's forearm is generally in neutral, a vertical post may be easier to control. If a client has little grasp, a goal post shaped handle can be used. This allows the client to simply rest their hand or wrist in the crotch of the U shape and use the shoulder movement to move the joystick. This usually works well with clients with SCI below C6. A custom forearm support is available that has a linkage which attaches to a joystick. The wheelchair user rests their forearm in the cradle and operates the joystick by displacing the trough utilizing shoulder movements. Operation is very smooth and requires little force.

Joysticks can be placed in many locations. The joystick box can be tilted horizontally to accommodate forearm limitations. Mounting the box at an angle across the body, rather than perpendicular to it, can be helpful for clients who internally rotate and/or adduct their shoulder. Joysticks can also be mounted at midline on a swing-away mount. The joystick can be mounted at the chin with a cup shaped handle, though this has been linked with TMJ (temporal-mandibular-joint disorder) and can be difficult to control over rougher terrain. A joystick attached to a foot plate is also available. The Proportional Head Control and the older RIM Controls both utilize a joystick behind the head. However, sustaining pressure against the head pad on a proportional head control can increase overall extensor tone and makes stopping (moving the head forward) difficult.

Various parameters can be changed electronically to aid joystick use. If your client wants to pull back on the joystick to go forward, the joystick can be reversed. If your client has limited range and/or strength, the sensitivity can be changed and/or short throw activated. Short throw reduces the joystick movement required to attain full speed. Changing the parameters varies with the power wheelchair electronics.

Non-Proportional Control

Driving a power wheelchair with non proportional controls can be more difficult than driving with a joystick. The biggest problem is in course correction. Imagine that you are driving long a straight hallway with a joystick controller. Without even noticing it the driver's hand naturally readjusts the joystick to reorient the chair if it begins drifting out of the straight line. With switch operated power chairs the driver must remove his/her hand/head/leg from the "forward" switch and put it on the right or left switch to stop the chair from veering and return it to the straight forward course. As the motors activate to reorient the chair the casters must be moved to change direction. By the time this translates into a movement of the chair a second or more may have elapsed and the driver may not have released the switch resulting in an overcorrection of the chair's position. The driver than must release the turn switch and activate the switch for the opposite turn direction. This can be very frustrating for drivers, and impossible for others. Several manufacturers have introduced technology which helps the chair maintain "straight" forward driving, minimizing the need for course correction movements. This type of technology should be considered for all drivers using switch access to drive a power chair.

Mechanical switches require the client to make a switch depression or displace all or part of the switch to activate the switch. Depending on how the system is set up, deactivation requires releasing the switch or maybe hitting it again. Mechanical switches are cheaper than electronic switches. The most common breakage is the cord, so these should be well secured. Mechanical switches can be placed anywhere on the body where the client demonstrates isolated, reliable control. Various switch types and sizes are available from many manufacturers. They require different amounts of force and are more or less durable depending on style and materials.

At least three switch sites are generally required for forward, left and right. Many clients cannot see what is behind them and can not use reverse safely, so they do fine with only three switches and simply turn around using right or left commands, and then move forward instead of in reverse. Still other clients with only three switch sites may need their chair to have a RIM setting, which allows them to toggle the "forward" switch by hitting it again to make it become a "reverse" switch. The most common switch placements are by the hands (vertical or horizontal), then the head (generally at the side), the feet (dorsiflexion or plantar flexion) and the legs (medial or lateral knee). The client must be able to both activate and deactivate the switch safely. For example, if a client adducts the legs when excited, they may not be able to quickly release a switch placed at the medial knee.

Sip 'n puff is pneumatic switch control. A plastic straw is placed in the client's mouth and a variety of mouthpieces may be used. Four switch commands are used: hard puff for forward, hard sip for reverse, soft puff for right and soft sip for left. Forward is "latched" so that the chair continues forward after a single hard puff until a reverse command is given to stop the wheelchair. Speed can be increased by giving additional hard puff commands. The electronics on the wheelchair allow some adjustment in the sip and puff force required. The client can be on a ventilator, as the commands are performed with intra oral air pressure rather than actual respiration. Good oral motor control is required. This access method is most often used with clients who have high level spinal cord injuries.

A fiberoptic stop switch with sip n' puff control is available . This small switch attaches to the end of the straw and detects the presence of the client's chin. If the straw falls out of the client's mouth, the switch no longer detects the chin and stops the wheelchair.

What if your client simply does not have three switch sites? Scanning, although a tedious way to drive, can allow independent mobility for a client with only one switch site. The first switch activation begins the scan. Lights are displayed by arrows indicating forward, left, right and reverse. If the switch is activated with the forward arrow lit, the wheelchair moves forward. To change direction, the client must release the switch, wait for the desired arrow to be lit and then activate the switch again for the amount of time needed to execute the turn. The client must be able to visually monitor the display accurately. This access method is rarely used and then most commonly for persons with significant muscle tone.

Electronic Switches eliminate force and often reduce travel. ASL (Adaptive Switch Laboratories) and Switch –It! make some of the most sophisticated access methods on the market and their products work with all the major power wheelchair electronics. Most of their switches are electronic (proximity, fiberoptic and infrared) and so require a power source.

The head array uses proximity switches that do not require an actual switch depression, but rather require movement within a set proximity to the switch for activation. In this case, three proximity switches are embedded into a 3-piece headrest. If the client moves their head back, the chair moves forward. Turning the head to the side turns the wheelchair in that direction. If only a side switch is activated, the chair turns tighter, useful for turning a corner. If the side switch is activated while the head is back (activating forward, as well), the chair moves forward and to the side gradually, useful for course corrections. The client stops the wheelchair by moving the head forward. This may not be a safe access method for clients who demonstrate total extensor patterns, as they would have difficulty bringing the head forward in flexion.

This access method requires fair to good head control. Head movements are often less likely to elicit increases in muscle tone and abnormal reflexes than use of the extremities.

Proximity switches can be mounted in other locations, as well. I often mount them under a tray so the client merely has to slide a hand over the area, rather than lift and remove the hand from a mechanical switch. Fiberoptic switches emit an invisible beam. The switch can be activated by breaking this beam (with a finger, for example) or by removing a block from the beam (as in the stop switch for sip 'n puff). The Fiberoptic Array consists of 2 - 4 fiberoptic switches, one for each direction on a power wheelchair. These can be placed anywhere, but are often mounted in a tray, leaving 4 small 1/8" holes. The client's arm rests on the tray and a single finger, using very small movements, can move between the holes to control the chair. If the forward switch hole is covered, the beam is broken and the chair moves forward. This can be a great access method for advanced muscular and neuromuscular diseases, such as Duchenne's Muscular Dystrophy, ALS and MS.

I love that moment when a client moves themselves for the very first time! Many of these newer access methods are providing just that opportunity to clients who were unable to drive before.

(This paper was adapted from a series of articles written by Michelle Lange and edited by Adrienne Bergen for RehabCentral.com, now found at MedGroup.com)

Making it my Choice

Beyond the Theory of Seating and Mobility

A Review of Equipment Prescriptions Based on Client Needs for Function

Sheila Buck, B.Sc.(OT),Reg. (Ont), ATP

Recently I have had two occasions of having the pleasure of dealing with clients who have been in wheelchairs for a number of years. These clients are fully aware of their needs for function and what they must do on a daily basis to work, play and take care of themselves. On being called to complete their assessments, they both initiated the client interview with the comment "please don't tell me what I need, listen to what I want". Both clients provided me with stories of past dealings with therapists and dealers who felt they knew best about what was needed, and did not listen to the client when providing equipment that would reflect on their lives and function for the next 5 years. Both have stories of pain, dysfunction, and "that wheelchair /seating that sits in the closet" after they reverted back to using their old chairs.

Dealing with both of these individuals provided me with an opportunity to question where do I go when I am working my way down the assessment path. It is so easy to utilize funding guidelines or "the best posture" theory to base the prescription on, but in the end the client may not receive what is necessary to function. In one instance the seating that was prescribed was so restrictive and heavy to maintain spinal alignment, that the client was no longer able to move with in her chair to access her work or home activity areas.

With these clients in mind it is important to follow the principles of completing a thorough mat assessment, but then the needs of the client must also be addressed. Although both of the above clients thought they had a good idea of what was available on the market, the market is continually changing. As a result it is imperative that all options be discussed and considered with the client. In order to do this, dealers and therapists must be fully aware of new ideas, products, hardware, and the multitude of combinations of assistive technology that are available that may make a difference to the client's life. Although all product may not have funding approval, the client may wish to explore these options to maximize independence. It is important however, that you do not present such product as "one more thing to sell", but as options to enhance function at the client's discretion.

A good seating evaluation involves assessment and consideration of many client factors including physical, functional and lifestyle. These and many other factors play a role in the design and manufacturing of seating products. Who then sets the priorities when determining the prescription of seating components? How do product design features meet specific client needs? How do you balance the client's needs and wants for function with theoretical concerns for pressure management and postural support? Establishing a list of priorities and goals is essential in developing a seating system that will not only meet the client's physical needs, but also address functional and lifestyle concerns.

Common Physical Concerns:

- Pressure management – tissue integrity
- Moisture/temperature management
- Balance through an upright posture – postural support and stability
- Orthopedic issues
- Physiological function

Common Functional Concerns:

- Upper/lower extremity function
- Sitting endurance / tolerance
- self care / ADL skills required
- comfort
- transfers
- propulsion

Lifestyle concerns:

Current

- transportability – weights, ease of assembly
- maintenance/cleaning
- cost effectiveness
- accessory accommodation
- aesthetics
-

Future

- prevent postural deformity/ pressure sores/shearing
- growth adjustability
- durability

AREAS OF ASSESSMENT

Medical/Physical

• Prognosis	• Bony protrusions
• Potential for change	• Weight changes
• Surgeries previous or planned	• Incontinence
• Medications	• Allergies
• Ability to sit unsupported	
• Skin condition - At risk skin areas – sensory changes	
• Tonal changes/contractures	
• Reflexes – normal/abnormal – use of reflexes in postural support	
• ability to reposition self	
• orthopedic – ROM, Contractures	

Lifestyle/environment
- Home /Other locales
- Transport methods
- Climate/environment
- Independent/caregivers
- Leisure activities
- Past, present, future

Cognitive Status /Ability to identify and communicate pain

Equipment Needs
- Current equipment or abandonment - what has and has not worked
- Equipment needs/ wants for function- height, weight, degree of support
- Method of propulsion
- Posture and function in equipment already owned

Postural Control vs. Pressure Distribution

Design Criteria: Product Considerations

Seating Components:
1. angles - or angular relationship of supports with respect to anatomic angles.
2. materials – internal and external requirements for support, comfort, and care of skin integrity.
3. orientation – of the support surfaces with respect to gravity, method of mobility, function and environment.
4. shape – shape of supports with respect to shape of the sitter in corrected/desired posture.

Cushion

1. Support Medium – ability to maximize surface contact area
2. Shape – pressure re-distribution, positioning features (pre ischial shelf, trochanteric shelf, anterior medial/lateral contour, sacral support)
3. Comfort
4. Stability
5. Maintenance
6. Cover – moisture protection, surface texture
7. Weight
8. Durability
9. Cost

Back

1. height
2. angles
3. accessories
4. support medium
5. shape
6. weight
7. adjustments/hardware

Prescription Justification

It is also important to explain your concepts and ideas to the client instead of just saying ”you need it!” All the benefits must be reviewed, but also the negative components which may affect function. It is imperative also from the therapist side that we do not lose sight of what our “needs” are for “maximal postural support” versus “compromise to maintain function” while adding support as able. Often the client may require the opportunity to trial product to ensure their ability to function with the change in postural support. This trial period will allow them to explore new product ideas without the fear of purchasing product which will not work after the fact. Being truthful up front about limitations in the product/device will allow the client to weigh the pros and cons and in the end make a decision based on all information provided as well as their insight into their own functional capacity. The following identifies the steps in functional equipment prescription:

- Identify problems and potential for function
- Develop goals
- State objectives
- Identify product properties
- Identify equipment parameters
- Translate parameters into product
- Verify product fit and use

With the above in mind it is imperative that we keep our focus on function with the following thoughts during the assessment phase:

- Our clients have lives beyond the time we see them sitting in their wheelchair in clinic or in their stationary home environment
- Purchasing a wheelchair is more personal than buying a car … It is buying a car, an office chair, a daily wardrobe and an orthopedic support all at the same time.
- We make decisions daily as to how we sit in our car, at the office, at home and at the cottage … our clients also have a say in how they wish to sit…. even if it is not perfect! (as long as they were fully aware in making that choice, how it will affect their long term function and posture …. How often did you listen to your mother when she said sit up straight!?)

In following these guidelines, along with the more objective mat assessment data, you can know that you have done your job to the best of your ability. You have provided ALL options available along with the features, benefits and limitations to those options, and have then allowed the client to make an educated choice in purchasing their assistive technology.

Positioning 24/7 – using seating and alternative positioning for all populations

Ann Eubank, OTR/L, ATP
Debbie Poirier, COTA/L, ATP
Bryan Malone, PT, MS

This course challenges the audience to think outside the constrictive US coding system. In today's rehab environment the entire service delivery process is driven by the payer source. Practitioners and suppliers, even before assessing the consumer, must first understand the limitations in equipment choice driven by the particular payer source. We must work within the funding source's guidelines and restrictions.

What if you had enough time to complete a very thorough assessment? What if you had the time and equipment to perform a simulation or more than one simulation? What if you had the resources and skilled personnel to fabricate any custom modifications you could dream up? What if the payer source trusted your clinical judgement to order, fabricate, and customize, as necessary, to meet the seating and positioning needs of your clients?

Given an environment as just described, the following results may occur, the consumer would more often meet his/her seating, positioning and mobility goals, the consumer's overall health would improve, driving healthcare costs down, and practitioner skill level in assessment, simulation and customization would increase. This course will present advanced skills developed as a result of practicing in this environment. The following subjects will be presented: assessment, simulation, design technique and fabrication of seating and alternative positioning.

The simulation process will be discussed in depth. A molded simulator and a planar simulator will be used to discuss the limitations of each and how using them in combination provides a more complete picture of the individual's shape. We will analyze specific details of the simulation process and how they effect the success or failure of the system. Some of the topics to be presented are, tonal patterns, depth of the system to support and elongate the trunk, relationship between the pelvis and spine, judging how much to correct a deformity, matching the mat evaluation to the simulator, what type of lower extremity support to use, how much, if any tilt to use and why, and assessing for head support.

Once the simulation is completed, the next step in the process is the fitting. We will be using a molded back that has been poured, but not covered, to demonstrate foam-sculpting techniques. We will use a variety of tools, to carve and grind the foam, creating a precise fit to the individual's shape. During the grinding process we will analyze the individual's response to the evolving shape and how to provide the most support for function. The grinding step is not usually, if ever, completed by practitioners or suppliers as most molds are sent off to the manufacturer. The audience member will have the rare opportunity to manipulate the foam and analyze the effects on posture, tone, function and comfort. Along with hands-on, case studies and video will be used to illustrate these skills. The entire process of mounting the system to a frame, the problem solving involved in choosing a frame, and customization will be included in the presentation. Although most clinicians and suppliers do not have the fabrication options shown, they will be able to use the ideas and concepts to better serve their customers. There are many custom modifications possible for little money using a few simple tools and materials.

We will take the next step into design and fabrication by introducing alternative positioning. The individual who uses a wheelchair usually has only one other position other than sitting, lying in bed. "Positioning 24/7" means the individual has a variety of supportive positions available which positively effect many systems in the body. People with spinal deformities may have a supportive back and seat in the wheelchair, but what happens at night? Progressive positioning is possible when the positioning is carried over into the night and other positions available during the day. We are just starting to learn what effects long term sitting and gravity have on the body. Some of the issues include, respiration, abnormal tone, pain, elimination, pressure, and weight bearing through the upper and lower extremities. These issues effect most, if not all people who use a wheelchair as their main form of mobility. The Assistive Technology Department at Clover Bottom Developmental Center has been fabricating and providing alternative positioning to people since 1996. The progress of these individuals has been documented. Some of the factors tracked are, increase in range of motion, decrease in hospitalizations due to pneumonia, decrease in elimination problems, increase in comfort, decrease in incidents of behavior problems, decrease in pressure sores, and increase in function within the home and at work.

It is important to understand who is appropriate for alternative positioning. It has become obvious in situations where alternative positioning is available, overall health costs decrease, yet this equipment, unfortunately, is rarely attainable. Because of the many health benefits of this equipment, we hypothesize that anyone who is unable to reposition throughout the day and night would greatly benefit from alternative positioning equipment. This course will illustrate the entire process of assessment, simulation, design and fabrication of alternative positioning. We will discuss how the average clinician, can perform these steps with commercially available equipment and materials.

The positions to be presented are custom incline supine (bed positioner), quadruped on forearms, prone on forearms, sidelying, and tall kneeler. The audience member will be given a comprehensive handout with illustrations. This course provides the opportunity, through case studies, video, demonstration and hands-on experience to assess, think, modify and build beyond the ordinary. Because the seating and positioning solutions presented were developed within a research and development environment, this course is advanced.

Special Session: Medicare Policy:
How it affects us and how we can affect it.

Laura Cohen, PT, PhD, ATP
Barbara Crane, PhD, PT, ATP

The Process – What is involved in wheelchair coverage for Medicare clients?

Coverage of wheeled mobility devices (manual wheelchairs, powered wheelchairs and power operated vehicles, or scooters) is provided to Medicare beneficiaries under the voluntary, outpatient based Part B of the Medicare benefit and falls under the category of DMEPOS (Durable Medical Equipment, Prosthetics, Orthotics and Supplies). The three most important determinations that will impact access to any item of DMEPOS are coding, coverage and payment.

While the Centers for Medicare and Medicaid Services (CMS), and more specifically the Centers for Medicare Management, has ultimate authority for each of these determinations, its contractors, the four regional Durable Medical Equipment Carriers (DMERCs) and the Statistical Analysis Durable Medical Equipment Regional Carrier (SADMERC) are responsible for specific policy development. Within the area of coverage for wheeled mobility, there is the National Coverage Decision (this currently contains the "bed or chair confined" language) and the Local Medical Review Policy, which contains detailed rules outlining coverage for the individual codes and other coverage restrictions.

The remaining key influences are coding of wheelchairs and their accessories (HCPCS), and payment policies, which assign payment category (e.g. purchase or rental) and of course the payment amount for specific HCPCS codes. Other items that can influence access to technology are coverage policies and payment levels for services, which are provided by medical professionals, and billed using Common Procedural Terminology (CPT) codes.

The Problem – How did we get here?

The National Coverage Decision for wheelchairs was originally drafted and interpreted in 1965. This coverage policy reflects both the wheelchair technology and level of clinical practice in existence at the time. However both clinical practices and wheelchair technologies have progressed dramatically over the past 4 decades. Clinicians specializing in recommendation of wheelchairs for individuals with ambulation disabilities have struggled for many years with the "bed or chair confined" standard that is currently the basis for coverage of wheelchairs. Additionally, current wheelchair technology, particularly powered mobility technology, is no longer adequately described by this antiquated coverage policy and the Certificate of Medical Necessity (CMN) does not collect adequate information to make clinical determinations of medical necessity or appropriateness for the wider range of equipment available to individuals who use wheelchairs.

How can clinicians affect this process?

Clinicians need to get involved!
There are many ways to do this, here are just a few:
1. Get informed and educated.
2. Get involved through professional organizations: Working with a group such as the Clinician Task Force is simply one of these. Clinicians also need to monitor the activities of their respective professional organization
3. Follow new coverage proposal and work through professional organizations to submit written comments. Additionally, if time allows there are often public meetings where individuals are allowed to provide comment.
4. Sign up for key list serves through the CMS website that will provide you with contemporary information in your areas of interest.
5. Organizations such as RESNA, APTA, AOTA, ASHE and NRRTS all have specific activities related to governmental affairs. These activities monitor and try to impact on both federal (CMS) and local activities that occur at the state level (typically related to Medicaid policies). Professional organizations have a responsibility to respond to their membership, so if you are a member of a professional organization get involved and contact the organization to make sure they know you have a vested interest in CMS policies related to wheelchairs and that the changes in coverage policy have a direct affect on you as a clinician.
6. Get involved through the political process: Contacting key congressional members who represent you and making sure they hear your view point and understand the importance of these issues for their constituents.
7. Spread the word; inform consumers and other stakeholders about the issues and actions they may take to get involved. Introduce them to advocacy groups such as the ITEM coalition (www.itemcoalition.org) and United Spinal Association (www.unitedspinal.org) involved in grass roots efforts to effect change on these important issues

The CMMCMP Clinician Task Force:

The CMMCMP Clinician Task Force was formed in May 2004 to draft a formal request to CMS for reconsideration of the current Wheeled Mobility Device Coverage Policy. Subsequently, CMS held an open door forum on June 14 and organized an Interagency Wheelchair Work Group (IWWG) tasked with revising the wheelchair coverage policy.
At that time the IWWG requested specific clinical guidance. The CMMCMP Clinician Task Force submitted a proposal to CMS and the IWWG outlining an objective and consistent process by which medical necessity may be determined and documented. The ultimate goal of the Clinician Task Force is to influence policy change to allow appropriate access to wheelchair technologies for those who have legitimate medical and functional needs.

The Medicare Program

Medicare, the nation's largest health insurance program, covers nearly 40 million Americans. Enacted in 1965, the program provides health insurance to people age 65 and over, those who have permanent kidney failure, and certain individuals under 65 with disabilities.

About CMS

"The Centers for Medicare & Medicaid Services (CMS) administers the Medicare program, and works in partnership with the States to administer Medicaid, the State Children's Health Insurance Program (SCHIP), and health insurance portability standards. CMS is responsible for the administrative simplification standards from the Health Insurance Portability and Accountability Act of 1996 (HIPAA) and quality standards in health care facilities through its survey and certification activity. Through Medicare, Medicaid and SCHIP, about one in four Americans receive health care coverage. Nearly 40 million people are covered by Medicare, about 33 million are eligible for Medicaid, and SCHIP helps States expand health coverage to as many as 5 million uninsured children. These programs spend about one in three of the Nation's health care dollars, about $429 billion in 2000 (of which the Federal share was $344 billion). CMS spends nearly one in five of the Federal Government's dollars."

"CMS's national headquarters is located in Baltimore, Maryland. The 10 regional offices work with the contractors who administer the Medicare program and work with the States who administer the Medicaid, SCHIP, HIPAA, and survey and certification of health care providers. We work closely with the Social Security Administration (SSA) to provide information about Medicare to beneficiaries applying for, or currently receiving, retirement or disability benefits at local SSA district offices."
http://www.cms.hhs.gov/researchers/projects/APR/2003/facts.pdf

About DMERCs

In 1965, Medicare was enacted as Title XVIII of the Social Security Act. Both Medicare programs, Medicare Part A, which covers hospital services, and Medicare Part B, which covers physician services and certain home health services, became operational in 1966.

In 1993, the Centers for Medicare & Medicaid Services (CMS) and the Department of Health and Human Services (DHHS), entered into contracts with four carriers to perform all of the duties associated with processing claims for durable medical equipment, prosthetics, orthotics, and supplies (DMEPOS) under Part B of the Medicare program. These four carriers were designated as DMERCs - Durable Medical Equipment Regional Carriers.

About SADMERC

The Statistical Analysis Durable Medical Equipment Regional Carrier (SADMERC) is a national entity that provides services under contract to the Centers for Medicare & Medicaid services (CMS). The SADMERC Reports and Analysis Unit provides data analysis support to the four DMERCs. The SADMERC HCPCS Unit offers guidance to manufacturers and suppliers on the proper use of the Healthcare Common Procedure Coding System (HCPCS), the means by which durable medical equipment, prosthetics, orthotics, and supplies (DMEPOS) services are identified for Medicare billing. Additionally, the SADMERC performs a variety of national pricing functions for DMEPOS services, assists CMS with the DMEPOS Fee Schedules, and analyzes DMEPOS fees to identify unreasonable or excessive reimbursement amounts.

Manufacturers and suppliers are instructed by CMS and through the DMERC supplier manual and advisories to contact the SADMERC HCPCS Unit to obtain proper billing codes for DMEPOS items. In addition to coding assistance, manufacturers and suppliers may also obtain Fee Schedule prices.

Helpful Resources:

CMS:
http://www.cms.hhs.gov
http://www.cms.hhs.gov/researchers/projects/APR/2003/facts.pdf

DMERC Sites:
http://www.umd.nycpic.com/dmerc.html (region A)
http://www.adminastar.com/Providers/DMERC/DMERC.html (region B)
http://www.palmettogba.com/index.html (region C)
http://www.cignamedicare.com/dmerc/ (region D)

SADMERC:
http://www.palmettogba.com/palmetto/other.nsf/Home/Other+Medicare+Partners+SADMERC+Home?OpenDocument

Professional Organizations:
RESNA:
http://www.resna.org/
APTA:
http://www.apta.org/
AOTA:
http://www.aota.org/
ASHA:
http://www.asha.org/default.htm
NRRTS:
http://www.nrrts.org/
NCART:
http://www.ncartcoalition.org/NCARTMission/ncartmission.html

The ITEM Coalition:
http://www.itemcoalition.org/

The Clinician Task Force:
http://www.cliniciantaskforce.org/ClinicianTaskforce/ClinicianTF.nsf/Home

United Spinal Association
http://www.unitedspinal.org

Wheelchair Sports/Recreation at the Rehabilitations Zentrum

Herfried Eisler, KT

Material not available at time of printing.

Thinking Beyond the Wheelchair

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The generally accepted wheelchair and seating evaluation looks at recommending equipment to assist the person who has an ambulation impairment regain their mobility with the addition of some sort of device which will allow them to ambulate in some sense similar to the ability of a person without an impairment. This interpretation of mobility, however, falls far short of the mobility we take for granted as able-bodied ambulators, and of the definition of mobility generally accepted by most of the 6 billion people in the world: namely, the ability to move freely. True mobility is the ability for an individual to go where they want to go, and when they want to go there. Mobility, in this fuller sense of the word, is simply not attainable in a wheelchair by itself. Just as most of us require the use of transportation of some kind (e.g., car, bus, etc.) to get to the activities we enjoy, the wheelchair user also must be able to access personal transportation in their mobility device in order to be truly mobile.

This workshop covers three crucial aspects of the mobility evaluation that must be considered in order to arrive at a successful outcome that results in independent community mobility: 1) Clinical considerations for seating and equipment to address physical needs in all environments, particularly while using personal transportation, both for passengers and drivers. 2) Person/Wheelchair/Vehicle Fit issues that contribute, (or detract) from optimal use of the transportation system, and 3) Optimal w/c and vehicle configurations for successful integration.

When seating a client in a wheelchair, we look for a stable base of support to maximize the user's function. Stable seating positions for independent mobility and function may not provide adequate stability in the dynamic environment of a vehicle. The wheelchair user who rides as a passenger is unable to control the movement of the vehicle that results from change in direction and velocity, and the movement created by the vehicle's suspension. Alternative seating positions need to be considered if the primary position is not providing enough stability. For some clients, that may mean the consideration of positions that are usually considered unacceptable such as placing the client in a posterior pelvic tilt. If the w/c user sits in a position in the vehicle where visual access to the outside is obstructed, then he/she is unable to anticipate vehicle movement, which further complicates user comfort and security. Other aspects that must be given special consideration are the need for a means to perform pressure relief while in the vehicle, caregiver access to the client, insuring a method of communication between the client and the driver, bowel and bladder control in the confines of a vehicle, and safe exit in case of an emergency.

The issue of stability is more acute for a driver with impaired balance and strength. For those who able to transfer to the OEM seat to drive, the shoulder and lap belt may provide enough support, while others may require additional supports that can be mounted to the seat. These could include head support and lateral trunk supports. For those users who drive from the w/c, a variety of new factors complicating the system are introduced. The w/c seat-to-floor height needs to be high enough to provide visual and physical access to see and touch, while not so high as to conflict with the steering wheel, roof, or viewing area at the top of the windshield. Many w/c components that may have been viewed as beneficial in other environments often compete for space in the vehicle. These include items such as full length armrests, elevating legrests, casters, etc. Some newer advents in positioning options, such as center mount foot platforms, are great for vehicle access, but frowned upon by many clinicians who prefer to see symmetrical seating postures. Soft suspension on the w/c that is great for w/c driving may allow too much movement for safe vehicle control. Who should decide where compromises are made when weighing optimal functional positions with optimal 'clinical' positioning?

Back in the 70's, matching a w/c with a van was relatively simple. There were very few choices. An E&J Rear Wheel Drive power chair and a full size Ford Van was it. Today there are a wide variety of power bases: Front Wheel, Mid-Wheel, Rear Wheel drive, from dozens of manufacturer's. They come with power seating that moves up, down, side to side, and back and forth. Accessible vehicles now come in Full and Mini vans, pickup trucks, and motor homes. They can be accessed through the side or the back, with inside or outside lifts, and driven by controls that range from simple hand controls to $70,000 high tech electronic controls. The big surprise here is that most of the wheelchairs work with most of the vehicles…as long as some planning is done ahead of time.

Some of the attributes of the w/c that affect vehicle accessibility and safety are front rigging, caster size, head support, seat-to-floor height, cushion height, ground clearance, ability to handle grade changes, externally mounted accessories (such as switches, brackets, etc), solid positioning devices and restraints, and suspension. Oftentimes one type of accessory can be exchanged for another that works better in the tight confines of a vehicle with minimal adverse effect on the client's positioning and access to other environments. Sometimes the substitution of an item to improve transportation function or access will have a noticeable impact in another area. For example, a client with a long trunk length may require a low seat-to floor height to ease entry into the van. This may, however, cause functional problems in other environments. Maybe he is now unable to reach the desktop at his job, or the countertop in the kitchen. The low seat to floor height may also result in poor clearance under the footrests and create difficulties traversing grade changes, thresholds, terrain, etc. The answer to resolving these obstacles is education of the consumer to the pros and cons of available options.

Person/Vehicle Fit Issues:
Driving is a complex task. The fit between the capacity of the driver and the task demands of vehicle use are a third important consideration when recommending mobility devices combined with vehicle modifications. Visual, cognitive and mobility abilities are important considerations from the driver's perspective. Visual acuity, useful field of view, rapid visual scanning, good visual contrast and efficient accommodation to changes in light are necessary visual elements that affect safe driving. In order to access various vehicle devices, the driver must have sufficient range

of motion and force. Reaction time must enable accurate response to important and irrelevant stimuli.

Considerable research has investigated cognitive demands of driving and how changes in cognitive abilities affect safe operation of a vehicle. Quick decisions and good judgement are required in reaction to the immediate environment. The driver must divide their attention between that required of the driving task and other distractions, both within and outside the vehicle. Sustained attention and vigilance are required over the course of a trip.

A Preliminary Study of the Person-Vehicle Fit

Sixty-nine older adults (age 55 – 93 years) participated in a telephone interview designed to solicit their opinions and issues on use of safety features of vehicles. Nine individuals with physical disabilities were included in this sample. The impetus for this study was the fit between the capacities of seniors and current vehicle design. The interview asked about driving habits, their ability to use vehicle safety features, beliefs about remaining safe in a vehicle and experiences with transporting others. Four main themes were identified in the transcripts: 1. vehicle attributes and dimensions, 2. person-vehicle fit, 3. beliefs about safety, and 4. actions to manage safety in a vehicle. The first two themes are relevant to this discussion.

The theme vehicle attributes and dimensions referred to participants' beliefs about the actual vehicle and whether these were safe or not. Participants expressed differing opinions on the influence of vehicle size; for some, a larger car offered greater protection while for others, the smaller car was more maneuverable, and thus, preferable. All participants expressed concern about the design of seatbelts. Often the coupling units were difficult to see. Seatbelts did not fit comfortably and different designs made it difficult to fasten and unfasten these devices. Seatbelts use is not a requirement that seniors have had throughout their lifetime as vehicle occupants so many felt they were a nuisance rather than a safety device. Many mentioned that they used seatbelts only because it was the law; although a significant number did indicate that they felt more secure when seatbelts were used.

Person-vehicle fit referred to the congruence between the capacity of the vehicle occupant and the task demands for use of various features. Specifically, participants identified a number of device features that either facilitated or hindered use. Visual aspects included size of visual displays and the colour contrast, particularly in night driving. The location of the device also determined whether it was used. Frequently, participants indicated that they were fearful of removing their hands from the steering wheel to engage the turn signal or make adjustments to temperature or other controls. Entertainment devices such as the radio or CD player may be situated so that use requires prolonged disruption of eye gaze on the road. Some participants indicated that range of motion or force required to access or activate devices was greater than what they were able to generate. From a cognitive perspective, devices that were complex to learn or control were not used.

This cohort of respondents has varying experience with computers and similar technology, which has interesting implications for the design and implementation of emerging in-vehicle technology intended to promote safer transportation. In-vehicle navigation systems are becoming more prevalent so they provide an interesting example for analysis. These systems must be intuitive to use, the information must be clearly displayed and readily interpreted. The location of these devices is critical so that they do not distract the driver from the primary task of driving.

Implications to Rehabilitation Professionals:

When making recommendations regarding mobility and van modifications, it is also important to consider the ability of the driver to safely complete all of the demands of the driving task. Mobility considerations include range of motion and force produced to activate or adjust various devices as well as to rotate the head to scan the environment when driving. Assessment of visual attributes is necessary to determine that the driver is able to see both in-vehicle and external environments and to scan these environments for pertinent information. Similarly, cognitive aspects of attention and judgement must be considered to ensure the safe operation of the vehicle. When identifying vehicle technology, either that from the OEM or after market adaptations, the triad of mobility, vision and cognition must be considered to ensure that the demands of using the device, safely, are congruent with the capacities that the driver brings to the task.

Successful integration of several complex pieces of equipment may seem like a daunting task. The simple solution lies in the combined expertise of a rehab team that includes specialists who can give input on clinical needs as well as each type of AT to be recommended. In addition to the usual team composed of the client, caregiver, doctor, therapist(s), and DME dealer, include someone who can give input on transportation equipment. A CDRS evaluation can identify driver capabilities and interface needs for primary and secondary vehicle controls. Make sure the equipment dealers make arrangements to trial each piece of equipment together in a mock system, with the user operating the various components, and the end result will be a truly mobile individual who is able to enjoy an active lifestyle.

Acknowledgements

The seniors who participated in this study reported here offered candid and detailed comments regarding their experiences and concerns regarding vehicle use. Appreciation is expressed to them for taking the time to participate in this study. Financial support for this project was received from AUTO21: The Automobile of the 21st Century, A Canadian Network of Centres of Excellence.

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Positioning For The Long Haul

Trudie Read, OTR/L

Successful wheelchair positioning has been described as that which "optimizes aliveness and self-expression" (1). The question is: how is this achieved?

In order to optimize the aliveness and self expression of a person who uses a wheelchair, the seating system needs to be comfortable, efficient and safe, which is measured within five performance areas:
1. Pressure distribution
2. Postural support
3. Vibration dampening
4. Weight
5. Maintenance

1. Pressure Distribution

The primary goal of a seating system is to distribute the interface pressure away from high pressure areas (the ischial tuberosities, trochanters and sacrum) and towards the areas that are able to tolerate higher pressure levels (the thighs). Therefore the first performance area of a client's seating system that needs to be assessed is its ability to distribute interface pressure.

Distributing the interface pressure away from peak pressure areas will assist with the prevention of pressure ulcers which have been estimated to cost the U.S. health care system between $2.2 and $3.6 billion a year (2).The cost of a pressure ulcer to the individual's health and quality of life is even harder to quantify. The development of a pressure ulcer on the sacral-ischial area can necessitate extended periods lying prone in order to promote tissue healing, which obviously affects their work, leisure and social activities. Even after a pressure ulcer has healed, the area will always be at a high risk for future tissue damage due to the scar tissue tolerating only very low interface pressure levels.

It is important to be aware that the amount of interface pressure that skin can tolerate without causing tissue damage decreases as part of the aging process. For this reason it is quite common for an individual who has used a wheelchair for 20+ years without a history of pressure ulcers to start developing areas of concern. In this situation the initial pressure ulcer is often a result of a trauma incident that compromises the skin integrity. The individual is also at a higher risk for trauma with age due to decreased strength and stamina which can lead to an increase in the amount of friction and shear experienced during transfers.

Obviously, prevention of a pressure ulcer is the best treatment, but it must be stressed that a seating system alone will not prevent the development of a pressure ulcer, and it is essential to educate the person using the seating system about the other factors that can affect skin integrity, including weight-shifting routines, nutrition and personal hygiene. In theory pressure ulcers are preventable--- that is if the individual lives a perfect, error-free life. This ideal lifestyle is becoming more difficult to maintain as the life expectancy of people who use wheelchairs is increasing (3). The seating specialist needs to be aware of this additional susceptibility of his/her aging client. Frequent seating system assessments are required in order to address the client's changing needs and prevent the development of secondary injuries.

2. Postural Support

The postural goals of a seating system are to:
- Correct flexible asymmetries in order to prevent secondary difficulties such as contractions or decreased range of motion
- Accommodate fixed postures in order to provide optimal pressure distribution
- Achieve and maintain the optimal functional posture

Pelvic asymmetries including posterior tilt, anterior tilt, rotation and obliquity, can be assessed through a mat evaluation to determine whether the assymetries are correctable or fixed in order to identify appropriate seating system components. The pelvis is the corner stone for positioning both the upper and lower body and so should be the starting point when assessing an individual and their seating system. Pelvic positioning creates the same spinal curves in sitting that are present while standing, which is essential when achieving a functional posture. These spinal curves affect upper extremity functioning, visual field alignment and body system functioning including, respiration, digestion and circulation.

Achieving and maintaining a functional posture in a seating system is an important goal. Sitting is a dynamic posture and the individual usually plans to do some functional activity while using the wheelchair. However, the optimal pressure distributing posture may not always be the most functional, for example using a tilt-in-space system can achieve good pressure distribution but it also moves the individual away from the functional horizontal plane; therefore compromises between posture and functionality must be made.

Comfort

During a seating system assessment, the level of comfort or discomfort that the individual is displaying must be noted as this is a valuable indicator of the seating systems ability to distribute pressure and to achieve and maintain a functional posture. If the individual is not able to verbally express their level of comfort, the following behaviors should be noted:
- Decreased sitting tolerance
- Increased agitation
- Decreased functional performance

Ask yourself, "Is this seating system optimizing the individual's aliveness and self expression?"

3. Vibration Dampening

Research has shown that the amount of vibration that is transmitted through a seating system to the individual is often too high for long-term exposure (4). This level of vibration can compound the over-use syndromes that are experienced by individuals who use wheelchairs, such as rotator cuff injuries, humeral necrosis, spondylosis, spinal disk degeneration/ herniation and lower back pain. This is a growing concern as the life expectancy of people who use wheelchairs is increasing which is also increasing the amount of vibration exposure. Effects of vibration on the body also include:

- Decreased comfort
- Increased fatigue
- Musculoskeletal degeneration
- Social inactivity

It is therefore essential for the seating specialist to include vibration dampening abilities in the seating system assessment in order to prevent the development of these secondary injuries. There are a wide range of products available for seating systems that reduce the amount of vibration experienced by the individual, including seat cushions, casters, and spokes.

4. Weight

The weight of the seating system is an important consideration during assessment. It can also compound over-use syndromes of the shoulder. A lightweight seating system has historically only been recognized to have benefits for the very active person, however the benefits of a more efficient system can be appreciated by many more client groups. Again the seating specialist needs to be aware of the light weight seating system components that are available.

5. Maintenance

The final consideration when assessing a seating system is the amount of maintenance that it requires. Points to consider include:

- Who is responsible for the systems maintenance: the end user, a single caregiver or rotating caregivers?
- What are their functional level skills: Gross/fine motor skills, eye sight, strength, sensation?
- Amount of training required.
- Frequency of required maintenance: daily, weekly, monthly.
- Factors that affect the system components: temperature, altitude, gravity.
- Availability of accessories required to perform the maintenance: pump, wrench.
- Repair process.
- Cleaning methods.

It is essential that the seating specialist provides sufficient training to the person who is performing the routine maintenance in order to ensure that the system performs optimally. Seating system maintenance needs to become a part of the individual's daily activities in order for the seating system to last the long haul.

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Pain: Defining, Categorizing, and Determining its Affect on Seating

Jessica Presperin Pedersen, MBA, OTR/L, ATP
Annie O'Connor, PT, OCS

"Providing Comfort" and "Increasing Sitting Tolerance" are phrases often used in the seating world when setting goals. The complaint of pain may be one of the reasons a person using a wheelchair seeks a referral to a seating clinic in an effort to find a product that will relieve or eliminate the pain. The seating therapist should not "chase" the pain symptoms by trying several cushions, backs, or other interventions, without having an understanding of the person's pain.

Annie O'Connor PT, OCS, is the Corporate Director of the Musculoskeletal Practice at the Rehabilitation Institute of Chicago (RIC). She states that musculoskeletal pain is a "multidimensional and complex phenomenon" that requires systematic assessment and management. Because the complaint of pain was noted by RIC patients of all ages and diagnoses, in all stages of care, Annie O'Connor developed a mandatory Allied Health Pain Curriculum for all therapists within the RIC system of care. (O'Connor 1,2) The course was designed for the treating therapists, but proved to be especially helpful to the therapists focusing on seating and wheeled mobility. The knowledge gained by this course provides the seating therapist with the tools to assess what type of pain the patient is describing, determine if the seating system is a root or ancillary cause, and refer to a pain specialist if necessary.

This article provides a brief synopsis of the classification section of Annie O 'Connor's course titled, Musculoskeletal Pain: Classification and Intervention, taught at RIC in the spring of 2004 with a focus on the wheelchair user.

Pain is defined by the International Association for the Study of Pain (IASP) as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage. (Merskey)

The first delineation in Classifying Pain is to delineate pain into two separate categories: Peripheral Nervous System Pain Types and Central Nervous System Pain Types. (Lundeberg and Ekholm)

Central Nervous System (CNS) Pain Types:
The central nervous system can be described as the brain and the spinal cord. The brain receives sensory input from the spinal cord and its own cranial nerves such as the olfactory and optic nerves. Its main function is to process the incredible volume of sensory input and initiate appropriate motor outputs. The spinal cord conducts sensory information from the peripheral nervous system (somatic and autonomic) to the brain and conducts motor information from the brain to various muscles and glands. The spinal cord also serves as a minor coordinating center for reflexes such as the withdrawal reflex. The pain types for the central nervous system can be further divided into three classifications: Central Sensitization, Affective Pain Disorder, and Autonomic/Motor Pain Disorder

Central Sensitization-This is non-localized pain that has a non-anatomical origin related to altered CNS circuitry and processing. The frequency of the pain can be constant or intermittent. There is no consistency to the description of the pain . The onset is a chronic pain that still occurs four months after the normal healing time. Upon evaluation, there is no relationship between the stimulus and response. Non-organic test may be positive such as light eliciting an abnormal response.

Affective Pain Disorder- This is non-localized pain from that has a non-anatomical origin caused by central pathways and circuits related to emotions and their perceptions. The frequency of the pain can be constant or intermittent. There is no consistency to the description of pain. There is no relationship between stimulus and response. During assessment the therapist will find that there was a psychological trauma that initiated the pain response. This is the major distinguishing factor from Central Sensitization. A referral to a pain behavioral psychologist is needed.

Autonomic/Motor- This is pain localized to the UE or LE localized and may include the spine. It is related to output systems of the brain. The painful elements are so great that the autonomic nervous system is affected. The frequency can be constant or intermittent. The patient may complain of swelling, increased tone, discoloration of the skin, or may have immune, GI, or parasympathetic system problems. The onset is chronic pain that occurs greater than four months after the normal healing time of any connective tissue trauma. A referral to a pain behavioral psychologist is crucial.

Peripheral Nervous System (PNS) Pain Types:

The peripheral nervous system can be described as all the nerves and nerve cells outside the CNS. It consists of the 12 pairs of cranial nerves which emerge from the brain and serve the head and neck as well as 31 pairs of spinal nerves which branch off from the spinal cord to the rest of the body. The function of the PNS is to relay information to and from the CNS. It consists of sensory neurons and motor neurons and transmits voluntary and involuntary actions. The pain types from the peripheral nerve system can be further divided into three classifications: Nocioceptive inflammatory, Nocioceptive Ischemia, and Peripheral Neurogenic.

Nocioceptvie Inflammatory Pain- This is a localized pain which originates in target tissues due to a mechanical or chemical trauma. The frequency of the pain can be constant or intermittent. The description of the area of pain is swelling, stiffness, or crackling. The onset is within two weeks of injury or a recent flare up of a chronic condition. A mechanical injury will show a close relationship with stimulus and response. The chemical injury will show that pain gets and remains worse as a result of repeated movement testing.

Nociopceptive Ischemia This is a localized pain that is intermittent in frequency. The complaints are fatigue, weakness or tightness. There is no apparent reason for the onset. The findings are that the pain is caused from prolonged positioning or repetitive movements in the same direction without reversing direction.

Peripheral Neurogenic Pain This is a pain localized to a dermatome or cutaneous nerve field. Its frequency can be constant of intermittent. It can be described as a deep aching, cramping, superficial burning, or stinging. Upon evaluation, the therapist will note nerve or container restriction.

Being able to identify if the pain is CNS or PNS is essential to the seating and positioning therapist. If the pain is CNS, the patient must be referred to a pain specialist. The wheelchair is not the source of pain. If the pain is determined to be PNS, the therapist must note which type of pain. Nocioceptive inflammatory pain might involve changing positioning components that are directly causing the pain, such as a trunk support that is too tight. Nocioceptive Ischemic Pain might be caused by prolonged sitting in one position. This may be relived by providing dynamic seating, changes in position, or getting out of the wheelchair for a period of time. Peripheral Neurogenic pain is influenced by nerve or container impingement. Sometimes seating systems or wheelchair configurations may actually be causing neurogenic pain such as headrests that are set too far in extension for an individual's mobility level. As one considers that the pain is nerve related, changes in wheelchair intervention might be considered.

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Under Pressure
Strategies for reducing the likelihood of skin breakdown while in ER

Ian Denison, ATP PT
Bonnie Sawatzky, PhD

This presentation sheds light on some of the limitations of pressure mapping devices as well as providing useful information that will help patients who spend extended periods of time on hospital gurneys reduce their likelihood of developing a skin lesion.
Time permitting we will report on a comparison study we recently performed addressing issues at the other end of the skin integrity spectrum.

Executive Summary
This document is a summary of a comparison test we performed to help the VGH Wound Clinic choose an appropriate mattress overlay to help prevent SCI clients from developing pressure sores while waiting for a bed in the Emergency Room.

The Problem
It is an alarming fact that at the time of writing this paper 16 of the 29 SCI clients in our facility had a pressure sore. One of the identified causes is spending time on the ER gurney. When clients become ill they are taken by ambulance to Vancouver General Hospital where they are placed on an ER gurney. They are transferred to a RIK mattress as soon as possible. Unfortunately ASAP might be up to 18 hours later.

Testing
Four foam overlays met the criteria established by the team and were tested. A 160 lb subject was pressure mapped on each of the overlays using an FSA device in two positions: -
o Supine
o Sitting with the head elevated at 40 degrees.

Discussion
Detailed analysis of the pressures at the heels left us concerned about the validity of the results we chose to use buttock pressure readings and subjective feedback as our guides.

Recommendations
We found that the most appropriate support surface to be the BFF Sensus foam overlay which reduced buttock pressures by 30 to 40% compared to the standard gurney.

To further reduce shear and pressure at the buttock area; clients should lie with the gurney flat.

If the client chooses to raise the head of the gurney this should only be done after the knees have been raised about 20 degrees. Clients and staff in ER need to be educated on the perils of sitting up with the knees extended.

Which Band Aid?

The Problem
One of our staff physiotherapists lifted a client's leg the other day while assisting them to transfer, when she removed her hand she had blood on her fingers that came from a wound the client had not mentioned. Of course intact skin is a pretty decent barrier to blood borne pathogens (BBP) and simply washing her hands should have been the end of the story. Unfortunately the PT had some open areas around her nails and since the client profile suggested there was a significant risk he might harbour BBP's the staff member was sent to emergency to commence prophylactic treatment to combat HIV.

This event prompted a discussion in PT regarding dealing with small open areas and little owies. Many of the staff balked at the idea of using gloves all the time and pointed out the wound may not be on the hand. Besides many of the assessments and treatments require significant "feel" which can't be achieved with gloves. Conventional band-aids or whatever the appropriate generic term is, are hopeless, since frequent hand washing is part and parcel of our job and the band-aids generally fall off during the first wash. The perforations also allow the pad to become wet through and they do a poor job of sealing the wound particularly on the sides.

Research
We contacted a number of authorities to see if they have recommendations on alternative wound coverings, but apparently they have bigger fish to fry. As a parent of two young boys I have some experience with alternative owie covers and decided to do a quick and dirty comparison to see which wound covering would prevent the small lesion from being a portal of entry or exit and protect both the clinician and client from exposure to BBP's.

At time of writing we are compiling and processing feedback from over twenty clinicians who participated in a controlled research project to determine if any adhesive bandages would perform better than other in a clinical setting.

Objective Insight in Loading Characteristics in Sitting

Joke H. Grady, OT, MSc

Introduction
This paper concerns the outcome data of a study concerning objective sit loading characteristics of a population of wheelchair bound persons. Protocolled pressure measurements formed the input data for a specially designed analysis program for clinical diagnostics of sit complaints / impairments in wheelchair bound persons. This load analysis software program, called in abreviation "SLAS", provides outcome data on sit load which can then be interpret in relation to the underlying pathology to determine the nature and the extent of the (wheel)chair sit problems.

Patients:
- Wheelchair bound persons with chronically or repetitive (wheel)chair-sit complaints / impairments.
- Wheelchair bound persons with a large risk on the occurrence of sit complaints / impairments.
- disease(s); neuromusculair diseases, severe poliomyelitis, M.S. , contusio cerebri, spinal cord laesion, amputation (both sided) / hipexarticulation/hemipelvectomy, mutilating reumatism; spina bifida, etc
  Only adults were part of the study.

Aim:
To examine the relation of the sit complaints / impairments pressure ulcer, pain and instability to the clinical sit-pressure / sit load parameters Recovery Debt (RD), Proportional Pressure Index (PPI), Mode Value (MV), Maximum Pressure (MP) and Contact Percentage (Contact%).

Sample
A sample of 99 wheelchair bound patients with and without sit complaints / impairments, living in the Netherlands.

Methods:
In the study the following devices were used:
- Pressure registration device (FSA) to measure pressure values
- Sit Load Analysis Software (SLAS): specially developped load analysis software for elaboration of pressure data.
  All patients were subjected to protocolled measurements

Results:
All clinical sit pressure / sit load parameters mentioned have a clinical relevant relation with sit complaints / impairments.
A difference in parameter score is shown between complaint /impairment yes and no. RD: the pressure ulcer group showed a statistical significant difference between complaint / impairment yes and no (p=0.038). PPI: the pain group showed a significant difference (p=0.017). MP:the pressure ulcer and the pain group showed a significant difference (p=0.043 and p=0.027). Contact%: the instability group showed a significant difference for seat and back (p=0.000 and p=0.006).

Summary and Conclusions:
A clinical relevant relation between sit complaints / impairments and clinical sit-pressure / sit load-parameters mentioned is pointed out. Results also show statistical significant differences between complaint yes and no.

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A Marriage Made In Heaven –
Join Two Old Technologies for a Customized Cushion

Eva Ma, OTR, ATP. ABDA

This is a single case presentation of combining CAD-CAM and air-cell technology to create a customized seat cushion for a client who is paralyzed at T-12 to obtain positioning, postural stability and pressure redistribution.

Among aging clients with spinal cord injuries, the change of skin condition and posture generate the need for specific interventions to prevent sitting acquired pressure ulcers.

The client is thirty-five years post initial discovery of tumor on his spine and resulted paralysis at T-12 level. He had a spinal fusion to correct his curvature of his spine but had not received a seating system evaluation post surgery. Consequently, he developed a Stage IV Decubitus Ulcer and required further surgery. He had a fracture of his left tibia and fibula several years prior and healed with the leg shorter and externally rotated. He is 6'2" and weighs about 190 pounds. He works as an attorney, which requires him to remain active.

He prefers to be high on his frame and feels unstable on a traditional air-cell cushion.

Initially, a customized Invacare Silhouette cushion with Recess for a 4" cells ROHO cushion were recommended. Through trials and pressure mapping the final product was a customized Invacare Silhouette cushion with Recess Cut out to accommodate the 3" tall ROHO cells cushion with dual valves.

Challenges being addressed are: how to manipulate the raw data captured during the simulation to create specific support surfaces thereby providing postural stability while at the same time reducing peak pressure areas as determined by pressure mapping technology and client's own experience. It is also necessary to determine both the height of cells and number of cells in the customized ROHO cushion

Follow-up visit with client at 6-months was conducted. Does the cushion achieve the goals?

Sitting Acquired Pressure Ulcers: Collecting Incidence Data in Tasmania, Australia

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Background
Prevalence and incidence of sitting acquired pressure ulcers (SAPUs) has not been established in the literature. At the Launceston General Hospital, Tasmania, Australia, the 9th annual point prevalence survey revealed the prevalence rate of 46% % of pressure ulcers occur at the buttock/sacral/coccyx region (posterior pelvic girdle). Over the past nine years the figure has varied between 79% and 37%. Further analysis of the 2004 survey data reveals an incidence of pressure ulcers occurring over the posterior pelvic girdle to account for 46% of facility acquired pressure injury. The pressure ulcers were staged at 61% stage 1 and 31% at stage 2.

Pressure ulcers are generally accepted to be caused by pressure, friction, shear and maceration and through the validation of the pressure ulcer, etiology of the damage can be elucidated. For example, skin loss through the peri-anal region extending up to coccyx and buttocks of the natal cleft with knowledge that the client is incontinent of urine and/or feces indicates that the pressure damage is related to maceration and the effects of urine and feces on the skin. Conversely skin damage over the ischial tuberosity in a client who sits on a chair with inadequate seating or repositioning indicates pressure as the likely cause of the skin damage.

Prevalence is the most used method to express the number of pressure ulcers within published surveys as it can define the total number of individuals with pressure ulcers during a defined period. However, incidence further defines the numbers of individuals who have developed pressure ulcers while in the facility. It has been reported that monitoring pressure ulcer prevalence and incidence and implementing education programs can reduce the number of individuals who develop pressure ulcers.

Data Collection
A Multi-disciplinary Pressure Ulcer Resource Group (MPURG) has been working for nine years to reduce the incidence of pressure ulcers in the Launceston General Hospital. An essential element requires both a physical and pressure ulcer risk assessment to be completed within 24 hours of admission to hospital. The Waterlow Risk Assessment is currently used at the Launceston General Hospital and clients at risk ideally should have a documented risk minimization/prevention plan. Where a pressure ulcer is found to present on admission or subsequently develops damage a notification form is sent to the Clinical Nurse Consultant for wound management. The pressure ulcer stage, anatomical location validated, wound product and prevention plan reviewed with the primary care nurse.

In 1998 an in-house Access database was developed to assist in pressure ulcer data collection. To date there are over 1170 individuals who data has been collected. From the inception of this PulcerMan database, the anatomical location of the pressure ulcer(s) has been collected. Pressure ulcers are mapped on the facilities notification form and entered into the fields that include, location, size, stage, and date of notification, wound management and prevention plan.

The data collected is highly dependent on registered nurses accurately reporting pressure damage and timely validation by the clinical nurse consultant for wound management. Under reporting of pressure ulcers is known to occur and confirmed during point prevalence surveys at the facility.

Development of the Bmap©
The Bmap˝ was developed to assist in the accurate identification of anatomical sites where pressure damage occurs. The grids segment the posterior pelvic girdle and upper thighs and include the natal cleft for mapping the stage and size of the pressure ulcer(s).

The Bmap˝ was used in the November 2004 9, 2004 annual point prevalence survey. The survey methodology was unchanged from the past five years and a body map was used in conjunction with the Bmap˝. Surveyors reported the Bmap˝ to be helpful in identifying the site(s) of pressure damage as they were able to use the underlying skeletal markers to site the pressure ulcer(s). The Bmap˝ has been used to validate pressure ulcer locations for the past three months and a retrospective audit from the hospital's PulcerMan database will be presented during the conference proceedings.

Future Applications of the Bmap©
It is hoped that the data from the Bmap˝ will be useful in building business cases for the procurement of additional pressure relieving and reducing mattress and cushion surfaces through the identification of pressure ulcer locations. Data collection has been vital in pervious years to purchase basic mattress, overlay and mattress systems and has most recently been used to identify the need for adequate patient seating and pressure relieving/reducing aids. Pressure mapping technology provides clear indications where pressure damage has the potential to occur, or has occurred.

In addition, the Bmap could be used in seating clinics to accurately determine the prevalence and incidence of sitting acquired pressure ulcers. The aim of the Bmap˝ is to assist in the accurate staging, location, size of pressure ulcers and wound management plan in conjunction with established seating and mattress systems in the community or acute care settings.

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Spectroscopic Assessment of the Blanch Response in Elderly Nursing Home Residents at Risk for Pressure Ulcers

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Background and Significance: Stage I pressure ulcers (PU) are difficult to detect, particularly in individuals with dark skin, because color changes and tissue blanching are masked by the skin's pigmentation.1 Improved assessment of early stage pressure damage may facilitate the initiation of interventions to prevent higher stage damage that is associated with increased health care costs and medical complications.2 Bio-optical techniques, such as visible and near infrared spectroscopy (VIS-NIRS), may improve our ability to detect the blanch response in light, moderate, and dark skin. Using light reflected from the skin, VIS-NIRS provides data on skin hemoglobin and melanin content.3,4,5 VIS-NIRS has been used in a variety of studies to assess pressure-related erythema.5,6,7 A variety of algorithms exist to compensate for the presence of melanin in the skin, allowing hemoglobin content to be assessed in both lightly and darkly-pigmented skin.4,5,8 By tracking the change in hemoglobin concentration that occurs when pressure is applied, a "spectroscopic blanch response" may be observed even though a clinical blanch response cannot be observed visually.3,8 Researchers have only recently used VIS-NIRS techniques to examine the blanch response,3,8,9 and little data are available on its use in assessing stage I PU. A pilot study conducted at the University of Pittsburgh demonstrated that a significant blanch response can be reliably detected in light and dark healthy skin at the heel using portable spectroscopy instrumentation (manuscript in preparation). The ongoing study discussed herein examines the spectroscopic blanch response at the heels of elderly nursing home residents with and without stage I PU.

Specific Aims: The study has three aims: (1) assess the intra-rater reliability of spectroscopic blanch response measurement in subjects with and without stage I PU, (2) test the hypothesis that there will be a significant decrease in total hemoglobin when pressure is applied to the skin of subjects without PU, regardless of skin color, and (3) test the hypothesis that regardless of skin color, the magnitude of the spectroscopic blanch response will be diminished in subjects with stage I PU compared to subjects without stage I PU.

Subjects: Participants are drawn from a population of nursing home residents in the greater Pittsburgh area. Participants must meet the following eligibility criteria: (1) male or female over the age of 65, (2) Braden scale score £18 (at risk for PU), (3) limited mobility (combined Braden scale Activity and Mobility subscale score £5), (4) no current PU on one or both heels OR stage I PU on one or both heels. Potential subjects are excluded from the study if they have: (1) scarring, bruising, rashes, or abnormal pigmentation of the skin over the posterior aspect of the heels that would prevent accurate assessment of PU status, or (2) stage II or higher PU at both heels. A total of 30 subjects will be assessed in the study, 15 without stage I PU at either heel ("No PU" group) and 15 with stage I PU at at least one heel ("Stage I PU" group). Subjects are recruited in light, moderate, and dark skin color strata to ensure a variety of levels of skin pigmentation in the sample.

Bio-Optical Instrumentation: Skin reflectance data are collected using a system comprised of four major components: a spectrophotometer (Ocean Optics, Dunedin, FL, Model SD 2000), a 100W quartz tungsten halogen light source (Oriel Industries, Stratford, CT, Model 77501), a fiber optic reflectance probe (Fiberguide Industries, Caldwell, ID), and a laptop computer with data acquisition software. A custom-designed spring assembly is mounted onto the fiber optic probe to enable the examiner to apply gentle pressure of up to 120 mmHg to the skin, simulating the pressure applied to the skin during a clinical blanch test.

Methods: Screening includes a medical record review, Braden Scale assessment, and skin inspection to determine the subject's heel PU status and skin color classification. Those who qualify for enrollment in either the No PU or stage I PU groups undergo three point spectroscopic blanch tests (PSBTs) at the heel of interest (dominant-side heel for No PU group members, heel with stage I PU for Stage I PU group). Subjects are positioned comfortably in bed, typically in a semi-sidelying position. A sterile, latex-free transparent dressing (Tegaderm‰, 3M) is applied to the skin over the dorsal aspect of the heel of interest, followed by a piece of clear double-sided tape that minimizes movement of the fiber optic probe during data acquisition. The fiber optic probe is placed in light contact (<5 mmHg) with the tape. The probe is positioned so that incident light is directed perpendicular to the skin surface. The probe is held in this position for up to 45 seconds while reflectance data is collected by the spectrometer. Without lifting the probe from the tape, the investigator gently increases the pressure delivered to the skin to up to 120 mmHg by depressing the plunger on the probe and compressing the spring. This gentle pressure is maintained for up to 45 seconds while reflectance data is collected by the spectrometer. The probe is then lifted gently off the tape and a two-minute washout period takes place. This process is repeated until three measurements at the heel of interest are acquired.

Data Analysis: Reflectance data are converted to optical density units using the formula
log10(reference - dark) - log10(skin reflectance - dark). The relative concentrations of oxygenated hemoglobin (HbO2), deoxygenated hemoglobin (Hb) and melanin present in the skin are determined using a constrained non-negative least squares fitting procedure that fits the in-vivo skin spectra to the extinction coefficients, as measured by in-vitro spectroscopy, of HbO2, Hb and melanin. Total hemoglobin (tHb) is derived as the sum of the HbO2 and Hb signals. The "spectroscopic blanch response" is defined as the change in total hemoglobin between

the light contact and gentle pressure conditions (ΔtHb). Aim 1 will be addressed by calculating intra-class correlation coefficients (ICC) for data obtained during the three PSBTs at the heel of interest in each group. To address aim 2, a one-tailed dependent samples t-test will be performed to determine if ΔtHb in the No PU group is significantly less than zero. Aim 3 will be addressed by performing a one-tailed independent samples t-test to determine if the magnitude of ΔtHb in the Stage I PU group is significantly less than the ΔtHb measured in the No PU group.

This work provides pilot data that will assist in the development of a larger scale clinical study to demonstrate the reliability and support the validity of assessing early pressure damage with VIS-NIR spectroscopic technology. This work also provides information that will assist in the development of clinical devices that use spectroscopic technology to detect early stage pressure damage.

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Pressure Approach in National Rehabilitation Center For Persons with Disability

National Rehabilitation Center for Persons with Disability, Japan

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Objective
Recurrence of pressure ulcers (PU) in spinal cord injury (SCI) patients has high medical costs and lowers his/her Quality of Life (QOL). This research introduces the pressure approach (PA) in seating clinic at National Rehabilitation Center for Persons with Disability and reports long term results of PA.

Pressure Approach (PA)
PA determines course of PU and conducts prevention methods including wheelchair seating and pressure relief education and management of his/her skin and PU.

Interviews include his/her medical history and daily life to determine whether PU repeats or not and how long they stay on each surface including wheelchair, car, toilet and bath in daily life. Position and stage is observed and all situations in his/her daily life are checked using a pressure mapping system (PMS). If the position of PU and high pressure area matches, then that surface is considered to be the cause of the PU occurrence. To help heal the PU an improved wheelchair, cushion or mattress, checked by PMS, is selected. Methods of pressure relief are also taught using pressure mapping.

Method
Subjects were 75 SCI patients who received PA from 1999 until 2002. They were checked for dates in and out of hospital for PU occurrence by his/her medical records. One group had PA intervention and other group, acting as control, did not receive intervention. Intervention group data of period with no PU from the day of PA until next hospitalized period to the end of December, 2004 is 97 data and 39 patients. Control group, with no intervention, until next hospitalization was 69 data and 36 patients. These data were processed using the Kaplan-Meier life analysis method and Log Rank method.

Results
Recurrence trend with PA intervention shows significantly smaller PU incidence than without PA intervention (P=0.02). Recurrence rate after PA intervention is 0.55, without is 0.75 in five years. The two year rate was the same ratio of 0.7 in both groups.

Conclusions
PA is effective in educating patients to decrease recurrence rate of PU.

The Effects of Wheelchair Seat Tilt on Seated Pressure Distribution in Adults without Physical Disabilities

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Pressure ulcers are a major cause of concern for individuals who use a wheelchair on a long term basis. A pressure ulcer on the buttocks prevents an individual from using their wheelchair, and often requires prolonged bedrest for healing to occur, resulting in lost work time and limited involvement in social and leisure activities. Treatment of pressure ulcers is very costly sometimes resulting in prolonged hospitalization and repeated surgery. Thus, evaluation of methods for the prevention of pressure ulcers is an important way of reducing the costs associated with their incidence.

Current technology intended to reduce pressure at the interface between a wheelchair seat cushion and the buttocks and thighs of the wheelchair user include different materials used to fabricate the cushion, and design of the wheelchair so the seat can be moved into different degrees of anterior and posterior tilt and/or the seat to back angle can be opened to allow a reclined position. Design of wheelchairs to incorporate tilt and recline, particularly powered tilt and recline that are activated by the wheelchair user themselves, is a relatively recent change in mobility technology. Power tilt and recline add significantly to the cost of a wheelchair, however, if they are shown to be effective in reducing the incidence of pressure, and consequently pressure ulcers, their cost can be justified.

To date, little research has focused on the ability of tilt and recline positions to reduce the pressure distribution at the interface of an individual and the wheelchair seat. Pellow (1999) found pressure reductions at the ischial tuberosities of two individuals with C5 quadriplegia using tilt and recline wheelchair positions. Two futher studies showed that wheelchair tilt and recline can reduce pressures at the seating interface in individuals with a spinal cord injury (Hobson, 1992; Henderson, Price, Brandstater, & Mandac, 1994).

The purpose of this pilot study was to develop a research protocol for examining the effects of wheelchair seat tilt on the pressure distribution at the interface of an individual and a wheelchair seat. It will also provide preliminary data concerning the pressure-reducing capabilities of the tilt wheelchair position.

Method

Participants

A total of 14 individuals were recruited through the School of Occupational Therapy at The University of Western Ontario. Healthy males and females, 18 years of age and older, with functional mobility of all extremities were eligible to participate. Individuals were excluded from this study if he or she required a mobility device, had a cognitive impairment that inhibited the understanding of the purpose and procedures, an existing pressure sore, sensory deficits that limit the ability to sense pressure in the buttocks and thigh, or an orthopaedic hip impairment.

Materials and Procedures

A power wheelchair with power tilt features was used for this study. A foam pressure-reducing cushion was placed on the seat of the wheelchair. The force sensing array was placed on top of the cushion the seat. The force sensing array was programmed to capture data twice per second. A baseline measurement of changes in pressure distribution while sitting in a neutral position was taken over a period of fifteen minutes, during which time the participant was asked to engage in a sedentary activity.

Following collection of baseline data, data were collected in different conditions of tilt. For each condition of tilt, the participant remained in position for five minutes to collect sufficient pressure data. The different conditions of tilt included 82° (neutral), 94°, 106°, 118°, and 130°. The degree of tilt was verified by measuring the angle between the back cane and the horizontal bar of the frame of the chair. All data for each participant were collected in a single session.

For each condition of tilt and across time, the mean pressure, peak pressure, and the number of sensors activated was collected. For each participant, the mean pressure at each minute was calculated by averaging 22 data frames, 11 before 11 after each minute mark. The average of the mean pressure at each minute across each angle of tilt was then plotted against time and qualitatively analyzed for any trends. A multi-factorial ANOVA test was carried out using the average of the mean pressure at each minute across each angle in order to determine if a significant difference in mean pressures existed between the various conditions of tilt. T-tests were also completed using the average of the mean pressures at 1, 3, 6, 9, 12, and 15 minutes for the neutral position, and at 1 and 5 minutes for the remaining angles of tilt. The average peak pressure at each minute of data collection was also calculated and plotted against time for each condition of tilt. A multi-factorial ANOVA test was conducted using these data to determine whether a significant difference existed in the peak pressure readings across each condition of tilt. The average number of sensors that were activated while the participants were seated in each condition of tilt was recorded. The average number of sensors was then plotted against tilt angle and analyzed qualitatively. Using the visual output from the force sensing array, trends in the location of activated sensors across conditions of tilt was also analyzed qualitatively.

Results

The ANOVA indicated a significant difference in the mean pressures recorded across the five conditions of tilt. The t-tests revealed that there were no significant within-subject differences between the mean pressure readings at each minute for each condition of tilt. The qualitative results from the graphs depicting the relationship between mean pressure and time for each condition of tilt yielded interesting and valuable information. In 6 of the participants, a reduction in mean pressure was noted with a change in wheelchair tilt from 94° to 106°, while 10 participants experienced a decrease in mean pressure when the chair was tilted from 106° to 118°. When the angle of tilt was increased from 118° to 130°, 11 participants experienced a considerable decrease in mean pressure.

The average peak pressure recorded during each condition of tilt was analyzed both qualitatively and quantitatively. Qualitatively, it was found that the average peak pressure decreased as the angle of wheelchair seat tilt increased. The most evident reduction in pressure was evident when the angle of tilt was increased from 118° to 130°. The results from the ANOVA test reveal that there was a significant difference in the average peak pressures that were recorded across the different conditions of tilt

The number of activated sensors was also recorded during the data collection process. For each participant, the average number of sensors activated throughout each condition of tilt was calculated in order that it could be plotted against angle of tilt. Qualitative analysis of these graphs revealed a general trend indicating that as the angle of wheelchair tilt increased, the number of sensors that were activated decreased. There were, however, 7 individuals who had an increase in the number of activated sensors when the angle of tilt was increased from 82° to 94°. The visual output produced by the force sensing array revealed consistent trends with respect to patterns of sensor activation and deactivation across the various conditions of tilt: 1) as the angle of wheelchair tilt increased, the number of activated sensors decreased, 2) areas exhibiting the highest pressure readings in the near-neutral conditions of tilt were the areas that maintained active pressure sensors in the increased tilt positions and 3) the area that demonstrated the greatest degree of sensor deactivation as the angle of tilt increased was the front portion of the force sensing mat, which corresponds to the front of the wheelchair cushion.

Discussion

The results from this study indicate that the seated pressure distribution at the interface of the wheelchair user and the seat cushion is influenced by the angle of wheelchair seat tilt. It was demonstrated that as the angle of tilt is increased, the average pressure and the peak pressure decrease significantly. It was also found that the pressure distribution between the buttocks and thigh of the participant and the wheelchair seat cushion did not change significantly over time when maintained in the same tilt position. These are important findings in that they help to validate the theory that placing an individual in a position of increased tilt will assist in reducing the seated pressure distribution, which in turn, has the potential to decrease the incidence of pressure ulcers

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Evaluation Of Newly Designed Water Cushion For Wheelchair Users

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ABSTRACT-
Wheelchair Cushions designed for wheelchair users to prevent pressure sores on the skin are constructed so as not to disperse concentrate the pressure at the body-cushion interface. But at the same time, ride comfort when driving a wheelchair decreases because the rider receives large vibrations from the cushion. In our study, the cushion manufacturer, Achilles, developed a newly designed water filled cushion (NDWF) that provides a comfortable ride and supplies a good pressure relief effect. We evaluated the pressure distribution of the cushions and the ride comfort by measuring the vibrations of at the head and seat frame when driving a powered wheelchair. We also measured the pressure distribution of the cushion. From experimental results, it became clear that the NDWF is comparable to typical conventional wheelchair cushions. In addition, we concluded that this cushion provides a comfortable ride and reduces interface pressures.

INTRODUCTION
Many cushions for wheelchairs are designed to distribute the concentration of the pressure at the body-cushion interface to prevent pressure sores [1]. Up till now, a comfortable ride has not been a primary consideration. According to ISO- 2631, the prolonged vibration experienced by individuals decreases their comfort [2]. Vibration exposure of individuals who use wheelchairs has been researched by Cooper et al. [3]. In this study, we evaluated the vibration experienced by individuals and the pressure distribution of the water-filled cushion (WF), which has a water bag installed in the entire area of the cushion. As a result of the evaluation, we found that the WF had a good pressure distribution effect, but vibration increased when using the WF [4]. In order to improve the ride comfort of the WF when driving a wheelchair, the cushion manufacturer developed a newly designed water-filled cushion (NDWF) with a smaller water bag than the WF in the buttocks area, where the contact pressure is high. High-density urethane chip foam was installed at the front of the NDWF to dampen the vibration and stabilize the wheelchair user's body. The purpose of this study was to investigate the effectiveness of the NDWF compared to other typical wheelchair cushions (air-filled (AF), viscoelastic fluid-filled (VF), WF, and the NDWF). In this study, we measured the vibrations at the subject's head and the seat frame of the powered wheelchair on each cushions as well as the vibrational dose value ratio (VDVR), which is the ability of cushions to effectively dampen vibration amplitude, using the vibrational dose value (VDV). We also measured the peak pressure and contact area, and evaluated pressure distribution effects using the rate of change from when the cushions were not used. This paper presents the effectiveness of the NDWF compared to the other three typical wheelchair cushions.

METHODS
A triaxial accelerometer (ARJ-A-T ±10g, Tokyo Sokki Kenkyujo CO., LTD, Japan) was mounted on a seat frame. Another accelerometer was mounted on a Bite-Bar. The Bite-Bar was held between the subject's teeth and the accelerometer measured the vibration experienced at the subject's heads. Signals from the accelerometers were amplified and sampled at 200Hz via a battery-powered acquisition system, and a pressure distribution mapping was recorded at the same time. The subjects sat on cushions under which a sensor seat (Big Mat, Nitta Corporation, Japan) was placed in order to measure the peak pressure and the contact area. Subjects drove a powered wheelchair (JW1-22B YAMAHA) over four different road surfaces (textured block, asphalt, brick and gravel roads) while they were sitting on four different cushions (AF, VF, WF, and NDWF). The powered wheelchair was driven at 4km/h over the four surfaces. Five subjects participated in this experiment; their average age, weight and height were 22.4 years old, 62.2 kg and 172.4 cm. respectively. Each driving trial was repeated three times, resulting in each subject being asked to drive 36 times (3 surfaces x 4 cushions x 3 times). From the collected signals, the VDV were calculated using equation (1). From the calculated VDV of the x, y, and z-axis, VDVtotal were calculated using equation (2). The VDVR were also calculated using equation (3). From the peak pressure and contact area data collected, the decreasing rate of the peak pressure (DP) and the increasing rate of the contact area (IC) were calculated based on those data when the cushions were not used [5]. These rates were calculated only when driving on the textured blocks, because we confirmed that the vibrations subjects experienced on the textured blocks were the largest of the four kinds of surfaces in our prior study.

$$VDV = \left\{ \int_0^T \left[a_W(t) \right]^4 dt \right\}^{\frac{1}{4}} \quad [\mathrm{m/s^{1.75}}] \quad (1)$$

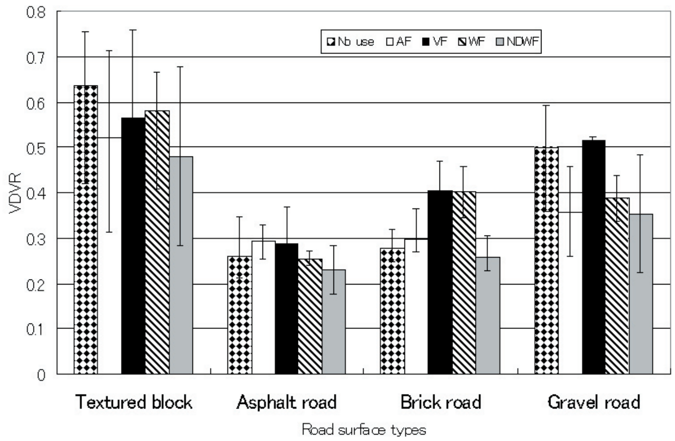
$$VDV_{Total} = \left(\sum_i VDV_i^4 \right)^{\frac{1}{4}} \quad (2)$$

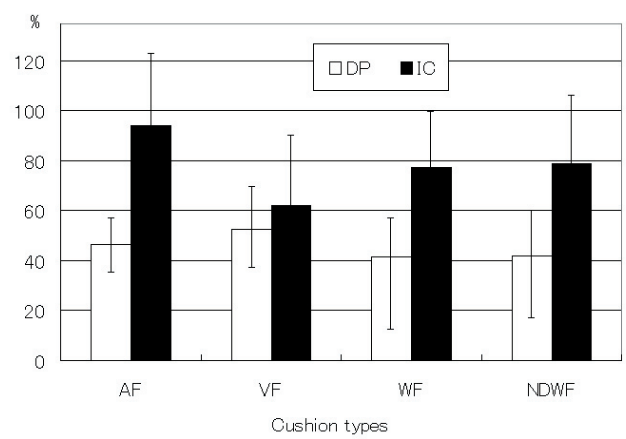
$$VDVR = \frac{VDV_{Total\,(head)}}{VDV_{Total\,(seat)}} \quad (3)$$

where aw(t) is the frequency weighted acceleration, T is the signal duration and are x, y, and z-axis

RESULTS

The average value and range of VDVR on each road surface across five subjects are shown in Fig. 1. The average value and range of DP and IC are shown in Fig. 2. The cushion with the lowest VDVR was the NDWF on each surface. The cushion with the best DP was the VF and the cushion with the best IC was the AF.





DISCUSSION

The VDVR of the newly designed water-filled cushion (NDWF) is less than the other three cushions on each surface. These results indicate that the newly designed water cushion was the most comfortable to ride in this study. The decreasing rate of the peak pressure (DP) and the increasing rate of the contact area (IC) of the WF cushion and NDWF were almost the same. From these results, the ride comfort of the NDWF cushion was an improvement and did not worsen the performance of the pressure distribution of the water filled cushion. Compared to other cushions, the increasing rate of the contact area of the NDWF cushion is a little less than AF cushion. The decreasing rate of the peak pressure of the cushion is comparable to other cushions. Therefore it is considered among the present limited data that the newly designed water-filled cushion is the cushion that is the most comfortable to ride and also reduces interface pressures.

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Alternative text

Equation 1: VDV equals the integral from zero to T of the aw(t) to the fourth power with respect to x, to the one quarter power. The frequency weighted acceleration (aw(t)) was calculated from the collected accelerations and VDV (which is one of the vibration evaluations) was calculated using this equation.

Equation 2: VDVTotal equals the sum of the VDVi to the fourth power, to the one quarter power. The vibration total value (VDVTotal) of VDV of the x, y, and z-axes was calculated using this equation.

Equation 3: VDVR equals the VDVTotal (Head) over VDVTotal (Seat). Ability of cushions to effectively dampen vibration amplitude was calculated using this equation.

Figure 1: Figure 1 shows the average value and range of VDVR on the four kinds of surfaces across five subjects. VDVR from the lowest was in the following order, on the textured block: NDWF-AF-VF-WF-No use, on the asphalt surfaces: NDWF-WF-No use-VF-AF, on the brick surfaces: NDWF-No use-AF-WF-VF and on the gravel surfaces: NDWF-AF-WF-No use-VF.

Figure 2: Figure 2 shows the average value and range of the decreasing rate of the peak pressure (DP) and the increasing rate of the contact area (IC) on textured blocks across five subjects. The DP from the highest was in the following order: VF-AF-NDWF-WF. The DP of the NDWF and WF were almost equal. The IC from the highest was in the following order: AF-NDWF-WF-VF.

Local Tissue Perfusion Recovery Using an Automated Seating System Featuring Dynamic Ischial Unloading

Mohsen Makhsous, PhD
Fang Lin, DS
Susan Taylor, OT
Mary Ziegler, RN
Diane Hartwig, RN
William Rymer, MD, PhD

ABSTRACT: Excessive pressure for extended periods of time deprives the tissues of oxygen and can lead to the formation of pressure ulcers. Current push-up regimens relieve the pressure briefly, but produce only limited recovery of oxygen. In an attempt to find a more effective solution, a new wheelchair seat design, characterized by unloading the ischia and supporting the lumbar spine, was evaluated by placing oximeters on the areas of highest pressure. Pressure was then reduced in the ischia either by performing the push-up routine or adjusting the position of the ischial and back supports. Results showed that using the new design allowed substantial oxygen and carbon dioxide recovery, while the push-up routine allowed only a brief recovery. KEY WORDS: Pressure ulcers, perfusion, wheelchair

INTRODUCTION: Individuals that spend extended periods of time seated, such wheelchairs users, can develop serious medical conditions. Prolonged sitting without proper repositioning results in excessive pressure over the ischial tuberosities and coccyx 1 and significantly increases the risk of pressure ulcers (PU). In turn, this imposes a tremendous burden in terms of cost and the impact on quality of life and the functional status of the long-term wheelchair-users. A new seat design, in which the back part of the seat (BPS) can be dynamically tilted downward with respect to the front part of the seat (FPS), was proposed by Makhsous et al. 2. It also includes additional lumbar support through a bladder adjustable in depth to provide back support. Two postures are presented with the design. The Normal posture is when the BPS is even with the FPS and the lumbar support is deflated. The WO-BPS (Without Back Part of Seat) posture is when the BPS is tilted down 20º with respect to the FPS and the lumbar support is fully inflated. The purpose of this study is, while using the new seating concept, to investigate tissue perfusion changes on the ischial tuberosities and thighs due to pressure redistribution, to measure the relief effect by sitting alternately between Normal and WO-BPS postures, and to compare alternately sitting between postures with the clinically recommended Push-up routine.

MATERIALS AND METHODS: Twenty able-bodied subjects (36.6013.24 yr; 71.8917.74 kg; 169.2713.24 cm) were tested. An instrumented wheelchair, of which the BPS can be tilted, was used. The angle of the BPS was controlled by a motor and had a range of motion of 20 downwards with respect to the FPS. The lumbar support was an air bladder that could be increased through a pump. A controller was used to change the posture. A pressure-mapping device (X2, Xsensor™ Technology Calgary, Canada) was used to measure interface pressure on the seat and back support. The Total contact area (TCA), average pressure (AP), and peak pressure (PP) were calculated on the seat. Transcutaneous partial pressures of oxygen (tcPO2) and carbon dioxide (tcPCO2) were chosen as the indices of tissue perfusion and were measured using three TCM3 monitoring systems (Radiometer, Copenhagen, Denmark).
The oximetry electrodes were placed at the left ischial tuberosity (IT), posterior side of proximal thigh (PT) and middle thigh (MT). Data was recorded continuously during two 60-minute protocols for each subject, of which the protocol sequence was randomly chosen. In the Alternate trial, the seat posture changed from Normal to WO-BPS at ten-minute intervals. In the Normal+Push-up protocol, the chair was kept at the Normal position; the subject performed the arm Push-up every 20 minutes. In between trials, the subject laid prone to allow perfusion return to reference level. Comparisons of the tissue perfusion level on each recording site, including the IT, PT and MT, were made between the two protocols and a paired t-test was used with the significance level as 0.05.

RESULTS: The average values of the tcPO2 and tcPCO2 for one hour sitting across all able bodied subjects for Alternate and Normal+Push-up trials at IT, PT and MT are given in Fig. 1a. Under the IT, the Alternate sitting protocol conserved significantly more O2 than Normal+Push-up (47.33±3.25 vs. 6.17±2.43 mmHg, $P<0.001$). At the same time, the Alternate protocol prevented CO2 accumulation (49.41±2.82 vs. 80.83±7.46 mmHg, $P<0.001$). No significant difference between the protocols was found at the PT, and MT.
While the sitting interface pressure was being released, the tcPO2 increased significantly ($P<0.001$) from 1.420.79 to 58.3120.36 mmHg. At the same time, tcPCO2 significantly decreased ($P<0.001$) from 84.3515.80 to 58.1311.00 mmHg. During the relief cycle, AP, TCA, and PP all decrease. After changing to WO-BPS, tcPO2 was further increased a total of 82.5112.07mmHg ($P<0.001$) and tcPCO2 was further decreased a total of 43.4511.80mmHg ($P<0.001$). The tcPO2 and tcPCO2 stabilized after Tw(O2)=156.8029.04s and Tw(CO2)=162.7033.37s (Fig. 1b), respectively. While changing the posture from the WO-BPS to Normal, the tcPO2 decreased and tcPCO2 was almost constant. After changing to Normal, the AP remained constant, while the tcPO2 went further down with a total decrease of 82.67 14.66mmHg ($P<0.001$). The tcPCO2 was slowly increased of 47.3522.30mmHg ($P<0.001$).

For the Normal+Push-up trial, the tcPO2 was significantly ($P<0.001$) decreased from 81.7712.90mmHg to 0.910.37mmHg at the start of sitting. The tcPO2 levels remained slightly above zero during the high-pressure period. Each Push-up had a mean time of TPS=48.4615.45s (Fig. 1b), during which the AP at the IT was changed from 71.7814.57mmHg to 9.458.47mmHg ($P<0.001$) and the tcPO2 was significantly ($P<0.001$) recovered to 18.2617.92mmHg but rapidly decreased to the same low level after each Push-up. The tcPCO2 was significantly ($P<0.001$)

increased from 45.0614.08mmHg to 80.2429.70mmHg at the start of sitting, and it significantly (P<0.001) decreased by 27.0014.23mmHg with each Push-up but returned to a high level after each Push-up.

DISCUSSION: During sitting, trunk weight is carried mainly by the ITs and their surrounding soft tissues5. Serious skin breakdown in the SCI population has been reported most frequently over the ITs, presumably because of the amount of time spent sitting combined with muscle atrophy and absent or impaired sensation3. The effectiveness of using the WO-BPS posture to reduce pressure over the IT has been demonstrated4and the results of this study show its benefits. The findings show that a reduction in pressure also correlates to improved perfusion, while compromised perfusion has been found to be an indicator of PU3. Sitting in the Normal posture gave higher average pressures than sitting in the WO-BPS posture. At the same time, while sitting in the Normal posture O2 was sharply decreased and CO2 was at a high level over the IT. Sitting in the WO-BPS posture significantly recovered tissue perfusion by effectively creating a low pressure environment over the IT. The relief effect from Alternate trial was significantly higher and lasted longer than that of the Normal+Push-up trial. Since the time required for recovery of both O2 and CO2 was over 150 seconds, while the mean Push-up time was 48 seconds, it can be concluded that the pressure relief achieved by a Push-up is far from enough for perfusion recovery. The Alternate protocol allows for a longer duration of pressure relief over the IT without straining the users arms and this pressure relief effect can last as long as the WO-BPS posture lasts. Further studies in clinical settings must be completed to determine the longterm effects of using this design.

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The Clinical Assessment and How It Relates to Technology

Sharon Pratt, PT

The focus of this series of posters is on the principles and biomechanics of seating, the assessment process and translating the assessment findings into generic product parameters. They summarize the steps often involved in the assessment process from initial client contact through the final equipment prescription. A clinical as well as technical viewpoint is presented.

Poster one –“ Pelvic and Spinal presentations” - details the most common postures found in the wheelchair seated client with suggestions on some of the clinical and technical reasons why one may be presenting with this posture.

Poster two- “Seating Shapes”- demonstrates how the assessment findings may be translated into seating shapes considering both the seat cushion and back support. Assessment goals for each body segment are highlighted with detail on some of the most important seat and back support shapes to consider – for example; pelvic contour width, depth and length as well as posterior pelvic/sacral support.
Poster three –“Seating and Wheelchair Angles”- reflects on how assessment findings may be translated into wheelchair and seating angles. Again assessment goals for each body segment related to angles are highlighted with a direct translation of the body angle to technology angle. For example the client angle “pelvis to thigh” – translates into “seat to back” angle with angles of greater than or less than 90 degrees discussed in terms of pros and cons. Also highlighted in this poster is the concept of orientation relative to gravity – with the message that all of these adjustments and considerations are inter-related, all effecting each other!

Review of Medical, Technology, and Psychosocial Issues for Persons With MS

Michael L. Boninger, MD
Rosemarie Cooper, MPT, ATP
Jean Minkel, MA, PT

Latest Update in Medical Treatment of Multiple Sclerosis (What are my patients taking and will it make a difference)

Dr. Boninger will present the latest information from the following references.

International Journal of MS Care
December 2002 Supplement
Milestones in the First Decade of Intervention: Effective Treatment Strategies in Multiple Sclerosis
Based on proceedings from the Annual Meeting of the Consortium of Multiple Sclerosis Centers
Contents
Pathology, Immunology, and Neuroprotection in MS
Mechanisms and Influence of MS Therapeutics
V. Wee Yong, PhD

MS Therapy: The Challenge of Selecting Optimal Treatment
Kenneth Johnson, MD

MRI in the Management of Multiple Sclerosis
Patricia Coyle, MD

Beyond Immunomodulating Therapy: Clinical Management of MS Symptoms
Patricia Kennedy, RN, CNP

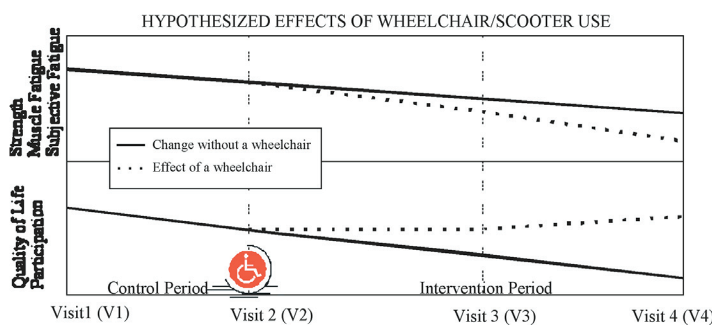
Current Research on AT &MS in Pittsburgh:
Problem Statement:
Multiple sclerosis (MS) is the most common cause of disability, other than trauma, in young adults. Although MS causes a wide variety of neurological deficits, ambulatory impairment is the most common form of resulting disability (Noseworthy et al, 2000). Within 15 years of onset, 50% of individuals will require assistance with walking (Noteworthy et al, 2000). Over fifty percent of patients with longstanding MS require assistance both in and out of the home (Baum & Rothschild, 1983). The basic nature of personal mobility is that it allows people to interact in their environment and society. Not surprisingly, Aronson (1997) found that reduced mobility was associated with reduced quality of life and reduced social activity in people with MS. Despite the connection between quality of life in MS and mobility, there is virtually no information available to guide decision-making for mobility interventions in this population (Fay & Boninger, 2002)

The fear of loss of strength and dependence on technology is a recurring theme in the debate about when a wheelchair should be used and what type of chair should be provided. Fear of becoming dependent likely leads to delays in wheelchair prescription, which may adversely affect quality of life and place individuals with MS at greater risk for falling. Clinicians and patients require more information when deciding whether to prescribe assistive technology such as wheelchairs. Recent work at the University of Pittsburgh Human Engineering Research Laboratories (HERL) has found that many individuals with MS who are using manual wheelchairs are ineffective at propelling them (Ambrosio et al, 2002). This award winning study, found, among other things, that many manual wheelchair users with MS could not propel their chair at a standard walking speed. This work further highlights the need for additional research in this important area.

Ongoing Work

The specific aim of our research is to assess changes in 1) health-related quality of life, 2) strength, 3) motor fatigue, and 4) self-reported fatigue as individuals with MS transition from ambulation to a wheelchair or scooter as their primary means of mobility.

We are conducting a longitudinal cohort study following individuals with MS who are referred for wheelchair evaluations. Changes are evaluated at four visits: V1 – at the time of wheelchair prescription; V2 – at or near the receipt of the mobility device; V3 – 2 - 4 months after the time of mobility device delivery, and V4 –eight months after receiving the wheelchair. The figure presents a model of how our hypotheses predict a wheelchair will impact an individual with MS. Between V1 and V2 we expect gradual declines in strength, quality of life, and participation in society caused by disease progression. Motor fatigue and self-reported fatigue are also likely to worsen during this interval. At V2, the subject is provided with a manual wheelchair, a power wheelchair, or a scooter. The theoretical effect of the mobility intervention is displayed by the dotted lines. We hypothesize that individuals who receive wheelchairs or scooters will have improvement in quality of life and self-reported fatigue and worsening in strength and motor fatigue.

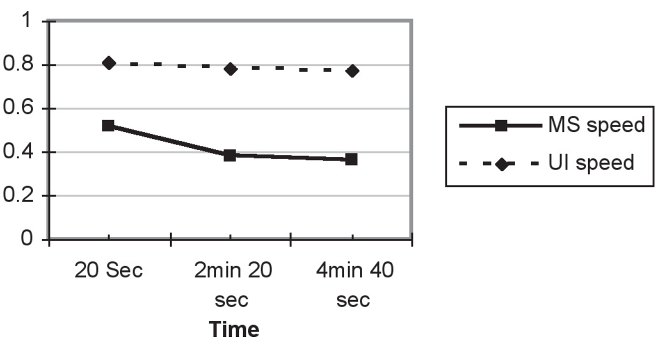


The Human Engineering Research Laboratory (HERL) contains both a VA Center of Excellence in wheelchairs and related technology and a National Institutes of Disability and Rehabilitation Research Model Center on spinal cord injury. HERL has been dedicated to advancing the quality of life in individuals with disabilities through assistive technologies such as wheelchairs. Recently, significant efforts have been made to characterize manual wheelchair propulsion in individuals with MS and to investigate factors contributing to a decreased satisfaction with wheelchair function in this population.

Completed Work

Investigators at University of Pittsburgh (Fay et al, 2001) were among the first to examine the biomechanics of wheelchair propulsion in people with MS. The purpose of this study was to compare the biomechanics of wheelchair propulsion in people with MS with other expert experienced wheelchair users. This study involved 15 manual wheelchair users with MS, 15 manual wheelchair users with a spinal cord injury, and 15 unimpaired individuals. For those subjects who used a manual wheelchair, their own wheelchair was secured onto double drum dynamometers via a four-point belt system. The unimpaired individuals were given a wheelchair to use from the laboratory. Subjects were asked to propel the wheelchair while kinetic data was collected. This study showed that individuals with MS propel their wheelchair significantly slower than control counterparts, and are actually unable to attain a target speed of 1m/sec, considered a standard for functional mobility (Fay et al, 2001). Furthermore, a fatigue trial (where subjects were asked to propel the wheelchair at a comfortable speed for 5 minutes) revealed that, not only do these individuals propel their wheelchair at significantly slower speeds when compared to controls, but also, they are unable to maintain this slow speed over a five-minute period (Figure 1). In fact, unlike control counterparts, the group with MS slowed down significantly during the trial (p= .024).

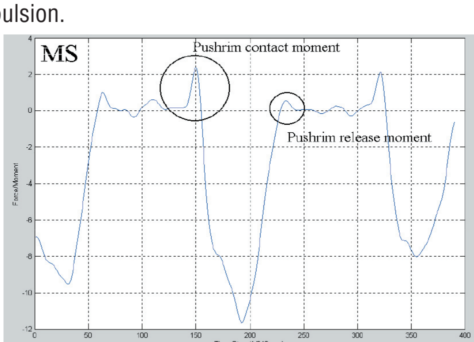
Figure 1: Comparison of speed and cadence in MS vs. unimpaired individuals (UI)



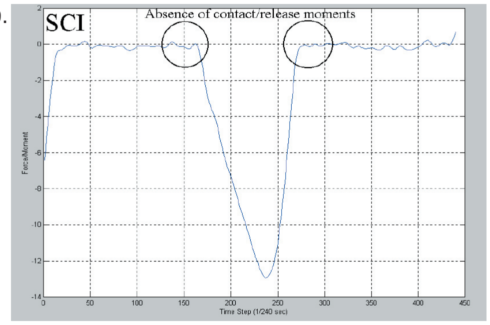
Kinematic analysis showed that these individuals propel their wheelchair in the least efficient propulsion style, expending more energy than control counterparts.(Boninger et al 2002) Kinetic analysis revealed that people with MS actually generated a "braking moment" with each stroke of the wheelchair (Ambrosio et al, 2002). That is, individuals with MS produced a moment opposite to the direction of forward propulsion, a characteristic not seen in control counterparts (Ambrosio et al, 2002)(Figure 2).

Figure 2 Typical moment about the Z-axis seen in a) individuals with MS and b) individuals with a spinal cord injury (SCI). A negative Z-axis moment represents a moment applied that contributes to forward propulsion.

a.



b.



Using the same patient sample, we investigated the ability of current clinical measures to predict the ability to functionally propel a manual wheelchair. Each subject underwent manual muscle testing, sensory testing, and spasticity as measured by Ashworth rating. It was found that these measures were not sensitive enough to predict functional limitations in manual wheelchair propulsion. Interestingly, the score rating from the Guy's Neurological Disability Scale (Sharrack & Hughes, 1999) was correlated with effective manual wheelchair propulsion. Since only three questions of the GNDS relate to upper extremity function, and these questions relate primarily to bilateral hand functioning and fine motor skills, a new area of investigation was revealed, raising questions about the correlation of strength, fine motor skills, and manual wheelchair propulsion.

Strength testing in persons with MS

We conducted a study investigating clinical and research measures of strength in individuals with MS. This study compared the correlation between the results of two different methods of strength testing and their sensitivity to detect functional weakness in people with MS. Upper extremity strength of 15 individuals with MS was studied using a Biodex machine (Biodex Medical, Shirley, NY) and was compared to a manual muscle test grade (MMT) (American Spinal Injury Association and International Medical Society of Paraplegia, 1996) as determined by examination. Findings revealed that the MMT results were not correlated with isokinetic measures of strength. In fact, MMT was found to greatly underestimate muscle weakness and did not have the resolution to detect disability. This indicates that the MMT may not be the most appropriate test for quantifying strength in populations with MS. However upper extremity strength on standard physical examination is commonly the determent factor when deciding between powered and manual mobility.

Relationships between quality of life and assistive technology

To investigate the correlation between mobility and quality of life, we collected pilot data on the effect of mobility device use on social participation in people with MS. In this study, questionnaires were administered to 19 individuals with MS, 8 females and 11 males. All subjects owned manual wheelchairs, and were further categorized based on their ability to ambulate and on the availability of powered mobility. Subjects were asked questions regarding the frequency of social participation in the last week. Social participation was defined as social activity including going to a party, going to the movies or theater, attending a religious or community event, attending a sporting event, and socializing with friends, family, and associates in different settings. This study revealed that individuals who no longer ambulated and had both power and manual wheelchairs were more likely to participate in social activities. This was an unexpected finding in that we expected individuals who ambulated to have less disability.

Researchers from the Department of Rehabilitation Science and Technology at the University of Pittsburgh have conducted a pilot study to measure the effects of individually prescribed wheelchair systems on outcome measures including quality of life (Trefler et al, in review). Subjects: 30 residents of a long term care facility, 60 years old or older participated in this study. Protocol: The SF-36 was used to measure health status. Questionnaires were distributed to the subjects three times: 1) before subjects were issued a new seating and mobility system, 2) immediately after the participants were issued a new system, and 3) three months after delivery of the system. In addition, subjects were asked to propel their wheelchair system on a level tile surface for 25 feet. The time to complete the course was measured during each of the three visits. Results/ Discussion: This study found that subjects became faster at propelling their chair after seating and mobility intervention. Individually prescribed wheelchair systems enhance independent mobility and quality of life in elderly individuals. Another interesting finding of this study was that the participants became more knowledgeable after intervention about choosing an assistive technology device, and features they feel to be important for their needs.

A measurement tool for recording manual and power wheelchair use
The impact an assistive device has on the life of its user can only be accurately assessed if some understanding exists as to how much the individual is using the device. The HERL has developed a data logger that attaches to manual and power wheelchairs and records movement activity (Spaeth et al, 2000). Movement sensing components allow the data logger to automatically begin recording when the chair is moved, and automatically "hibernate" when the chair is stationary. Using an onboard memory and a software program for data collection, the data logger is capable of recording speed, distances traveled, and the number of times in a day the individual is using their wheelchair. These variables may be collected for up to two weeks. The data logger has been shown to be reliable and accurate and has been used to investigate the driving characteristics of wheelchair users in the community (Cooper et al, 2002).

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Interfacing Assistive Technology Devices with Power Wheelchairs

Michelle Lange, OTR, ABDA, ATP

A wide variety of assistive technology devices can be interfaced to power wheelchairs, thanks to continued advances in electronics. This includes power tilt and/or recline systems, augmentative communication devices, computers and electronic aids to daily living. Interfacing streamlines access methods, so that one access method can control more than one device. For persons with limited access, interfacing can greatly increase independent control. This course will systematically explore how and when to interface assistive technology.

All assistive technology must be integrated. Integration is setting up multiple assistive technology devices to work together. For example, a communication device mounted to a power wheelchair should not obstruct the view for driving. Interfacing actually connects assistive technology devices electronically, usually for the purpose of streamlining access. Interfacing uses the driving access method to control other assistive technology through the power wheelchair electronics.

Interfacing can be rather confusing until you have a chance to try it out. Here are two examples. Susie is 9 years old and has cerebral palsy. She drives a power wheelchair with proximity switches built into her headrest. She also has a communication device that she controls with a switch by the left side of her head. Since she uses switches in the same location (left side of head), but for two different devices (a power wheelchair and communication device) she never uses the communication device while in her power wheelchair. Interfacing allows her to use the same switch for driving (left turns) and for communication (scanning). She presses a reset switch with her hand to change from Drive Mode to Communication Mode. Her access of the hand switch is inadequate for driving or controlling the communication device, but sufficient for simple mode changes.

Paul is 19 years old and has cerebral palsy. Before interfacing, he drove a power wheelchair with scanning, using a left head switch. He also used a communication device with the same left head switch. When he wished to communicate, his mother would unplug the switch from the power wheelchair and plug it into the communication device. Paul wanted a better method of driving, speed control, a power tilt system, access to his communication device and computer as well as control over devices in the home environment, such as the TV and lights. After extensive evaluation, four switch sites were determined - the left side of his head, under his right index finger and to either side of his right index finger. The finger switches (touch sensitive) were mounted in a splint. Through interfacing, Paul is able to use the finger switches to access various assistive technology devices and uses the head switch as a reset to change modes. His first mode is driving and the switch under his finger is his forward control. The switches on either side of his finger are for left and right directional control. The second mode toggles the forward switch to reverse. The third mode allows Paul to change his drive speed. The fourth mode allows access to the communication device using the left finger switch. The fifth mode controls the power tilt system, left switch for up and right switch for down. Paul accesses the computer and controls devices in the environment through his communication device, which can, in turn, be interfaced to a computer and an Electronic Aid to Daily Living. Obviously, Paul's system is very complex. He must be able to activate each of his switches accurately, monitor what mode he is in (through a display) and have good memory, sequencing and judgment skills.

Before interfacing electronics, it is important to evaluate whether a specific client can benefit from interfacing and has the skills required. Next, the appropriate equipment must be obtained. This usually consists of an interfacing component (i.e. Invacare COMM1,2 or Penny & Giles ACM) and the appropriate cables. The electronics must then be programmed to enable interfacing and customized to a specific client's needs.

(This paper was adapted from a series of articles written by Michelle Lange and edited by Adrienne Bergen for RehabCentral.com, now found at MedGroup.com)

Wheelchair is a Compound Word

Ian Denison, PT, ATP
Bonita Sawatzky, PhD

Clinicians and AT Suppliers spend countless hours refining positioning systems for their clients. Once perfected these elegant creations are often attached to the most convenient mobility platform that happens to have wheels. The Wheels and more specifically, tires provide a wheelchair's only contact with the floor. They transmit motive force, braking force, absorb shock and are responsible to a large degree in determining the rolling resistance. Until now we have done a masterful job of addressing the chair component of "wheelchair". This presentation will give you information to consider when considering the "wheel" component.

Tire Pressure
Over time tires loose air. Rubber is porous, valves leak. So check tires regularly. Every time the client sits in the chair he should give his tires a squeeze, if they squish even a little they need air. We have found that tires need to be inflated on a monthly basis to maintain adequate pressure.

Filling tires
It is very difficult to get adequate pressure in a tire using a hand pump, even a high-pressure hand pump. We recommend an electric pump (although they are quite noisy) or go to the gas station where the lines are normally maintained at 150 psi. Suggested maximum pressure is listed on the sidewall of the tires casing.

Valves
Most tubes are made of butyl rubber rather than latex. Tubes come with one of two kinds of valves, either Schraeder or Presta. A Schraeder valve is the type that is on your car and works the same way. A Presta valve is the type that you have to unscrew the top to actually open the valve to let air in or out. The Presta valve also requires its own adapter (about 3 bucks at a bike shop), so the air pump at your local gas station may not be very helpful to you if you don't have one. Most bicycle pumps are set up for Schraeder valves and come with the adapter for the Presta valve and lately some pump manufacturers have been making pump heads that fit both, no adapter needed. We prefer the Schraeder valve.
IMPORTANT – When ever you get a flat don't just pull the old tube out and put a new one in, try to check the tire for what caused the flat. Experience has shown whatever caused it may still be in there. Do a visual check first then carefully run your finger on the inside of the tire and check for protruding objects.

Tires
Manufacturers mix different additives with the rubber to achieve desired traction/wear characteristics. Generally, a softer formulation will give better traction, but at the expense of more rapid wear. Rubber is normally a sort of tan color, Tires are made black by adding carbon black to the mix. Carbon black considerably improves the durability and traction of the rubber in the tread area but is unsuitable for wheelchairs used indoors since it tends to mark.
Some manufacturers substitute a silicon compound for the carbon black. These tires usually have a grey tread. Whether silicon or carbon black provides better traction is subject to dispute.

Traction
Factors that determine the traction of a tire include: inflation pressure, rubber formulation, tread design, suspension, weight and the coefficient of friction of the floor.
Bicycle tires for on-road use have no need of any sort of tread features; in fact, the best road tires are perfectly smooth, with no tread at all! This applies to wheelchairs used on smooth hard surfaces. Treads can help improve off-road traction in two ways: On hard, irregular surfaces, the knobs of the tread can hook onto projections of the road surface, reducing the tendency to slip.
On soft, squishy surfaces, like carpet and grass or gravel the knobs poke into the surface, digging in for improved grip and increasing the surface area to help the tires "float".

Rolling Resistance
Rolling resistance determines the energy required to propel a chair up to speeds of about 2 metres per second, at which point air resistance plays an increasingly significant role.

Rolling resistance is the combined drag created by tires, casters and bearings. It stays fairly constant whatever the speed of the wheelchair.

The cause of rolling resistance is the combined deformation of the wheel, tire and road surface at the contact point. Energy is lost (and rolling resistance occurs) when these structures do not spring back elastically (hysteresis), failing to return all the energy to the wheelchair.

Rolling resistance is proportional to the total weight on the tire. Therefore, for a given user the tire/air pressure combination which produces the least deformation of tire, wheel and road surface will result in the lowest rolling resistance.

For example, a hard tire on a hard surface will produce hardly any deformation at all resulting in low rolling resistance. The same tire on soft ground won't deform but the ground will deform significantly, thereby increasing the rolling resistance. The higher the air pressure, the less the tire will deflect. We found that reducing tire pressure in a Pr1mo V Trak to 75%, 50% and 25% of the recommended pressure increased rolling resistance by 4.2%, 11.8%, and 32% respectively. The trade-off with this is that if you pump the tire up too hard, you lose the benefits of pneumatic tires: the ride becomes excessively harsh, and traction will be reduced. In addition, extremely high pressures require a stronger (heavier) fabric and stronger (heavier) rim flanges.

Wide treaded tires perform best on soft and/or rough terrain e.g. grass, snow, sand and gravel etc. On soft ground, the coefficient of friction is so high that a large contact patch spreads the weight over a larger area and produces a relatively low rolling resistance

Tire width and pressure are inextricably linked. It is a serious mistake to consider one independantly of the other. Generally, wider tires call for lower pressures; narrower tires call for higher pressures.

Footprint
The part of the tire that is actually touching the ground at any moment is called the "foot print" or "contact patch." Generally, the area of the contact patch will be directly proportional to the weight load on the tire, and inversely proportional to the inflation pressure. The stiffness of the tire walls also determines to some extent how the footprint increases with added load and reduced pressure. We found that reducing tire pressure in a Pr1mo V Trak to 75%, 50% and 25% of the recommended pressure increased the footprint to 140%, 190% and 320% of the fully inflated tire respectively.

Airless Tires
Of all the inventions that came out of the bicycle industry, probably none is as important and useful as Dr Dunlop's pneumatic tire. In the bicycle and automotive world airless tires have been obsolete for over a century, but they continue to thrive in wheelchair applications. They are heavy, slow and give a harsh ride. They are also likely to cause wheel damage, due to their poor cushioning ability. A pneumatic tire uses all of the air in the whole tube as a shock absorber, while foam-type "airless" tires/tubes only use the air in the immediate area of impact. We feel that people working in hazardous areas such as a workshop with many sharp objects on the floor is about the only person who will benefit from airless tires.

Semi pneumatic tires soak up water and can increase weight by as much as 10% when immersed in water. The water slowly seeps out of the foam as the chair is used on absorbent surfaces like carpets.

Energy Expenditure
Is closely related to rolling resistance which in turn is related to the size of the footprint. We found that the energy cost of wheeling at four different pressures with VT tires showed a 3%, 12% and 25% increase in energy cost of wheeling at 75%, 50%, and 25 % of recommended pressure.

The energy expenditure results are similar to those found in the rolling resistance study signifying that the increase in energy is primarily due to change in rolling resistance.

In our tests; pneumatic tire performance showed no statistically significant deterioration until pressures had decreased to 50% of the recommended value. Performance of solid tires is inferior to pneumatic tires even when they were inflated to 25% of the recommended pressure. This increase in rolling resistance directly affects users as shown by oxygen consumption tests. The tires inflated to 25% corresponded to almost a 25% increase in energy expenditure.

Cost
There is a misconception that the overall cost of pneumatic tires is significantly greater than solids. The initial purchase cost of the two tire types is comparable, with the solid tires being slightly more expensive. Complaints are also frequently expressed regarding the time required to maintain the pressure in the tires. Since wheelchair tires lose 10-25% of their pressure in the first two weeks and 25-40% after a month, pneumatic tires need to be pumped once per month to maintain adequate pressure >50%. In our experience, the frequency of punctures that a typical ECU resident might expect in a chair whose tire pressures are maintained at 50% or more is somewhere in the region of one every three to five years (tires are more likely to puncture if pressures are low). A typical resident may have to replace pneumatic tires after about ten years. Solids will last indefinitely.

A more active user might average two punctures per year and have to replace tires between one and two years.

Other Benefits of Pneumatic Tires
Pneumatic tires also have the extra benefits of a surface easier to grip during propulsion if they find the push rim too smooth, Pneumatic tires provide significantly more vibration dampening which gives the individual a smoother ride and decreases the vibration that often triggers spasms and pain (Gordon et at, 1989). This is particularly true in the spinal cord injured individual. And finally, the improved rolling resistance decreases the strain to the caregiver who is often pushing the chair longer distances.

So next time you help someone with a wheelchair order make sure that you consider the wheels.

Custom Contoured Seating: A Pediatric Lightweight System and an Adjustable Contoured Back

Delia "Dee Dee" Freney-Bailey, OTR/L, ATS

Introduction: A Pediatric Lightweight System

In the early days, most children were placed in adult wheelchairs expecting they would to "grow into" them. Seating consisted of pillows, pad and foam to fill in gaps. When the first pediatric wheelchairs were introduced they did not even allow children to self propel. Strollers, positional orthopedic wheelchairs, and safety travel chairs were designed for only the caregivers to push and transport in vehicles.

The current lightweight pediatric seating systems on lightweight wheelchair bases are fitting children better than when pediatric chairs were first introduced. They should be seen as a complete system, which includes the seating, mobility base and support products.

Ergonomics

During the past few years, researchers have found that injuries from long-term use of wheelchairs have become a major issue and much has changed with the prescription process of seating and mobility. Long term use of propelling wheelchairs has shown advanced deterioration of joints due to the weight and improper drive wheel positions.

When children are identified early as wheelchair users they may be committed to a lifetime of pushing. Not only are they pushing their own body weight but some present wheelchairs and seating systems weigh more than the child. Many seating systems have adult hardware that adds weight and bulk. The hardware often interferes with efficient pushing or cause skin problems. Materials in the seat and back cushions such as gel/fluid or full thickness plywood within the seating system add additional weight.

Proper propulsion by setting the wheels on an ultra lightweight wheelchair in the proper position gives users the best biomechanic advantage. According to research, changing the position of the rear wheels, the weight distribution and seat angle of the wheelchair significantly affected propulsion ergonomics concerning push frequency and stroke angle.

Mobility Base and Seating System

The use of lighter weight materials can allow the child to function as one with his/her mobility system. Rigid frame chairs have less flex than folding frames and often weigh lighter. One pediatric titanium wheelchair weighs as little as 7 pounds with the wheels removed .

Seating manufacturers recognize the many options of materials that are available and are taking a creative approach to integrating them into their seating systems. In using a variety of materials many custom creative seating options can be explored.

In customizing a mobility system, honeycomb sheets and foam cushions are creatively interfaced with other positioning products to provide a variety of solutions for clients with simple to complex seating needs.

The use of honeycomb as a seat cushion, honeycomb sheets for pressure points or as a breathable upholstery option are lightweight, anti-fungal and anti-bacterial. Many seating components such as lateral trunk supports, headrest and calf supports can be lined with honeycomb sheets to give a total lightweight seating package. This material has been effectively used when moisture or humidity is a concern. The honeycomb's design is also an advantage when the client has incontinency issues.

Clinicians and providers can take a pro-active approach to pediatric postural support by using a custom contour seating system designed for the orthopedically challenged child. A strong, yet light 1/4 birch multi-ply and ABS reduces both the weight and thickness of each upholstered component.

Smaller pediatric hardware allows more adjustability and more refined placement of components on the seating system. Providers will have more options and fewer challenges when dealing with multiple positioning needs for the pediatric client.

There is a complete line of pediatric hardware available designed with a child's proportion in mind. Smaller and lighter pediatric hardware can be scaled to fit as small as a 9 inch wide seating system. The hardware incorporates quick-release attaching components, modularity, and is manufactured from aircraft-grade aluminum.

The Adjustable Contoured Back

The second part of this presentation is a creative solution for the orthopedically challenging clients who need a contour back on an attendant pushed mobility base. Most contour backs that accommodate fixed deformities have little or no ability to change once the mold is fabricated. This dynamic adjustable contour back would be appropriate for pediatric clients with growth considerations or clients who have changes in their orthopedic status.

Evaluation

During a mat evaluation review the client's posture and position in supine as well as sitting on a firm surface. If the client presents with a scoliosis, lordosis, back asymmetries or rotation, most planer back cushions will not fully support this type of back.

Many clients appropriate for this type of adjustable contour back have existing molded back inserts that did not meet their needs. These clients had minimal contact on the surface of these contoured backs and had either grown as children or changed from the original molded shape.

Present options for custom contoured backs are custom molding using plaster or a positive molded shape, foam in place, matrix and a system using adhesive coated foam pellets inside of a flexible enclosure.

Replacement of custom seating systems usually require resubmission for funding. Correctional
re-molding will take additional time, costs and the client won't be sitting comfortably until the final fit and product is delivered. This may be a minimum of 4-6 weeks or more depending on the skill of the clinician and provider.

The problems seen in case studies were as follows:

- Present system outgrown
- Needed a seating system that could accommodate client with and without TLSO
- Severe rotation of back that no longer is supported by contoured back cushion
- Severe scoliosis that progressed and contoured back cushion no longer appropriate
- Present seating system in power chair did not meet parents needs for easy transport
- Dependent mobility client got hands stuck in large back wheels
- Fatigue due to back not being fully supported for limited out of bed time
- Present back cushion "pushed" client into more flexion as planar back did not accommodate for deformities
- Poor support allowed child to lean heavily on to lateral trunk support
- Present manual wheelchair and custom molded seat system too heavy for mother to push

Manual Attendant Pushed Base

The foldable frame is a manual attendant pushed mobility base. The seating is at a 30 degree of fixed tilt. When the frame is folded, it compactly fits into most trunks. Once opened, the solid seat with its many positioning options attaches to the frame.

Lateral hip guides, lateral trunk supports, abduction wedge, abduction straps, chest straps and auto type seat belt are attached to the seat and frame. The footplates have optional foot positioners that have a secure criss-cross design to hold both shoes and feet securely. A headrest with multiple adjustments in height, rotation and slight offsets is attached on the frame.

All hardware is adjustable and should be set prior to client sitting in the chair. Footrests should be also set to support feet in its proper height adjustment. Angle adjustable footplates are also an option.

This attendant pushed mobility base is not crash tested.

Seating System and the Adjustable Contoured Back

The seating system that has a solid seat with optional seating components as mentioned above and the adjustable contoured back is depth adjustable to accommodate a variety of shapes.

The standard seat cushion is a foam cushion on a solid base with attaching hardware. The seat cushion cover has a zipper to allow alternate types of seat cushions. Optional seat cushions of various materials such as air, other foams, honeycomb, fluid, gels or other materials can be inserted. Also, any customization of the seat cushion such as leg length discrepancy cuts or pelvic obliquity pads must be done after market. However, in our case studies we found most of the clients used the standard foam seat cushion successfully.

Padded upholstery covers the back contouring strapping system. Client's who have been checked after 45 minutes of sitting have not shown any skin pressure marks from the straps. Clients with expressive language had given feedback stating that the back cover was very comfortable.

Once the cover is unzipped and untied, the adjustable contoured back and its unique strapping system is exposed.

The patented "Cat's Cradle" concept allows the back strapping system to conform to the client's back in multiple planes. Cam locks allow the straps to start out loose and once the client is in the chair the straps are tightened beginning at the pelvis level. The outside color coded straps are tightened and secured to give support of the back at all levels. Once the outside straps are tightened, the inside straps give a rotational component to adapt to various deformities in client's backs.

Butterfly buckles allow the inside straps to move along the outside straps to conform to the client's back. Once all the straps are secured and ends of the straps are tucked inside, the zippered cover is secured.

Headrest should be finely adjusted to support the head at the occiput.

Case studies

A variety of clients of diagnosis and ages will be presented. The youngest client evaluated was a 7 year old girl with Rhett Syndrome. A teenage boy and a teenage girl with cerebral palsy with spastic quadraparesis were fitted as well as a teenage girl with 7Q Syndrome. Many adults with a variety of diagnosis including CP with a severe scoliosis, spinal fusion, and microcephaly were successfully seating and accommodated in the adjustable contoured back.

Conclusion

Goals accomplished with this adjustable contour back on an attendant pushed mobility base were:

- Improved postural alignment
- Provide pressure relief
- Accommodate and/or minimize deformities
- Relieve pain/increase sitting tolerance
- Improve head position/visual field
- Accommodate joint limitations
- Allow for growth/weight gain
- Provide mobility
- Reduce tonal influences
- Provide stroller base for caregiver for ease of use in community
- Provide comfortable seating

Once the hardware and supports on the seating system was set to fit the client, set up the time to adjust and fit the back took an average of about 20-25 minutes. The therapist and suppliers of the case studies stated that their clients appeared more relaxed, looked comfortable, was well supported and future adjustments would be simple to do if the client were to change his/her orthopedic or postural status. Those clients who were able to give verbal feedback stated they were very comfortable, it was very relaxing and being in it was like getting a big hug.

In the future, another possible application may be for a serial correctional back support system on those appropriate clients. There are many possibilities of application for this unique adjustable contoured back system.

Place and meaning of sit load analysis software (SLAS) in diagnostics and treatment of sit complaints / impairments

J. de Vries, MD, PhD

1. Target group for the application of sit load analysis (SLAS):

Near to fully wheelchair bound patients:
- With chronically or repetitive (wheel)chair-sit-complaints / impairments.
- With a large risk on the occurrence of sit-complaints / impairments.

2. Main target diagnosis groups:

Children:
spina bifida, M. Duchenne, spastic tetraparesis.
Adolescents / adults:
neuromusculair diseases, severe poliomyelitis, M.S. , contusio cerebri, spinal cord laesion, amputation (both sided) /hipexarticulation/ hemipelvectomy, mutilating reumatism; beside that the same diagnosis groups as in children.

3. Sitting in (wheel)chair:

When seated, the body weight (weight of head/arms/trunk/buttocks) is transferred on to the contact areas (seat/back) of the (wheel)chair which the body is in contact with. The body functions hereby as a force divided over a contact area. Force divided by Area is equal to Pressure. The force is generally not perpendicular to the contact area. Therefore the force can be divided in a vertical (normal) and a horizontal (shear) force. In connection to this a vertical (normal) pressure and a shear pressure can be distinguished.
The force (normal/shear) of the body weight on to the seat/back results in a force and pressure on the local tissues. This force and pressure (normal/shear) acts on the seated body and comprises cq. deforms the soft tissues. Depending on the size and the duration of the local pressure this can cause pain complaints.
Depending on the size of the local pressure the micro-circulation also can be compressed (risk on this in pressure values of more then 60 mmHg present to an increasing extent and certainly present when above the 100 mmHg). This can, depending on the duration of the occlusion of the local micro-circulation, lead to reversible or irreversible damage to the soft tissues/skin.
The product of pressure by time is called load.
The shear force causes primarily that the body moves in relation tot the seat / backrest (sliding away in the chair underneath or to the side) = sit instability.
This sliding away in the chair depends on the friction coefficient between body and chair and the contours of the seat/backrest. Furthermore the shear force can cause a (painful) shear of the skin/weak tissues cq. the micro circulation. Whether or not this leads to complaints/pain cq. impairments (decubitus) depends on the size and the duration of the executed shear.

- Wheelchair sit complaints/impairments:

Most occurring wheelchair sit complaints are:
- Pain
- Feeling of sit-instability
- Tiredness.

Most occurring sit-impairments are:
- Pressure ulcer threat
- Pressure ulcer
- Sit-instability

The above mentioned wheelchair sit-complaints/impairments are caused by an excessive tissue loading (= product of pressure versus time) during sitting. An excessive tissue loading results in pain, pressure ulcer threat or a pressure ulcer (e.g. pain or a pressure ulcer at the location of an ischial tuber). A feeling of or a real sit instability (with complaints of tiredness) is the result of the fact, that in sit the the line of action of the body weight is not perpendicular (not vertical) to the seating surface, resulting in a shear force. Seated healthy people are capable to actively correct the occurring body shifts by sitting in different positions. Wheelchair bound persons with a non or less functioning body (passive sit) cannot actively make the necessary corrections with as a result sliding away in their chair (underneath or to the right or left).
In conclusion the main wheelchair sit complaints / impairments have a load related character

4. Empirical treatment of (wheel) chair sit complaints/impairments by (wheel) chair sit-provisions.

The empirical treatment of (wheel) chair-sit provisions consists out of the application of standard (wheel) chairs seats/backrests or custom made (wheel)chair sit provisions (= sit orthosis) in one or two parts (separate seat and backrest).
As far as the standard (wheel)chair sit provision is concerned no product information is provided in respect of the efficacy of the specific seat/backrest of the (wheel)chair on sit- complaints / impairments. The applications of the standard (wheel)chair sit provisions occurs via the wheelchair dealer solely on the basis of experience, thus empirical.
The same applies to the manufacturing of the custom made seats (sit orthosis).

Moulding of the custom made seating (sit orthosis) occurs by means of the vacuüm-beads method.
The moulding method is thereby totally up to the sit orthosis builder.
The sit orthosis builder tries to offer a solution for the treatment of the (wheel)chair sit-complaints/impairments on the basis of his experience.
The moulding of the sit orthosis occurs without factual insight in the size and the direction of the sit load (responsible for the sit complaints /impairments).
The sit orthosis-builder is primarily a technician with mainly knowledge of material and construction of the (wheel)chair sit provision. His knowledge regarding the treatment of the medical problem meaning the (wheelchair

related) physical sit complaints/impairments (medical (pathology, anatomy, kinesiology cq. biomechanical knowledge) is limited.
Thus the medical (wheelchair) sit complaints/impairments are treated empirically by a non-(para) medical (wheelchair technician/sit orthosis-builder) person.

The empirical treatment of wheelchair sit complaints/impairments in the target group (see above) shows that this form of treatment in approximately 30% of the cases does not lead to the wanted solution (complaints /impairments stay or come back). The treatment by trial and error cost a lot of time and money. Furthermore there is a negative influence on the quality of life of the patient client (can e.g. only sit up for a short time or need to rest in bed frequently).
The result of the empirical treatment show however an incomplete picture in relation to the presence of wheelchair sit complaints/impairments. Often the target group does not or insufficiently mention the present complaints/impairments:

- Pain at the bottom "is part of the game"; red buttocks "cannot be avoided"; sliding away "had that always, I just need to be put back again in the right position", being restless "is part my character", etc.

The present treatment providers (wheelchair technicians/sit-orthosis builders) only provide solutions for a small part of the sit complaints/ impairments.

5. Objective treatment (wheel) chair sit complaints/impairments by (wheel) chair-sit provisions.

Sit pressure measurement / sit load analysis

- Sit pressure measurement

Since approximately 10 – 15 year it is possible to obtain sit pressure measurement data by using a pressure measurement system (seat and back mat; registration/elaboration/re [presentation-software). On line insight can be obtained about the local pressure values (only normal pressure!), the pressure distribution cq. the contact area (= number of sensors with a pressure value).
A pressure measurement in the time however can be elaborated and gives insight (in respect of the measurement time) in the maximal pressure and the average pressure per sensor. From a medical point of view – sit complaints/impairments are "pressure/load related"- there is however a need for insight in the size and the direction of the sit load. Beside that it is necessary to distinguish between a critical (needs treatment!) and a non-critical sit-load.
With the help of present sit pressure measurement systems above mentioned insight in the sit load cannot be obtained. Therefore the added value of the present pressure measurement systems in respect of diagnostics and also treatment of (wheel) chair sit complaints/ impairments is limited. By wheelchair dealers/sit orthosis-builders sometimes a pressure measurement system is used. This because it shows "sit pressure pictures" (= sales element!) more then professional (content) considerations (see below).

- Diagnostics: combination of sit pressure measurement and sit load analysis (SLA) .

As already concluded sit complaints/impairments can be related to the size and the direction of the load. The size of the load can be quantified as the product of pressure versus time (e.q. the local pressure in the time at the location of the sacrum).
The Centre of Mass of the trunk is starting point for the line of action of the reaction Force. This line of action of the reaction Force determines the direction and the magnitude of the body shift on the seating surface (= sit instability). As there is a mathematical relationship between the COM and the COP the direction and magnitude of the body shift on the seating surface (= sit instability) can be quantified by calculating the COP deviation changes.
The above mentioned outcome requires pressure measurements during a certain period of time and with a certain frequency. Research showed, that 3 sit pressure measurement intervals of 1 minute should be taken. The time in between the intervals should be 14 minutes, meaning that the sit pressure is measured in the 15e, 30e and 45e minute. In this way representative data can be obtained
In order to be able to relate intra- and inter individual measurement data for comparative reasons only protocol led measurements can be used. As sitting is the kinematic function of back, pelvis, hip and knees the pressure measurements should consists out of simultaneously measure back and seat.

Via the above mentioned diagnostic sit pressure measurement in the time and application of the SLAS objective insight can be obtained in the extent of the local tissue load, e.g. at the location of the sacrum. The sit load analysis software (SLAS) has been developed especially to make clinically relevant judgements of sit pressure measurement data (in the time) possible. Insight in the local tissue load of the bottom/back obtains a clinical meaning when a non-critical (=safe local tissue load) and a critical load can be distinguished, meaning a local (over)load responsible for pain, pressure ulcer threat or decubitus.
Through research (within the framework of the development of the SLAS) it has been determined that there was:
- a non-critical load when independent of the time duration the pressure is <60 mmHg
- a moderate-critical load when more then 20% of the time there is a pressure value of >60 mmHg and < 100 mmHg.
- a manifest critical load when more then 20% of the time there is a pressure value larger of >100 mmHg.
By applying the SLAS it is also possible to obtain insight in the presence of a local overload on a specific area of the bottom

Furthermore insight can be obtained in the extent of shifting of the body load over the x and y direction of the COP in the time. When this shift in the x/y direction is more then 0,2 cm in 45 minutes there is a functional hindering sit instability (often referred to in terms of complaints of being very tired).

In sit it is necessary to use an as large as possible percentage of the body surface (back, bottom, upper legs) to transfer the bodyweight on to the seat/back of the (wheel) chair. When this percentage is larger the pressure becomes lower. Also the larger contact surface of bottom/upper legs influences the sit stability in a positive manner.
Research shows, that a contact% of bottom / upper legs of at least 75% is normative.
For the back this is 30%. With help of the SLAS the factual contact% of bottom/upper legs and back can be calculated.

As a result it is now possible to obtain objective (diagnostic) insight in the nature and the extent of sit complaints/impairments by application of a combination of protocol led sit pressure measurement (in the time) with a sit pressure measurement system and the validated SLAS. It can be determined if the sit complaints have a load related (size/direction) character and if so what the urgency is.

- Treatment of load related sit complaints/impairments in respect of sit pressure measurement/ sit load analysis (SLA):

In the previous mentioned the empirical treatment of wheelchair sit complaints/impairments is often short coming. It lacked up till now medical objective starting points (diagnostics) for n in medical terms responsible treatment by means of a (wheel)chair provision. Via a diagnostic sit pressure measurement/analysis the necessary insight can now be obtained (see earlier).
This insight needs to be used in the medical treatment of a (wheel) chair sit provision. On the basis of the applied insight (in size and direction of the load) and the bio-mechanical translation thereof the treatment of sit complaints/impairments has become a medical treatment meaning a treatment that needs to be directed by the medical profession. The sit orthosis-builder lacks the necessary medical knowledge. The orthosis-builder is a technician who shapes the medically determined solution to the sit problem (as in prosthetics or orthopaedic shoes).

The above mentioned makes that the following working method in the realisation of a pressure/load related (wheel) chair sit provision is needed: On the basis of data of the diagnostic sit pressure measurement/sit load analysis the medical profession provides a sit receipt. This sit receipt is directed towards a from a pathology/bio-mechanical point of view establishing adequate sit stability in combination with a safe sit load. Starting with the receipt it is determined which type of sit provision needs to be applied:

- adaptive modular sit provision or
- an tailored to (body) size sit provision(= sit orthosis)

In the application of an adaptive modular sit provision (semi-orthopaedic seat / backrest) adaptation are made towards standard sit components on the basis of the medical receipt and they are judged on their efficacy by applying a sit pressure measurement/sit load analysis (SLAS).
When necessary complementary adaptations take place (stability/load-controlled) until a satisfying sit solution has been reached. Above mentioned adaptation trajectory is a joint venture of the medical profession (directs the treatment!) and the wheelchair technician.

In the application of a sit orthosis the moulding takes place with the vacuüm bead-method by means of application of a sit pressure measurement/sit load analysis via the SLAS. This means that on top of the vacuüm-bead bags sit pressure sensor mats are put. This makes it possible to mould load related (by the sit orthosis builder) which is again conducted by the medical profession on the basis of a by the medical profession made sit-orthosis receipt. When an adequate situation has been reached and the sit orthosis is “stable” meaning within the norm given by the SLAS the plaster of mould can be made and the sit orthosis been build. In conclusion the medical profession is responsible for the medical directing of the technical moulding of the sit orthosis and the result. Also here one can speak of a combined activity of the medical professional and the wheelchair technician/sit orthosis builder.
The sit orthosis is judged again on its maintained stability when put to trial with the patient. Via a sit pressure measurement/sit load analysis it is again judged on its efficacy (receipt) and adjusted as often and as much as necessary until an adequate solution has been reached. This from a functional medical as well as a technical point of view.

Functioning Everyday With A Wheelchair (Few): Applications For Assessing Wheelchair Function In Clinic, Home, And Community Environments

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Background

The trend of increasing consumer needs, demands for wheelchair seating and mobility services, technological improvements, and lack of sufficient funding for many consumers has made it necessary for practitioners and researchers to provide evidence that seating-mobility interventions are effective. Outcomes data provides a means for consumers to measure the effectiveness of technology in meeting their needs, assist providers in justifying their assistive technology recommendations and efficacy of their service delivery program, and allow payers and insurers to ensure that effective services were purchased. Therefore, to provide the necessary data, valid and reliable outcomes measurement tools that specifically measure consumer-generated functional outcomes of seating-mobility interventions must be available.

Although a significant increase in assistive technology use and advancement exists, a scarcity of evidence remains on the quantitative benefit and efficacy of seating-mobility technology and service delivery. Presently, the assistive technology community has a handful of instruments that measure outcomes related to key areas, including:

(1) Functional wheelchair use
- Functioning Everyday with a Wheelchair1-3 (FEW)
- Wheelchair Physical Functional Performance4-5 (WC-PFP) Test
- Wheelchair Users Functional Assessment6 (WUFA)

(2) Person-technology match
- Assistive Technology Device Predisposition Assessment7-8 (ATD-PA)

(3) Psychosocial effect of technology
- Psychosocial Impact of Assistive Devices Scale9-10 (PIADS)

(4) User satisfaction
- Quebec User Evaluation of Satisfaction with Assistive Technology11-13 (QUEST)

(5) Wheelchair skills
- Wheelchair Skills Test14-16 (WST)

Purpose of Instruments

Two performance-based instruments were designed to match the Functioning Everyday with a Wheelchair (FEW), a valid and reliable self-report questionnaire to measure functional performance of individuals who use a manual wheelchair, power wheelchair, or scooter. The FEW–Capacity (FEW–C) and FEW–Performance17 (FEW–P) are criterion-referenced, performance-based observation tools used by practitioners and researchers to measure functional performance of seating-mobility users at a single point in time, and if administered repeatedly, over a period of time. Both instruments were structured based on the Performance Assessment of Self-Care Skills18 (PASS), and were designed to measure function based on the International Classification of Functioning, Disability and Health19 (ICF) constructs of capacity (FEW–C) and performance (FEW–P). The FEW–C focuses on consumers' functional performance of activities in a controlled clinic or laboratory environment, and the FEW–P focuses on consumers' functional performance of activities in their actual home or community environments.

The FEW–C and FEW–P consist of 10 items, which are identical to the 10 FEW items. There are a total of 34 subtasks with a range of 2-6 subtasks for each item. In general, the length of time to administer the 10 FEW–C or FEW–P items is 45-60 minutes. The length of time will vary for several reasons, including the number or types of subtasks administered, environmental constraints, and any factors affecting how a consumer performs a task in a standardized environment or in their actual environment.

FEW–C and FEW–P Items	Direct Observation	Self-Report
1. Wheelchair stability, durability, and dependability	X	X
2. Comfort needs	X	X
3. Health needs	X	X
4. Personal and public transportation	X	X
5. Operate wheelchair/scooter	X	
6. Reach and carry out tasks at different surface heights	X	
7. Transfers	X	
8. Personal care tasks	X	
9. Indoor mobility	X	
10. Outdoor mobility	X	

Administering and Scoring the FEW–C and FEW–P

As criterion-referenced instruments, the FEW–C and FEW–P can be administered in total, or selected tasks can be individually administered or combined. The FEW–C is administered in a clinic or research laboratory (i.e., standardized environment) by a trained examiner. The FEW–P is administered in a home or community environment (e.g., house, apartment, assisted living facility, nursing home, group home, dormitory, worksite, volunteer site) by a trained examiner. It is not necessary to follow a specific testing sequence when administering these instruments.

The performance-based items yield three distinct category scores for independence (I), safety (S), and quality (Q) based on a predefined 4 point ordinal scale. Scores range from 3–0 with 3 = (I) completely independent, (S) safe practices observed, and (Q) quality standards met to 0 = (I) continuous physical assist or total assist given, (S) severe safety risks requiring action, and (Q) quality standards not met. A unique component of the FEW–C and FEW–P involves the examiner providing hierarchical levels of assistance (verbal assist, visual assist, or physical assist) to facilitate task initiation, continuance, and completion. For example, if a participant was moving his or her wheelchair and was about to bump into an obstacle, you could provide a verbal assist to alert him or her of the obstacle, or give a physical assist by touching him or her to stop them from bumping into the obstacle. This method differs from other measures in that there is often no interaction between the examiner and the participant (i.e., you simply provide the instructions and score what you observe).

Strengths of the FEW–C and FEW–P Instruments

- In comparison to other available seating-mobility outcome measures, the FEW, FEW–C and FEW–P provide the most standardized system of assessing self-report and performance-based functional wheelchair use in clinic and home or community environments.
- Unlike any other available seating-mobility outcome measure, the FEW-C and FEW-P provide hierarchical levels of assistance that can help identify the nature and severity of problems consumers experience using their wheelchair.
- Provides valuable information concerning the:
  - Activities wheelchair users do perform and cannot perform
  - Strengths of their activity performance
  - Level of independence, safety, and quality a consumer demonstrates during an activity
- Ideal for examining pre and post seating-mobility interventions to determine what solutions were most effective in meeting a consumer's needs to function in their environments.

Subtask: Carpeted Surface

		INDEPENDENCE DATA			SAFETY DATA				QUALITY DATA				SUMMARY SCORES			FEATURES		
	Based on the *__size, fit, postural support, and functional features__* *of the wheelchair /scooter:* Mobility Device used during task: ☐ **Manual** ☐ **Power** ☐ **Scooter** Assistive Technology Devices (ATDs) used during task: 1. 2. **Total # of ATDs used: ____**	Verbal Assist	Visual Assist	Physical Assist	Safe practices	Minor risk- no assist	Risk- potential harm	Severe risk- prevent harm	Standards met	SM, Improvement possible	Standards partially met	Standards not met	INDEPENDENCE	SAFETY	QUALITY	STABILITY	DURABILLITY	DEPENDABILITY
		VA	V^{S}A	PA	SP	MR	PH	SR	SM	IP	PM	NM						
	FEW–C/FEW–P Subtasks																	
1.	__Travels from and returns to starting location following course identified by therapist adequately__ (maintains appropriate speed/propulsion for terrain, does not bump into or scrape body parts on surrounding surfaces, maintains balance, avoids obstacles) and __efficiently__ (does not need to stop, back up, etc., controlled manner)	**VA** **VA** **VA**	**V^{S}A** **V^{S}A** **V^{S}A**	**PA** **PA** **PA**	**SP**	**MR**	**PH**	**SR**	**SM**	**IP**	**PM**	**NM**	**3** **2** **1** **0**					

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Seating, the Next Generation

Joan Padgitt, PT, ATP
Thomas R. Hetzel PT, ATP

People with disabilities are living longer. Baby boomers are coming of age and acquiring disabling conditions at an increasing rate. Ironically, improved prenatal care, neonatal care and living conditions have increased the number of children with congenital disabilities, and they are living longer. Improved trauma and ER care has increased the survival rate of people with traumatic injuries, and improved long-term management of secondary or co-morbidity factors has significantly decreased their mortality rate. Wheeled seating and mobility providers are now faced with supporting the largest-ever generation of people aging with severe disabilities. This is the challenge.

As people age with disabilities that impair mobility, their needs for wheelchair seating and mobility solutions become more complex. In the case of acquired or traumatic injuries, early intervention has emphasized support of good skin integrity. Traditional seating interventions utilize a variety of designs and materials with the emphasis on distributing pressure evenly over the surface of the cushion support and, to some extent, controlling shear forces. To do this, a material must conform to body shape and bony prominences, and respond dynamically to movement and shear. Unfortunately, the more effective a material is at distributing pressure and controlling shear, the less effective it is at supporting postural stability. Imagine trying to walk on an air or water bed and you will understand the impact these materials have on postural control.

Aging paraplegics who have had success with traditional seating technologies are developing severe over-use syndromes of the upper extremities, chronic pain and deterioration of postural alignment and control. Their skin's tolerance of pressure, no matter how well distributed, diminishes with age. In addition, deteriorating functional independence and postural issues become superimposed over severe and chronic skin problems, and people often lose their ability to sit. It is not uncommon to meet formerly active and independent paraplegics, fifteen years post-injury, relying on power or power-assisted mobility, tilt and recline systems, overhead lift systems for transfers and modified minivans for transport.

The mobility side of the industry is doing a relatively good job at introducing new and/or enhanced manual, power, and power-assisted wheelchairs with or without power seating options. The seating industry, however, has developed few significant improvements for addressing the constellation of seating challenges faced by people aging with disability. Good pressure distribution through use of foams, gels, fluids and air most often comes at the price of postural stability. The consumer and seating practitioner are forced to choose between skin OR posture. But if the provided system results in skin breakdown, it can't be used. Skin always wins.

More aggressive custom contoured systems may provide a better platform for postural control but are not appropriate for high-risk skin clients due to the systems' inability to respond to postural dynamics and positioning error. Imagine a cushion made by having the consumer sit in wet concrete. In its liquid state, the concrete will flow to conform to body shape. Once it solidifies it will match the exact shape of the consumer's bottom at that point in time. Now imagine moving even subtly within the contours of that custom seat. What happens? The relationship of bony prominences to the contours of the seat changes, and the result is increased loading of at-risk areas and unloading of areas that should be supported. Movement within the shape increases shear and thus the risk of skin break-down. This is how conventional contoured seating performs. It has little to no ability to accommodate change in a person's activities, weight, tissue atrophy, posture and functional skills.

Conventional contoured seating systems are also hot and non-breathing. Heat and moisture are gaining on pressure and shear as primary risk factors for skin breakdown, yet few wheelchair seating systems effectively reduce heat and moisture build-up at the seating interface.

In a perfect world nobody would need a wheelchair. But in this imperfect world, wouldn't it be better if people could have wheelchair seating that is built uniquely for them? That achieves optimal skin integrity and postural control without compromise? That is breathable to keep them dry, and also help them stay warm in the winter and cool in the summer? That doesn't weigh much at all? Why not construct it in a way that ensures an accurate fit to the wheelchair to further enhance the user's balance, control and mobility? Why not make it capable of changing as a consumer's needs change?

All these goals can be achieved by presently available techniques and materials. Transfer of material technologies from other industries, coupled with orthotic and prosthetic principles, has created seating options that can be uniquely applied to each consumer. These products can promote good skin Integrity without compromise of postural control. The cushion material can be breathable, thereby reducing heat and moisture build-up. Information about peoples' shapes can be captured in their wheelchairs, not in simulators detached from mobility, ensuring optimal functional performance. Though currently available on a very limited basis, this material-savvy, orthotically informed approach will define the future of seating and mobility.

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Impact of Long Term Sitting in the Spinal Cord Injury Population:
Effects on Posture, Pulmonary Function, Skin Integrity and Quality of Life

Amy Bjornson, PT, ATP

Overview
- Incidence, Morbidity
- Past Medical Management: Surgical, Medical
- Current Medical Management: Surgical, Medical

Therapeutic Management
- Therapies: PT, OT, Respiratory
- Assistive Equipment

Outcomes – Retrospective Analysis

C6 Tetraplegic 26 years post
C5 Tetraplegic 8 years post
C7 Incomplete 5 years post
C2 Tetraplegic 7 years post
C7 Quadriplegic 15 years post
T8 Para 7 years post

- Pulmonary System
  - –General Health
  - –Tidal Volume
  - –Inspiratory Flow
  - –Chest Excursion

- Posture
  - –Seated Height
  - –Chest Width
  - –Seat Depth

- Skin Integrity
  - –Incidence of Breakdown
  - –Cause
  - –Effect

- Function: Activities of Daily Living
  - –FIM scores
  - –Function Tests
  - –Subjective

- Subjective Quality of Life
  - –Translation to Therapeutic Intervention
  - –Translation to Seating System
  - –Translation to Mobility Device

Modification of a Seat Digitizer to Accommodate Significant Musculoskeletal Deviations

Linda Elsaesser, PT, ATP

INTRODUCTION

The decision to utilize any body support system is determined not only by the postural support device features but more importantly the people served, the context in which services are provided, the strategies utilized and the defined outcomes.

The intent of this instructional course is to describe one component in the evolution of a service delivery model for Seating and Mobility Assistive Technology (SMAT) services based on current legislation, guidelines and standards. The clients served were predominantly those with Developmental Disabilities living in the community, with significant body function/structure impairments and severe activity limitations.

Modification of the seat digitizer was intended primarily to provide effective postural support, improve efficiency by decreasing the time necessary to fabricate custom molded seat cushions and assure client satisfaction by provision of a postural support that meets their needs in a timely manner. The supporting service delivery process, therapeutic interventions utilized and method to modify the device will be discussed. Case studies with digital photos included.

BACKGROUND

The evolution over the past 20 years of back and seat supports for clients with significant musculoskeletal deviations has seen the use of foam, triwall, Desmo's, vac pacs, the Matrix system, foam in place and in the mid 1980's the introduction of custom molded simulators.

Utilization of these simulators to produce seat supports soon revealed that weight of the seat cushion, solid seat and mounting hardware were cumbersome to move about the environment. The systems while providing significant support could also limit weight shifting for pressure relief and functional movement. Loss of tissue integrity was frequently a concern. Capturing the data via plaster wrapping or digitizing remains time consuming. Fabrication of custom seat cushions from liquid foam is laborious and difficult to achieve accuracy in anatomical alignment.

The PinDot shape-sensing technology was introduced in the 1990's and provided computer assisted manufacturing of the custom-contoured Silhouette seat cushion. It became immediately obvious, however, that the seat cushions produced could not accommodate significant pelvic deviations yet the technology appeared to have far greater potential.

Clinicians have proposed using weights to press the client further into the molding frame as well as utilizing the computer program to modify the three-dimensional shape of the data deeper into the foam. Evaluation of the foam base provided with the system will reveal a one-inch deep grid cut into a four-inch block of foam. Once the grid has compressed, the solid block of foam can only produce a wide, shallow impression. Any readings produced will not accurately reflect pelvic obliquities beyond that one-inch depression. Use of software programs redefines the directly measured data into subjective modifications and is time consuming.

MODIFICATIONS

Recognizing that Chris Bar from the UK was providing far more cushions within his service delivery model, I took the opportunity to discuss my concerns with him. He stated that he was experiencing the same difficulties and was considering replacing the foam with a RoHo Quadtro cushion. The supplier I was working with in the US graciously modified the simulator and it has been successfully utilized since the mid-1990's.

The sensors are threaded through holes in the base of the cushion between the cells then through the seat cover. The four-inch high soft individual cells will register not only pelvic obliquities but also prominent ischiums, greater trochanters and femoral bowing. It will enable adjustments to provide anatomically correct femoral alignment relative to the pelvis as well as enable increased hip flexion angle to place the hip extensors at a biomechanical disadvantage to decrease extension thrusting. Emphasis on medial thigh area to facilitate external hip rotation can be accomplished. The anatomical, physiological and kinesiological rationale behind these statements will be discussed.

The high degree of cushion adjustability now enables evaluation of the success of proposed postural interventions, degree of correction available and/or need for accommodation of body structure deviations. Interventions can be easily adjusted with immediate feedback present. The provider does not have to attempt to subjectively modify the data and await a finished seat cushion to determine if extrapolations have been effective. Requests for cushion remakes are seldom required. Capturing the data is extremely efficient. The finished product is soft yet supportive, lightweight and can be utilized in multiple environments.

METHODOLOGY

WHEELCHAIR SEATING A State of the Science Conference on Seating Issues for Persons with Disabilities contained an executive summary with Seating for Postural Control as one of the four core topics and confirmed the continued need for evidence-based practice, standards for clinical postural measures and functional outcomes.

Despite a lack of standards, a SMAT clinic that is providing services and educating students must be able to define some measure of best practice. Darcy Umphred stated that all founders of the original approaches believed that having a sound rationale for any and all treatment procedures was vital for professional validation. An objective evaluation that clearly identifies the etiology of movement patterns rather than the symptoms produced is vital for accurate postural support recommendations. Cook & Hussey make the statement "the center of gravity is known to be important in governing balance and dynamic control". The severe neuromusculoskeletal impairments of the clients served by this clinic revealed that neutral alignment was seldom an attainable goal with a balanced center of gravity frequently resulting in decreased function.

These principles, traditional neurophysiological techniques and 20 years of assessment of recommended interventions were combined to form a personal methodology that relies on: 1.evaluation based on objective biomechanical principles with 2.recognition of retained primitive reflexia as predictors for deviations and 3.utilization of neurophysiological techniques to regulate tone to 4.obtain a functional seated posture that is defined as a balanced center of gravity (body structure) and movement (body function) as a central set and basis for attainment of personal outcomes. Deviations of this central set away from the center of the wheelchair were seen as indicators for the degree of AT interventions required and predictors for functional outcome potential. While this definition of best practice still remains anecdotal, the value of these concepts was reflected in the ability of the practitioners to efficiently evaluate body structure/function, propose and assess efficacy of interventions for satisfactory services within time frames supported by funding.

OBSERVATIONS

It has been observed that clients may have more sitting stability in the molding frame of bead type systems than on the final seat support. This appears to be related to the very firm control provided in the molding frame that is removed when softer seat cushions are produced to decrease sitting pressures. Use of the air flotation cushion in the modified seat digitizer does not "hold" the pelvis but rather provides the degree of elevation/depression necessary to inferiorly support the pelvis and femurs to achieve a stable base of support.

Clients have expressed the ability to feel when they have achieved a stable sitting position. This appears to be related to a balanced center of gravity that is the sum of all the postural deviations away from midline. Non-verbal clients often exhibit either distress with increased dystonic posturing or a "fixing" posture for stability that is eliminated when balance is achieved.

The high degree of cushion adjustability enables evaluation of the success of corrective interventions, degree of correction required and/or accommodation of the musculoskeletal deviations. It becomes a simple matter to add additional corrective measures until it is observed that correction is excessive then cushion can be readjusted in that one quadrant.

CONCLUSION

As provision of Seating and Mobility Assistive Technology services moved away from specialized facilities to community-integrated settings, it became necessary for providers to redefine their wheelchair clinic service delivery to reflect community inclusion, provision of services within funding constraints and cost-effective, functional outcomes. The recognition of the value of accreditation has mandated that Assistive Technology practitioners be able to expand their vision beyond therapeutic goals to embrace health care criteria that values organizational performance and client-focused excellence. Data was collected which supported client satisfaction with this service delivery model. While modification of the shape sensor was primarily intended to improve the effectiveness of the seat cushions produced, the simulator was initially chosen for its ability to rapidly collect and transfer the data necessary to develop custom molded seat cushions.

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"The Trouble with the Shoulder. . ."
A Review of Pathomechanics, Conservative and Surgical Treatments for the Shoulder

Patrick Meeker, MS PT

Here's what I hope you'll learn…
- The shoulder is complex and not designed for weight-bearing
- There are a few studies indicating poor surgical outcomes for w/c users*
- The best defense (from pain and dysfunction) is a good offense

What's all the fuss?
- Shoulder pain prevalence in wheelchair users ranges from 30-78%
- Nearly 75% of paraplegics with shoulder pain were suffering from impingement syndrome
- Degree of pain/derangement/disability is directly proportional to age/ time since injury
- Shoulders become weight-bearing joints
- Designed for mobility, not stability
- Published studies on surgical treatments are divided on success, but…

We may be able to make a difference…By understanding,
- The complex architecture of the shoulder
- The relationship between muscle actions and joint mechanics
- The conservative, pre-op and post-op therapy regimen
- ADL retraining, modification and avoidance
- The importance of preventative maintenance
- Shoulder research with wheelchair users
- In general, specific shoulder strengthening programs are highly encouraged
- Pain is often the limiting factor
- Age and time since injury were intrinsic risk factors for shoulder derangement
- Comorbidities often complicate shoulder surgery outcomes
- Research is extremely limited
- Specific Research
- Bayley (1987): impingement pain in paraplegia- increased joint pressure, increased pain and dysfunction- defined use as weight-bearing joint
- Few patients had appropriate therapy and very few opted for surgery
- Robinson (1993): acromial decompression successful for pain reduction
- Only 6 shoulders in 4 patients; suggests powered mobility for prev.
- Goldstein (1997): 65-71% had RCT, surgery ineffective at best
- Only 5 patients; high intrinsic risk/comorbidities
- Sinnott (2000): higher lesion level/ higher risk of RCD
- Early and intermittent use of powered mobility can be preventative
- Boninger (2001): pain + imaging findings correlated more with BMI than with rotator cuff tears- RCT prevalence may be overestimated
- Kulig (2001): Joint forces during propulsion showed no significant difference between LP, HP, C6 and C7; only speed and distance
- Gagnon (2003): study of posterior transfer pattern- strength program is critical for prevention and rehabilitation of the shoulder
- Anatomy and Physiology of the Painful Shoulder
- Bony Architecture
- 1/3 of humeral head articulates with glenoid
- Significant bony prominences for mm attachments
- The Glenoid Labrum and Capsule
- Static stabilizer
- Functionally deepens fossa
- Redundant inferior capsule
- Important in both adhesive capsulitis and anterior instability
- Note attachment of biceps tendon
- Bursae sacs have potential space to fill
- Glenohumeral Ligaments
- Discrete capsular thickenings
- Anterior, dynamic stabilizing role of biceps tendon
- Primary static stabilizer
- Rotator Cuff Muscles- Posterior
- Rotator Cuff Muscles- Anterior
- Superior View
- Note:
- Tenuous placement of coracoacromial ligament above supraspinatus tendon
- Area of avascularity in supraspinatus tendon
- Superior View
- Rotator cuff are the dynamic stabilizers of GH joint
- Note position of mm, tendons and scapula in retraction
- Scapular hypermobility/ protraction correlates with subacromial impingement
- Scapular Dyskinesis and Impingement Syndrome
- Occurs with inhibition and/or disorganization of mm activation patterns
- GH prime movers (deltoids) activated first
- ST stabilizers show significant latencies, esp. mid/lower trap
- Upper trap prone to tightness; lower trap prone to weakness
- Re-organize scapular mm patterns w/ closed kinetic chain exercises
- Deltoid and middle trap/rhomboids fire simultaneously in normal STR
- Conservative Management
- Examination, Assessment and Treatment
- Physical Exam
- Palpation
- AROM
- PROM
- Functional assessment-ADL, transfers, etc
- Neuro screen- r/o cervical involvement
- Strength testing
- Special diagnostic tests
- Differential Diagnosis of Anterolateral Shoulder Pain
- Loss of active and passive range of motion: Adhesive capsulitis
- Pain with resisted supination: Biceps tendonitis
- Pain originating in neck, extending below elbow: Cervical radiculopathy
- Positive apprehension test, age < 40, Hill-Sachs/Bankart: Glenohumeral instability
- Painful arc, positive impingement signs and injection test: Impingement syndrome
- Primary Care
- Without evidence of full-thickness RC tear, adhesive capsulitis or radiculopathy
- 3 step process
- Reduce inflammation- NSAIDS
- Restore flexibility and ROM- Ther Ex, passive stretching, joint mobilization

- Increase strength- progressive resistive exercises- open and closed kinetic chain
- Curtis (1999) Spinal Cord: 6 mos. shoulder ex's resulted in 40% _ pain compared w/ 2.5%_ control group
- Closed-Chain vs. Open-Chain
- Closed kinetic chain
- Force applied can't overcome resistance
- Fixed distal element
- Moving body away from source
- Utilizes prime movers and stabilizers
- Mimics ADL's
- Push up
- Open kinetic chain
- Force applied can overcome resistance
- Fixed proximal element
- Moving weight away from body
- Isolates specific muscles or groups
- Targets muscles for strengthening and recruitment patterns
- Bench press
- Chest Press Plus
- Begin with neutral/ slightly retracted scapulae
- Strengthens
- Upper Subscap
- Infraspinatus
- Supraspinatus
- Pectoralis major
- End with exaggerated protraction of scapulae
- Serratus anterior
- Dynamic Hug
- Begin with retracted scapulae
- Strengthens
- Supraspinatus
- Upper subscap
- Pectoralis major
- Lower subscap
- Finish with arms still bent in "hug" and protracted scapulae
- Forward Punch
- Begin with retracted scapulae; elbows out in 15° ABD
- Strengthens
- Supraspinatus
- Upper subscap
- Infraspinatus
- Pectoralis major
- Finish with shoulders down and scapulae in neutral
- External Rotation
- Begin with arm/elbow ABD 15° with roll*
- Strengthens
- Infraspinatus
- Teres minor
- Supraspinatus
- Deltoid- post fibers
- Finish with near max AROM
- Scaption
- Start in "plane of scapula"
- Thumb up
- Supraspinatus specific
- Deltoid: ant and lat fibers
- Upper trapezius
- Finish with full elevation
- Thumb down
- Supraspinatus
- Deltoid: lateral and post fibers
- Upper trapezius
- Finish at shoulder level
- Upright Rows
- Begin with full scapulae protraction
- Strengthens
- Mid/lower traps
- Posterior deltoid
- Latissimus dorsi
- Finish with full scapulae retraction
- Changing angle of pull hits all fibers
- Lat Pull Down
- Start with full scapulae protraction/ shoulder elevation
- Lats
- Lower trap
- Middle trap/ rhomboids
- Finish with lower angle of scapulae retraction
- Other important exercises
- Internal rotation
- Scapular pinches- isometrics
- Bicep curls- remember supination
- Tricep- eccentrics too
- PNF- Proprioceptive Neuromuscular Facilitation
- Diagonal patterns
- "pick an apple, put it in a bag"
- "the bodybuilder pose"
- Remember, the key to all shoulder exercises is building core proximal scapular stability
- Surgical Management
- Diagnostic Imaging
- Plain radiographs
- Bony abnormalities
- Joint space
- Arthrogram
- Not used as much
- Can show partial/full thickness tears
- Computed Tomography
- Bony defect
- MRI
- The choice for soft tissue damage assessment
- Arthroscopic vs. Open Repair
- Historically, rotator cuff repair was an open procedure
- Required longer immobilization
- Limits on deltoid mm activation 2° splitting in all three approaches
- Comorbidities of open procedure include fibrous ankylosis, adhesive capsulitis and limited final ROM
- Arthroscopic advances have produced better short-term and long-term outcomes
- Procedure dependent upon severity of derangement
- Impingement and Acromion Shape
- 73% of RC tears had type III
- Subacromial pressure increases as morphology changes from I-III
- Shape alone does not account for pain complaints
- Arthroscopic Acromioplasty
- Goals for Successful RC Repair
- Force couples balanced
- Intact subscapularis ant. and inferior _ infraspinatus post.- reduces superior humeral head translation
- Normalized kinematic fulcrum
- Decreased humeral head translation superiorly and anteriorly
- Repaired tendon has edge stability- less tearing
- Rotator cable attached over maximal surface area- decreases tensile forces

- The Rotator Cable
- “Rotator cable”- thickening of coracohumeral ligament
- Proximal stabilization for force couples
- Redistributes tension away from avascular zone
- Mimics the principle of offloading vulnerable tendon attachments like with lateral epicondylitis bracing (tennis elbow)
- Rotator Cuff Tears and Repair
- SLAP Lesion
- Superior Labrum, Anterior to Posterior
- Pain patterns mimic impingement
- Don’t occur in isolation
- Bicep’s tendon is integral part of superior labrum
- Difficult to diagnose preoperatively
- 4 types

- Surgical Anchors and Sutures
- Post-op Protocol
- Successful treatment depends on
- Client compliance with exercises
- Control of pain
- Degree of pathology
- Goal is to regain motion and strength quickly and safely
- Order and balance are essential to addressing the cause of the problem
- Transfers with Involved Shoulders
- Lead with involved shoulder
- Trailing arm EMG mm activation greater than leading arm
- Leading arm uses less RC mm for transfer completion
- Strengthen pec major and lats with resisted ADD eccentrically (overload with partner)
- This offloads the GH joint due to more distal mm attachments
- Wheelchair setup choices
- First, we must assume manual, self propulsion
- Wheelchair seating is a battle of compromises
- Three key ingredients:
- Weight
- Configuration
- Function
- These three ingredients work synergistically
- How does setup make a difference?
- For efficient propulsion- body weight distribution is critical
- Wheelchair setup demands knowledge of client’s history and potential for function
- Understanding wheelchair types and setup to maximize these parameters- may prevent long-term shoulder dysfunction
- Weight
- Today’s chairs offer a considerable decrease in weight from just 5 yrs ago
- Different industries impact
- Bicycle
- Aerospace
- Automotive
- Materials include Steel, Aluminum, Titanium, Carbon Fiber
- Weight of components and accessories adds up (bookbags)
- Rigid vs. folding frame
- Folding vs. Rigid frames
- Folding
- Has more moving parts
- Often used with pediatrics because of the “growth” factor
- Some feel easier to transport
- Rigid
- Less moving parts
- More efficient to push
- Often thought of as a “sport” wheelchair
- Can “customize” the fit
- Rigid back can improve efficiency and decrease weight
- The basics
- Propulsion mechanics
- Body weight distribution
- Rear wheel position
- Axle adjustment
- Fore/aft, up/down, camber
- Rear wheel type
- Spoke, mag, carbon composite
- Handrim type
- Tire type: pneumatic, semi-pneumatic, solid
- Tire width
- Seating position
- Size matters- proper width and depth
- Growth potential
- Seat base “dump” (seat to floor angle)
- Backrest type- rigid is best
- Backrest angle (seat base to backrest angle)
- Armrest height- are they needed? in the way?
- Function
- Seated position
- Pelvic position- tilt, obliquity, rotation- Dynamic Stability
- Spinal curvature?- lordosis, kyphosis, scoliosis
- Lower extremity position- symmetric, leg length discrepancy (femur/ tibia-fibula), foot position
- Head position/support
- Shoulder/ Upper extremity position
- How are we set up anatomically to deal with wheelchair propulsion?
- Front end
- Castor type- solid vs. pneumatic
- Castor size
- Small- increased maneuverability/ decreased shock and obstacle accommodation
- Large- increased shock and obstacle accommodation/ decreased maneuverability
- Castor wheel position
- Tracking between front and rear wheels- alignment
- Vibration transmission
- In a Nutshell
- Shoulder pain is very common
- Anatomic variables play a huge role
- Impingement syndrome and rotator cuff injuries are treatable
- Surgery is often a last resort
- Preventative maintenance with specific exercises is the key to longevity
- “Train before the pain”

- References available upon request.

Empower and Assist!

Brenlee Mogul-Rotman, BSc, OT, OTR, ATP, OT Reg (Ont.)

In the "olden days" of technology (about 15- 20 years ago!) there were manual wheelchairs and "electric" wheelchairs. There was also a category called power add-on packs. Power add-ons were not very common, nor very practical. There were very limited options of types of power add-ons and the features of the systems left much to be desired. The add-on pack added so much weight to the manual wheelchair that most often than not, the device was not worthwhile to meet client needs. Luckily, this has and continues to change for our clients that would benefit from power add-on or power assist.

For most wheelchair users, recapturing and maintaining independence is the most significant goal in life. Accepting more help or using more advanced equipment can be seen to some individuals as "giving up" or as failure. But it is hard to deny the fatigue and pain that may come from time spent pushing a manual wheelchair. Switching to power mobility may be the way to maintain independence! There is often a stigma attached to using power mobility and for many clients with various conditions, use of power mobility may be a failure, lack of progress or even a sign of being more disabled.

There are numerous factors that may impact an individual's decision to choose some sort of power mobility instead of or following manual wheelchair use.

These include

- Decreased strength or function
- Increased pain
- Decreased mobility
- Weight gain or loss
- Less activity
- Skin breakdown
- postural deformity
- fatigue
- Aging of primary caregivers.

Some individuals will require the use of some sort of power at the time of there first mobility system while others will require the use of some sort of power later on during their life and disability.

So the options are manual mobility or power mobility…but power wheelchair?? The weight, the cost and the inconvenience are sometimes more than the client can handle or more than they actually need. How about a "middle of the road" option, and that is POWER ASSIST.

Power assist

The concept of power assist uses a combination of programmable software and lightweight batteries and motors to give the user a power boost whenever the wheel rims are pushed. Power assist devices allow a manual wheelchair to be used and the individual to continue to propel, only with significantly less effort and strain. The two available systems to date allow for use of various types of manual wheelchairs. The client can choose a system that has the batteries and software in the wheel hub or a system that has a single, separate battery that mounts to the rear of the wheelchair. Both systems will add weight and width to the manual wheelchair, and both systems are removable. The individual is able to switch power on and use the power assist, and the power can be turned off so that the wheelchair can be pushed by a caregiver or the individual themselves. With no power on, propelling independently is possible, but more difficult due to the increased weight. There is programmability to speed and various other parameters depending on the chosen system.

Why Power Assist?

Who would use power assist? Any individual who experiences strain and difficulty when propelling or an individual who experiences fatigue and loss of energy throughout the day could benefit. Clients with deteriorating conditions or conditions that require energy conservation could find use with power assist. Those with soft tissue injuries related to overuse would still be able to propel, but with less risk of continued tissue trauma and pain. Any client who has weakness and fatigue related to getting from point A to point B could use power assist. An individual who is able to propel short distances or flat surfaces only could use power assist in order to expand their environment, go faster, longer and safer.

Power assist allows the individual to remain in their manual wheelchair. By staying in the manual chair, the seating and posture will also remain unchanged and the transition to the new "device" may be faster and easier. Some of the therapeutic benefits of power assist include

- maintenance and improvement to the cardiovascular system
- reduced strain on muscles and joints
- prevention and reduction of carpal tunnel syndrome and other repetitive movement syndromes
- prevention of deformity and skin breakdown from improper positioning resulting from strained propulsion with power assist
- psychological benefits of using a manual wheelchair instead of a power chair
- energy conservation
- improved functional ability
- community integration
- enhanced quality of life.

Things to consider

When assessing and considering power assist, it is important to remember that power assist systems allow for portability, however increase weight of the overall mobility device. Can the client and /or caregiver remove the power assist wheels and batteries? Can the client propel once the power is off, and if not, will they be able to leave the power on all day long? Who will charge the system? Are extra batteries needed and if so, are they available? The power assist systems add approximately 3 inches to the overall width of a manual wheelchair. Doorways, hallways, ramps, elevators and the whole environment must be assessed to ensure that the extra width can be accommodated. Don't forget about the van lift and interior! When assessing systems, ensure that the system chosen will be compatible with the type of manual wheelchair. Can the client manage the on/off, speed settings etc? The assessment of power assist must be similar to a power wheelchair assessment in respect to driving ability, cognitive ability, safety and user needs. The full mat and seating assessment should be completed with the mobility goals and needs determined by the assistive technology team. The pros and cons of power wheelchair vs. power assist should be reviewed and discussed.

Justification

How do we justify the use of a power assist system? The assessment and determination of needs will lead to a type of system to meets the most client needs for the short and long term. Although power assist systems are costly, very often, they are more appropriate for client use than a power wheelchair, and this is due to various reasons. Power assist should be considered and justified as a type of system that will prevent injury, deterioration, deformity and improve function, independence, safety and ability. Power assist is cost effective over time by allowing the client mobility, continued exercise and use of the body for propulsion, but in a less destruction way. Power assist can allow a client to remain in their existing vehicle, and reduce need of further vehicle modification as well as home renovation. Care giving needs and portability continue to be easier in many situations than a power wheelchair.

Power assist systems allow for an individual to use a manual wheelchair but have some "help" when propelling. Ease of use, transportability, prevention of injury, maintaining manual mobility and cosmesis are all reasons to use power assist. But power assist may not be for everyone, and for some individuals, power wheelchairs are more realistic and will meet more needs. A proper assessment and determination of needs and goals should be completed by the team and if all options are considered then the appropriate type of equipment will be prescribed. There are pros and cons of every type of equipment and if we allow our clients to be informed consumers with some choice and education, then the right decision for each individual will be made. Our goal for our clients is optimal functional ability and return to an active and safe lifestyle. It is our job to allow our clients to opportunity to investigate, evaluate and decide- we are there to assist, educate and facilitate. Our clients should have the power and we are their assist!

Alternative External Stabilization Systems Used in Sitting and Standing

Catherine Mulholland, OTR/L

The chant of all Pediatric Clinical Therapists
"proximal stability precedes distal mobility."

Considerable research and development has been done in the provision of mechanical postural supports in both sitting and standing the child with neuromuscular deficits. These supports are utilized to compensate for atypical postures and patterns of movement and with the exception of rigid orthotics, are a component of the child's seating or standing system itself. As many of the child's atypical posture patterns are a result of muscle imbalance or weakness, new research and development is beginning to focus on the utilization of "proximal dynamic soft support" systems. These soft systems are worn by the child to compensate for muscle weakness, to promote stability and to "guide" motor movement while in their seating and standing systems.

Four systems are widely used 1: The Adeli Suit 2: The Therasuit 3: Second Skin and 4: Theratogs.

The following situations are given as examples:

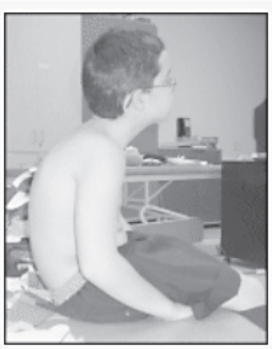
Sitting: Many children with severe CNS deficits lack the stability of a lumbar curve when sitting. The lumbar curve itself does not develop in normal development until such time that the toddler begins to rotationally creep and ambulate. It is the lumbar curve which promotes spinal stability and proper alignment for optimal head control and upper extremity function.


absent lumbar curve

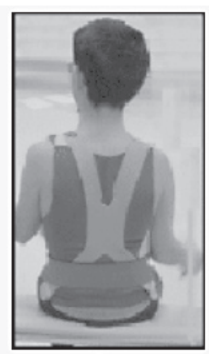

spinal extensors strengthening


lumbar curve

If a child does not ambulate, the musculature involved in supporting the lumbar curve rarely develops adequate strength, with the result that the child sits with a pronounced posterior tilt of the pelvis. Absence of a lumbar curve and sacral sitting promotes poor trunk stability, poor head alignment and protracted posturing of the shoulder girdle. Soft systems designed to compensate for this weakness can provide an improved upright posture in sitting by compensating for spinal weakness.


sitting without


improved head alignment


strap configuration

Standing and Gait: The mechanics of ambulation require a complicated choreography of stability and movement. When a child is asked to step forward without these skills, atypical compensatory motor movements secondary to muscle weakness and imbalance are common. The "wave" movement elicited in a normal gait pattern can actually strengthen these atypical muscle groups and make the imbalance more severe, An example might be severe scissoring noted when a child has weak hip flexors. To be able to step forward, the adductors are used as a compensatory muscle group. A soft system which aides the weak hip flexors while providing firm resistance to the adductors may allow the child to strengthen the flexors and develop a more normal motor pattern. If resistance alone is provided to the adductors, the scissoring would more likely become more severe over time.

to aide hip flexion

to aide knee flexion

to compensate for muscle imbalance

Resources:
1. Adeli Suit (www.Euromed.pl)
2. Theratogs (www.theratogs.com)
3. Therasuit (www.suittherapy.com)
4. Second Skin (www.secondskin.com.au)

Saturday, January 22, 2005

CPT Coding and Reimbursement for AT Service Providers

Barbara Levy, PT, ATP

LEARNING OBJECTIVES

The participants will:

1. Define the components of CPT Codes and describe how the codes and reimbursement rates are determined.

2. Describe the process for obtaining editorial changes and new codes.

3. Name 10 CPT Codes and describe the use of each code as they relate to AT Services.

4. Name and describe 5 coding challenges that affect the use of CPT Codes for service billing.

5. Utilize the Correct Coding Policy Manual to determine which codes can be used together and which are considered edits.

6. Describe the documentation requirements to support the billing codes.

7. Compare and contrast the billing requirements and reimbursement process for various practice settings

8. List, describe, and integrate 3 specific resources to maintain current (and changing) knowledge of CPT Codes, the allowable reimbursement rates, and documentation requirements.

Physician's Current Procedural Terminology (CPT) - Accurate descriptive terms for reporting medical services and procedures. CPT provides uniform language and allows for reliable nationwide communication. The American Medical Association (AMA) holds the copyright to the CPT Codes.

Resource Based Relative Value Scale (RBRVS)
This is the standardized payment schedule that is based on the cost of providing the service. All payors are suppose to use CPT based on HIPAA regulations.

Relative Value Unit (RVU)
These indicate how much one procedure is worth in relation to another procedure.
Components of Relative Value: Physician (provider) Work, Practice Expense, and Professional Liability Insurance Costs.
Components of Work include: Time to perform the service, Technical skill and Physical effort, Mental effort and Judgment, and Psychological stress.
Components of Practice Expense include: Administrative labor, Clinical labor, Medical supplies and equipment, Office supplies, All other expenses.

Conversion Factor
Translates the RVU into an actual dollar amount.

National Average Allowance (NAA)
Conversion Factor x Relative Value Unit (RVU) = NAA
NAA x Geographic Practice Cost Indices (GPCI) = Local Payment Rates

Requests for Coding Changes
Through a process that includes research, consultation and coding expertise, coding proposals are developed, reviewed and acted on by the AMA's CPT Editorial Panel, CPT Advisory Committee, Relative Value Scale Updating Committee (RUC), Health Care Professionals Advisory Committee (HCPAC), and the AMA Department of Coding & Nomenclature.

Documentation requirements for a new code: Code Description, Clinical Vignette, Applicable Diagnoses, Rationale, Supportive Research Documentation, Related Code Deletions.

Editorial revisions that do not require a change in relative value can be submitted by a professional association, in the form of a letter of request, to the AMA.

Physical Medicine and Rehabilitation 97000 Series CPT Codes"AMA

CPT code Description
97001 PT Evaluation
97003 OT Evaluation
No time attached

97002 PT Re-Evaluation
97004 OT Re-Evaluation
No time attached.

97112 Therapeutic procedure; neuromuscular reeducation of movement, balance, coordination, kinesthetic sense, posture, and/or proprioception for sitting and/or standing activities.
Each 15 minutes.

97504 Orthotics Fitting and Training, upper extremity(ies), lower extremity(ies) and/or trunk.
Each 15 minutes.

97530 Therapeutic activities, Direct one on one patient contact by provider (use of dynamic activities to improve functional performance)
Each 15 minutes.

97535 Self Care/Home Management Training (e.g., activities of daily living and compensatory training, meal preparation, safety procedures, and instructions in use of assistive technology/adaptive equipment)
Direct one on one contact by provider.
Each 15 minutes.

97537 Community/Work Reintegration Training (e.g., shopping, transportation, money management, avocational activities, and/or work environment modification analysis, work task analysis, use of assistive technology/adaptive devices)
Direct one on one contact by provider.
Each 15 minutes.

97542 Wheelchair Management/Propulsion Training
Each 15 minutes

97750 Physical Performance Test or Measurement (e.g. musculoskeletal, functional capacity), with written report.
Each 15 minutes.

97755 Assistive Technology Assessment (e.g. to restore, augment, or compensate for existing function, optimize functional tasks, and/or maximize environmental accessibility), with written report.
Each 15 minutes

Coding Challenges
ICD9-CM
The ICD9 codes support the medical necessity and are linked to specific CPT Codes.

Modifiers
Provider Specific – To be used after each code:
GP – Physical Therapist
GO – Occupational Therapist
GN – Speech Language Pathologist

59 – Distinct Procedural Service
52 – Reduced Services
22 – Unusual Procedural Services

Time Billed

8-23 minutes = 1 unit
23-38 minutes = 2 units, Etc.
If provide less than 8 minutes, you cannot bill for one unit.
If two different procedures provided within a 15-minute time frame, bill for only one of the procedures. Number of units billed = total treatment time. Person must be present in the room.
Example: 24 minutes of code 97112 + 23 minutes of code 97542 = 47 minutes
3 units are billed (2 – 97112, 1 – 97542)

Documentation
Documentation must support the procedure codes that are billed and demonstrate the need for the skilled intervention. Treatment plans must be completed every 30 days and should include objective, measurable, functional and obtainable goals. They also must include the date of the patient's last visit with the physician and the date of the next scheduled visit. The patient must see their physician within 60 days after therapy begins and every 30 days past the 60th day. The physician's certification must be signed and in the medical record prior to billing for services.

HCFA 700 form - Plan of Treatment for Outpatient Rehabilitation
HCFA 701 form - Updated Plan of Progress for Outpatient Rehabilitation
Correct Coding Initiative (CCI)
Purpose is to curb fraud and abuse.
Problematic CCI edits are problematic codes that will not be reimbursed when rendered by the same provider on the same date of service as other codes.

References:

American Medical Association's CPT 2004 Book

APTA website (www.apta.org) members only pages for Private Practice Relative Value Units and Medicare Calculator, HCFA Correct Coding Initiative

Botten, Linda; Introduction to Coding and Billing Systems for Assistive Technology
Therapy Services; RESNA Annual Conference, June 2000

Briefings on Outpatient Rehab Reimbursement & Regulations – December 1999

Fearon, H.; Brewer, K; Zawicki, P.; Reimbursement for Rehabilitation Services:
Bridging The Gap Between Documentation and CPT Coding; APTA Conference, 1999

Fearon, H; Levine, S.; Tools For Managing Reimbursement in the Outpatient Physical Therapy
Setting; APTA Seminar, January 2004

Hayes, M.; Working Document of RESNA Technical Assistance Project, December 2000

Physicians Fee & Coding Guide; Healthcare Consultants of America, Inc.; 1999 and 2000

Sprigle, S; 1999 CPT Codes and possible editorial revisions; RESNA CPT Code
Working Group Document

Resources:
1. AMA Department of Coding and Nomenclature 800-621-8335 for AMA Press Catalog
2. AMA CPT Assistant Publication
3. The Coding Companion and CPT Insider
4. National Correct Coding Policy Manual; US Government's National Technical Information Services (NTIS); 800-553-6847
5. Federal Register: New Orders, Superintendent of Documents, PO Box 37194, Pittsburgh, PA 15250-7954
6. Healthcare Consultants of America, Inc.; 1054 Claussen Road, Suite 307; Augusta, GA 30907; 706-738-2078
7. Medicare RBRVS: The Physician's Guide 800-621-8335
8. Websites:
   http://www.cms.hhs.gov/physicians/pfs
   www.ptmanager.com
   www.cms.hhs.gov/physicians/cciedits/default.asp
   www.ama-assn.com

A complete power point handout and further information will be provided to attendees.

Man's Best Friend: The Benefits of Service Dogs

Shirley G. Fitzgerald, PhD
Diane Collins, PhD
Natalie Sachs-Ericsson, PhD

Service dogs (SDs) are trained to assist individuals who use wheelchairs with functional tasks and community participation1. Specifically, SDs assist people to accomplish basic and instrumental activities of daily living1,-4 including but not limited to retrieving items, transfers, dressing and mobility. This session will provide background information on service dogs: their potential benefits, how service dogs are trained and process of obtaining a service dog. Furthermore, we will present a review of ongoing research and a demonstration.

Benefits of Service Dogs

Several studies have shown that SDs are beneficial in reducing the reliance on human assistance, thereby dramatically decreasing out-of-pocket expenses. In addition, those partnered with SDs were found to have more positive psychosocial characteristics2-6. Unfortunately, the only randomized clinical trial3 in this field has been discredited by several researchers.7-9 However, other studies have documented the benefits associated with obtaining a service dog. For example, Fairman et. al.4 found reductions in assistance hours as a result of using SDs. In this cross-sectional study, SD partners used 2.1 less hours of paid assistance each week, and 5.9 less hours of unpaid assistance each week after receiving their SDs. The estimated cost savings from decreased paid hours was $600 per year4.

SDs are also trained to perform mobility-related tasks like pulling a manual wheelchair, opening/closing doors, and aiding in transfers2-4. These tasks facilitate access to the environment and community, a factor positively correlated with higher quality of life among wheelchair users10,11. Environmental accessibility affords participation in social activities, education, employment, and recreation. Camp conducted a qualitative study of five individuals partnered with SDs2. Though decreases in reliance on human assistance were not assessed, enhanced independence and community participation were among the themes that emerged during interviews with study participants4.

SDs, therefore, are similar to assistive technology (AT) as they can influence the extent to which an impairment results in disability12. However, the benefits SDs afford their partners go beyond those provided by mechanical devices; SDs provide constant companionship, enhanced feelings of personal safety, and serve as social connections with others2-6.

Training of Service Dogs

An estimated 16,000 individuals are partnered with SDs today13. The cost of raising and training these highly skilled dogs, who typically work for eight years, is estimated to range from $8,500 to $18,50014,15 Most service dog agencies are non-profit and the cost of the dog is entirely paid for by different charities such as the United Way. However, service dog facilities must spend considerable time and resources raising money for their program.

The larger service dog programs, such as Paws with a Cause" and Canine Companions for Independence, have their own breeding programs, which are designed to breed dogs for good temperament and health. There has also been some success in obtaining service dogs from shelters. Programs have developed protocols for the selection and training of shelter dogs that are based on a careful evaluation of the dogs temperament, stability, health and progression through training.

The most common type of breeds used for service dogs include Labrador and golden Retrievers, although standard poodles have been trained, as their coats are hypoallergenic. The process of training a service dog usually starts as early as when the puppy is eight weeks old. At that time, the puppies are often placed in the home of a 'foster puppy raisers' who take care of the dogs for the first 12-14 months of their life. Whether or not the dog is obtained from a breeding program or from the shelter and extensive period of socialization and basic obedience takes place before the dog graduates to advanced training at the service dog facility. While the puppy is in the care of the foster puppy raiser, in addition to being taught basic obedience and good manners, these dogs learn to feel comfortable and confident in all types of environments. During this stage the puppies are taken to obedience classes and introduced to the real world in every avenue possible. As they are considered 'dogs in training', laws in most states allow the puppy raisers to take the dogs into community settings (e.g., restaurants, shopping malls, etc.). The goal is to put the dog into similar situations as will be encountered when the dog is paired with someone in a wheelchair.

After the 12-14 months, the service dogs are returned to the agency for specialized training which typically takes from six to nine months. In the first phase of advanced training (approximately three to four months), the focus is on basic obedience, retrieving and public access. In this phase, the dog must reliably learn to perform the basic obedience tasks and consistently demonstrate a solid temperament and eagerness to learn. The next phase of training focuses on the specific service dog tasks. How this phase of specialized training occurs is a function of the service dog agency. There are two main schools of thought for this phase of training. One philosophy is to train all of the service dogs with the exact same service dog tasks, which are those tasks needed by the majority of individuals with mobility impairments. This method maximizes the number of dogs that can be trained in a given program. In contrast, the other philosophy is to tailor the dog's skills to the specific needs of the individual who is on the waiting list to obtain a service dog.

When the service dog's training is complete, the next phase is the placement of the trained dog with the individuals with a disability. This 'placement process' is critical, in that the individual obtaining the service dog must learn to work effectively with their new partner. The amount of work and commitment the individual must give to this process cannot be under emphasized.

Obtaining a Service Dog
Individuals wishing to obtain a service dog must contact the specific service dog agency and complete an extensive application process. Letters of recommendations from friends, family and the individual's physician are also required. In the application process the person is typically asked to identifying why he or she would like to obtain a service dog and to clarify what expected benefits the person believes he or she would gain from having a service dog. This initial application process is followed up by an interview with a representative from the service dog agency. From the application and interview process the agency must assess if the individual will be able to benefit from a service dog, if the service dog will increase the individual's independence, and if the individual has reasonable expectations as to the benefits as well as costs of acquiring a service dog. The facility must also judge if the individual is willing and able to put in the considerable time and energy required to work effectively with a service dog. Finally, the service dog facility must judge if the individual is physically, emotionally and financially able to well care for a service dog.

For those programs that specially train the service dog for the specific needs of the individual, an assessment of those specific needs are also obtained. For example, PAWS will send a local field trainer to the individual's home and videotape an interview with the person as well as their family. In this interview the field trainer documents the individual's physical abilities and limitations. Moreover, their living arrangements are documented. During the last phase of training of the dog the PAWS trainers rely on this videotape to train the service dog to the specific needs of the individual. This includes training the dog to perform tasks using similar types of equipment that the individual has in his or her home.

When the dog's training has been completed, the training of the individual who is obtaining the service dog begins. Learning to work with a service dog involves considerable work, practice and patience on the part of the individual.

Overview of Ongoing Research

Currently, two research studies aimed at producing validated results to ultimately provide a rationale for the clinical efficacy of service dogs are underway. The first study, "Efficacy of Service Dogs as a Viable Form of Assistive Technology," is an 18-month longitudinal study in which four groups of individuals who use wheelchairs (N=200) are compared: 1) those newly partnered with service dogs, 2) those on service dog agency mailing lists to receive service dogs, 3) dog or cat pet owners, and 4) those not seeking service dogs who do not have dogs or cats as pets. Study participants are assessed five times over the study in the outcomes of functional independence, community participation, psychosocial wellbeing, and socioeconomic characteristics. The main goals specific to this study are to determine the impact of service dogs on their partners in terms of function, psychosocial wellbeing, and economic savings, and to identify the individuals who benefit most from being partnered with service dogs. For example, do individuals with progressive conditions, or who are single benefit more from service dogs than those with static conditions or who have spouses? If we find that individuals partnered with service dogs experience significant benefits, we hope to determine if those benefits experienced that can be replicated by dogs or cats as pets as well.

"Hearing and Service Dogs as Alternative Assistive Technology" is the second ongoing study at our Lab. This study is a two-part cross-sectional study in which individual partnered with service dogs and hearing dogs (assistance dogs) are compared to individuals with mobility or hearing limitations and do not have assistance dogs. The first part of the study is the completion of questionnaires asking about the demographics, assistive technology use, pain, and fatigue of study participants. Part two is a hands-on assessment of completion of daily activities at the home or community setting of study participants. The outcomes of interest of this study include differences in assistive technology device use, effort in completing daily activities and using assistive technology devices, and how the cost and use of service dogs compare to assistive technology use. In addition, we are seeking to determine the frequency of abandonment of assistive technology devices of individuals both with and without assistance dogs.

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Impact of a Progressive Seating Program on the Spinal Cord Injured Patient

Vicki H. Bunton, PTA
Paul Wilkie, PT, RTS, ATP

The objectives of this lecture are to identify the roles of the seating clinic team in and inpatient and outpatient setting. The lecture is directed toward progressive seating of the spinal cord injury population. Fundamental knowledge of the spinal cord injured population will be reviewed to better understand equipment selection. The seating evaluation process will also be discussed to ensure proper equipment selection and fitting. At the end of the lecture, case studies will be presented to demonstrate the complete process including progressive seating, evaluation and equipment fitting for the spinal cord injured patient.

Seating Clinic Team Members: General Overview
Primary Physician—Initiate referral and provide medical history. Verifies and signs needed documentation for reimbursement.
Nurse—Assist in providing medical information and client functional status that is pertinent to progression and selection of equipment.
Physical Therapist/Occupational Therapist---Provide functional status and short and long term goals. Helps coordinate equipment education and family training.
Psychologist---Assists in adjustment counseling for the family and client.
Medical Social Worker—Assist in discharge planning and insurance verification.
Respiratory Therapist—Assists in identifying respiratory equipment needs and clients respiratory status / progression.
Rehab Technology Supplier---Assist seating clinic team in equipment knowledge, evaluation process, progressive seating, and discharge equipment fitting. Initiates order process, including insurance equipment coding and insurance verification. Provides definitive equipment services, including final fitting and service needs.
Seating Clinician---Responsible for coordinating and communicating with all above mentioned seating clinic team members. Main responsibilities include progressive seating, evaluation process, equipment selection, preparing documentation, and final fitting.

Charlotte Institute of Rehabilitation Seating Clinic:
The Charlotte Institute of Rehabilitation Seating Clinic was started in 1995. Initially the seating clinic was responsible for providing equipment recommendations for the outpatient setting. Since its inception, the Charlotte Institute of Rehabilitation Seating Clinic has grown to provide equipment needs for the inpatient and outpatient populations in the Carolinas. Two full-time and one part-time Therapist provide services in the clinic, including 1 PT, 1 OT and 1 PTA. Support staff is also available to assist with clerical duties and appointments. A Rehab Tech provides vital assistance in completion of complex wheelchair and seating set-ups. The inpatient role of the seating clinic team includes progressive seating for all appropriate referrals and provides patient / family education. Additional resources are given to families for preparation of community reintegration and home accessibility. Definitive equipment recommendations are provided. The client is fitted with an appropriate discharge loaner wheelchair and seating system to facilitate continuation of their therapeutic goals. The outpatient seating clinician's role is similar to the inpatient role, with the added challenge of limited available time to perform the evaluation.

Progressive Seating:
Progressive seating is the process of providing appropriate equipment on the continuum of the client's rehabilitation progression. For the spinal cord injury population progressive seating includes providing the client with the most appropriate equipment based on their current medical and functional needs. Considerations during the initial stage of progressive seating include sitting tolerance, pain level, skin integrity, and orthostatic hypotension. As the client medical condition and function improves, equipment adjustments are made. During this stage equipment trials, education, and simulation are performed. The last stage of the seating progression incorporates equipment selection and discharge equipment set-up.

Pertinent Medical Information As It Relates to Seating the Spinal Cord Injured Population:

Review of spinal cord injury levels and probable functional outcomes
Related medical information / complications

Evaluation Process:
- Subjective Information:
  - Obtain History, including medical and social issues.
  - Discuss discharge environment and client's lifestyle
  - Obtain client's goals and/or complaints of current equipment
  - Assess current equipment
- Objective Information:
  - ROM
  - Body Measurements
  - Pelvic and Spinal Alignment
  - Skin Integrity
  - Function
  - Tone
- Pressure Mapping:
  - Assists in cushion selection
  - Biofeedback for pressure relief technique
  - Assists in assessment of high risk pressure area
- Simulation and Trial of Equipment
- Recommendations and Equipment Selection

CASE STUDIES:
Two case studies will be provided to give an overview of the progressive seating and evaluation process. A third case study will be presented to encourage group discussion.

Questions and Answers:

Hyperextension, Obligatory Reflexes, or the Opisthotonic Reaction?

Facing the seating challenges of children whose seating systems do not recognize this body posture.

Karen M. Kangas, OTR/L

As a practicing clinician for over 30 years, I am sharing here, my own clinical observations, and clinical strategies. I am not presuming to be a medical doctor, nor am I diagnosing an individual's medical condition. However, I am, through observation, and many years of treatment, attempting to describe, make sense of, and interpret my own clinical findings (and reconcile them with current literature and research, such as it may exist). I have become increasingly more able to observe these reactions and body postures throughout my own work. I have also become reconciled to their own "validity" and "truthfulness" as I have seen change in children and their control of their own bodies, as I have worked with them over time. I feel driven to share these observations with you all, as I am so concerned about the type of seating we are providing so many more children. I become concerned that our own recommended seating systems may contribute to the child's inability to participate in their daily lives and community. May this article and workshop, help all of you, to better help those children and adults you serve.

Often, when an individual (especially a child) is diagnosed with cerebral palsy, brain injury, and/or clinical rigidity, an opisthotonic reaction is present. The individual is often described as having "hyperextension" or "obligatory reflexes" (especially the ATNR, or Asymmetrical Tonic Neck Reflex/Reaction), or "pushes his head hard" or "is so strong", or the individual has broken footplates, or headrests by pushing in their own very "strong" way. What is often not mentioned, is how often, these same individuals have bald spots on the back of their heads, or have beginning bald spots. Or these same individuals may become very "sweaty," seem often anxious, and have many frequent bouts of "startle reactions" throughout the day. These individuals may have spasticity, athetosis, rigidity, or dystonia.

These individuals are the ones for which sub-asis bars were invented, for whom the "dynamic" springy front riggings were developed, for whom occipital bars were supposed to work, and who are most often placed in seating systems with the most restrictions; including very aggressive "anti-thrust" seats, multiple or 4 pull pelvic belts, chest harnesses, pulled tight, elbow blocks, wrist straps, straps in arm troughs, and multiple foot controls, boots, ankle and toe straps. However, even with all these restrictions, many individuals can still "break" or push against parts, of the seating systems, looking as if they are indeed, involved in a "fight with themselves."

Most of the time, when these observations, (above) are made, the i ndividual, instead of having "hyperextension, or obligatory reflexes" has an opisthotonic reaction.

This opisthotonic reaction is activated by pressure on (or near) the occiput, on (or near) the scapulae, and/or on (or near) the sacrum. The individual, subsequently, involuntarily, responds and the head and sacrum "bridge" as if they were attempting to reach each other. This reaction is quick,and involuntary, and it is often misinterpreted as "hyperextension." However, it is not simply a reaction of tone, but appears to be more of a reflexive response. (When the individual is seated upright, or with the trunk forward, and if neither the occiput, nor scapulae, nor sacrum are being touched, often, control of the trunk and head can be exhibited with adequate righting reactions, and control.)

To move out of the opisthotonic reaction, the individual must move into an asymmetrical tonic neck reaction/reflex. If this process in interrupted or blocked the opisthotonic reaction will repeat itself, appearing as if the individual is involved with almost intractable extensor tone, or demonstrating an "obligatory ATNR.".

This reaction and sequence of reactions, to my observations, however, do not appear to be tone related, but rather appear to be protective in nature. These reactions appear to exist in all human beings, as do the "primitive reflexes" (the ATNR, the STNR, the Tonic Labyrinthine, the Moro, etc.) but are not demonstrated as obviously, or for as long a time (in development) since they become integrated with more voluntary control, including so many more complex and subtle body patterns. I do not think that increased postural control "inhibits" these reactions/reflexes, but rather it appears that when postural control is evident, the body no longer requires their exigent or immediate existence or access. IN short, when the body can utilize righting and equilibrium reactions, these more "protective/ survival" reactions are not needed by the body.

Most often an individual with opisthotonus demonstrates strong extensor tone. Seating is created to try and "break" the tone in order to attempt to manage the tone, to assist the individual in swallowing, in having head control and/or in sitting upright without pushing.

What appears to be happening is this: The individual's body appears to be attempting to protect her (as all our bodies do). Since the individual does not utilize many postures of weight bearing, her body appears to be more responsive to these protective reactions. She "jumps" as if anxious, as she cannot anticipate what is about to occur. (This is totally normal reaction for anyone who cannot anticipate what is to occur to them, and if someone else attempts to move their body). If her occiput, scapulae or sacrum receives pressure, the opisthotonic reaction is activated. Then, as she attempts to move into an ATNR to move out of the opisthotonic reaction, her body is actually blocked by the obstacles of her seating. As her body pushes against the seating, if the occiput, scapulae or sacrum is pressured by this movement the opisthotonic reaction re-occurs, and so on and so on. As her body often pushes up to actually place the head up and over the headrest, it must then be noted that she has, herself, removed her occiput, scapulae, and sacrum from touching the seating surfaces. We, as therapists, then respond by flexing the child, and pushing against the pelvis and occiput, attempting to get them back into their seats. We add even more containment to their seating systems.

However, if weight bearing can occur, or any voluntary action that requires weight bearing, which is through the trunk, pelvis and lower extremities, then the protective reactions do not have to be present.

Many individuals who demonstrate opisthotonus also appear to be tactilely sensitive. This is also a protective reaction of the body, especially when weight bearing and ambulation are not actively controlled. The actions which include proprioception (the body's knowledge of each joint's location), weight bearing (relationship with gravity), equilibrium (balance), righting reactions (using the body to be upright when activated by gravity), automatically activate and utilize the vestibular system (the system controlling equilibrium, weight bearing, righting and balance). The vestibular system does not require the protection of the tactile system (the system we all utilize when resting), but rather contains its own.

The body appears to be "out of control" since it is tactilely sensitive, (that means extra sensitive to handling, is prone to extra protective responses, e.g. frequent startle reactions) as well as utilizing this opisthotonus/ ATNR/block sequence. Often, individuals with these characteristics, truly want to HELD into their chairs, as they do not feel they have control over their bodies, but that things just happen all the time, to make them out of control. These individuals also clearly do best with handling by people they know, and with whom they can anticipate what is about to happen.

They do need a very structured seating system, as they truly do not believe they have any control over themselves most of the day. Sub-asis bars and strapping are often preferred to make sure that the body is held under control.

However, the very "over-holding"of the structured seating is also, at times, is setting off the very sequence of reactions which are preventing control of the body.

How can seating be provided which does not activate this reaction? How can we recognize this reaction, and its sequential motor patterns?

First the individual needs to be handled out of the chair, on a mat table, (if an adult). The individual must be handled without touching the occiput, the scapulae or the sacrum. A younger child can be placed on her side on a mat. Moving and handling the individual must be slow, and anticipated by the individual. Therapists must place their hands on the person, tell them what is about to occur, at pressure slowly, and move then slowly. If the reaction is set off, activity must stop, and the handling must begin again. The purpose of moving into a side posture, is to then have the therapist figure out how to move the person up into a seated posture, (at the edge of the mat table or a bench) without touching the feet or head, or the scapulae, occiput or sacrum. Often, it is at this stage that tactile sensitivity can be observed. When the person is moved up and into a seated posture, they then "collapse" into the person handling them.

I am often, able to move the person into a seated posture, brining their pelvis into a weight bearing posture, and their trunk up and in front of the pelvis. Care must be taken at the feet, often the feet if, hit inadvertently, can startle the person, and then cause the opisthotonic reaction to occur. The pelvis must be placed in a more asymmetrical position, allowing the knees to be lower than the hips. This promotes weight bearing.

I also utilize a "barrier" vest when working with a child. (This will not work with an adult or large child). I work with an orthotist or a certified orthotist technician to make this vest. They are very used to making TLSO's, and at first may be skeptical regarding the use of this one. This is a lightweight trunk orthosis. It can be billed as such, and should be billed at the cost of labor, materials, etc. by the orthotist. (It has been reimbursed here in PA by all insurance companies and by Medicaid as a lightweight trunk orthosis for under $500.00. This cost does presume that the vest is created "in house" at the site of the orthotist. This allows them to make it directly on the child, create it on site, and then fit it. The child then leaves with the vest in hand. This is the method I suggest using. Otherwise, if the orthotist sees the child at home or school, and then must go back to construct the vest, measurements must be taken, and a mold constructed, from which the vest is made. This is much more costly, and is not constructed directly on the child. I strongly suggest this not be the process considered.)

A prescription for a lightweight trunk orthosis is needed by a physician, for the child. I usually talk to the physician personally describing what I need and why I need it.

This vest is a lightweight, low temperature plastic, formed to fit the child's trunk. (Plastazote, pink/flesh colored is soft, and white is firmer, use 1/2" depth. I prefer to use the pink/flesh colored, have only used the white for a larger child, it is not my preference, as its edges are less soft next to the skin.) If the child has a feeding tube, a hole can be cut out (through both layers) to readily accommodate it.

Straps can be attached on the front with grommets, and a D-ring, or can be totally circumferential, and be glued into place. If the grommet type strapping is chosen (both work, I have no preference, it is usually the orthotist's preference I follow), however, please instruct all who assist the child in getting in and out of the vest, to hold the grommetted part securely when pulling the strap closed. This is NOT an MAFO or AFO strap. The plastazote is a "soft" material, and the strap will pull right out of the material, if the strap is pulled too hard, without assisting it by holding onto the strap's base at the grommet.

It is to be worn by the child during an activity to assist them in maintaining an upright posture, and prevent their trunk from collapsing. As a therapist I explain that as I handle some children, they have a tactile reaction of collapsing as they interpret a singular point of pressure from my hands. They also can be observed to "hang" on their chest straps or trunk supports. This vest prevents the collapsing, yet also acts as a "barrier" to the sensation of singular points of contact. The child is then able to weight bear in the pelvis (while they are in treatment or how we have created their seating system) and learn to integrate the use of the shoulder girdle with the pelvic girdle, learning increased upright alignment.

The skepticism is usually about the use of this low cost, low temperature material, as it is not nearly as strong as a standard hard plastic formed orthotic vest. We do not want it to be. As a low temperature plastic, the child does not have difficulty getting used to it, and any adjustments needed to be make (pressure under the axilla, or at the hip) can be made by simply cutting the material, it does not have to re-formed, nor re-heated. The material needs to be just firm enough to prevent a full trunk collapse, and to prevent the sensation of a singular point of pressure.

To make the vest, the orthotist needs to measure the child on an examining table, while the child is in supine. They need to measure from the axillae to the ASIS, and in the rear (with the child moved to side-lying) the PSIS. Then the circumference of the vest, is in one piece, it is NOT valved.

Measure the child's trunk from one nipple all the way around to the same nipple, then add an addition length from one nipple to the other. (In short, the vest will lay over itself on the front of the child from nipple to nipple). This will give it some additional strength, to prevent collapsing, and the straps can be placed on this front section without touching the child.

The vest must be formed around the ASIS's so that it will sit properly on the hipbones, when the child is seated in an upright posture. It is not so hard fitted, that there will not be room to move within it, that is why this softer material is used.

The child wears a T-shirt, it takes only a few minutes in the oven at the orthotist's to heat the cut material. Then, the orthotist will come out, and the treating therapist needs to assist him by lifting up the child, laying them on the material, bringing the material around and over the front of the chest. One person pulls the material over the other, while the other adult presses in at the hips for some curvature of the material there.

It is actually a very simple process, I tell the orthotist it is a simple TLSO, made of a much more lightweight material. It is not to prevent scoliosis, it is just to prevent collapse. When the orthotist realizes it will cross over in front, they are then readily able to make the vest. They add straps to it, on the front, and usually sand or bevel out the edges. The whole process from measuring, to heating, to fitting, to creating, has never taken more than an hour, and is often closer to 30 minutes.

Plastazote; low temperature plastic, lighterweight and less conforming than standard, valved, TLSO orthotic jackets. Pink/flesh color is SOFT (the one I use most often now); White is firmer, I have used it, too. I use the 1/2" depth.

From: Cascade Orthopedic Supply, Cascade West 1-800-888-0865; Cascade East; 1-800-888-0380; Cascade South; 1-800-888-0477 (These manufacturer's are well known to orthotists.) If there are any questions or concerns regarding this construction, please do not hesitate to contact me. If a real photo is needed, of a child wearing the vest, please do not hesitate to contact me, and I can readily email one to you.)

With the use of the barrier vest, I can then begin to assist the person in activity, teach handling techniques to the caregivers, and develop seating systems which allow the individual to utilize more weight bearing. The opisthotonic reaction does not go away, is not cured, nor is it "inhibited." Instead, we look for the body to develop processes of integration, ever developing more complex patterns of movement, where less protection is required.

Under Pressure: Managing Pressure Outside the Bed

Linda Norton, OT Reg. (ONT)

In Canada the incidence of pressure ulcers is approximately 26% in acute care hospitals, 31% in non acute care facilities (Long Term Care, Nursing homes, and 17% in community care …. with an average cost of care in the community of $27,500.00 (Canadian) for 3 months of care.(1) Bed rest has commonly been prescribed as a treatment for pressure ulcers, however there is no compelling evidence that bed rest is an effective treatment for pressure ulcers, and in fact may result in many medical complications (2) Finding an alternative to bed rest to manage pressure becomes important in light of this research.

Clinical Practice Guidelines:

The Agency for Health Care Policy and Research (3) and the Registered Nursing Association (4) are two of a number of organizations which have developed guidelines related to the management of pressure ulcers. Their guidelines (3, 4, 5) state in part that "a client who has a pressure ulcer on a seating surface should avoid sitting. If pressure on the ulcer can be relieved, limited sitting may be allowed." (Strength of evidence = C) This recommendation was based on expert opinion and the results of two studies.

One was a study to measure interface pressure during balanced and unbalance sitting. In this study, interface pressure was measured on the measuring device without a pressure reducing cushion, with the feet unsupported and the hands lightly supported in front of the chest or abdomen. Each of these factors would cause an increase in seating interface pressures, and as a result, the high interface pressure scores would not be unexpected. In fact the authors agree with this assessment "we believe that with the feet supported, however, part of the weight borne by the thighs would have been shifted anteriorly to the feet and some would have been shifted posteriorly to the buttocks."(6) The position studied, is not typical of clients using mobility devices. Most clients use some type of cushion, often a pressure reducing cushion, usually use footrests and have a better weight distribution. Those who are able, also engage in pressure management techniques such as lateral shifting, lifting off the cushion, bending forward etc. This dynamic position change also impacts the pressure distribution over time. Considering the significant differences in the posture evaluated, and the typical posture and equipment used by people with disabilities, the findings of this study can only be applied with caution.

The second study examined how often spinal cord injured clients engaged in "lift off" behavior to relieve pressure (7). The authors discovered that the clients were not engaging in "lift off" behavior as often as instructed. Interestingly, only one subject in the study did develop a pressure ulcer after a prolonged episode of sitting, however did not develop a sore after similar previous episodes. The authors concluded "while a single episode of prolonged sitting of this magnitude may be necessary for the formation of a sore, it is not always in and of itself sufficient."(7) This study seems to suggest that this group of clients with spinal cord injuries could tolerate sitting in their chairs without apparent ill effect even when not engaging in "lift off" behavior as often as recommended.

There is a large body of research which has documented the complications of bed rest. Complications of bed rest include contractures, muscle atrophy, osteoporosis, pathologic fractures, urinary tract infections, decreased cardiac reserve, decreased stroke volume, resting and post exercise tachycardia, orthostatic hypotension, pulmonary embolism, deep venous thrombosis, pneumonia, anorexia, constipation, bowel impaction, depression and decreased executive functioning(8-13) .

Bed rest as a treatment was evaluated by Allen et al (14) by reviewing reports of 39 trials of bed rest for 15 different medical conditions and procedures. These medical conditions/ procedures included pressure ulcers, rheumatoid arthritis, proteinuric hypertension during pregnancy, spontaneous labour, acute low back pain, uncomplicated myocardial infarction, cardiac catheterization, lumbar punctures etc. In the 24 trials reviewed regarding medical procedures, it was found that "no outcomes improved significantly and eight worsened significantly." (14) In addition, of the 15 trials investigating bed rest as a treatment for medical conditions, including pressure ulcers, "no outcomes improved significantly, and nine worsened significantly…overall there was no evidence that bed rest has any significant beneficial effect when used as a treatment" (14)

The psychosocial complications are of particular interest due to the rapidity of the onset. One study examined the impact of bed rest on normal healthy volunteers. Twenty-nine percent of young persons placed in a simulated hospital room developed subjective sensory distortions after 2 _ hours.(12) "If young, healthy adults on moderate social isolation for only 2 _ hours experience unmistakably distorted sensations, what must happen to the elderly, the debilitated, the truly "isolated" patient who lies in bed day after day" (15)

Managing Pressure Outside the Bed

Managing pressure is only one component of prevention and treatment of pressure ulcers. In addition to managing pressure other factors must be assessed and addressed including nutrition, incontinence, local wound care etc.

In bed, it is important to ensure that the support surface is providing adequate pressure distribution. The Agency for Health Care Policy and Research Guidelines (3) as well as the Registered Nurses Association of Ontario (4, 5) recommend a static support surface is used when the client can assume a variety of positions, and does not bottom out the surface. A dynamic surface is recommended when the client can not assume a variety of positions, they bottom out other surface or if the wound is not healing. (3-5) These guidelines may need to be tempered with other considerations. For example, it may not be pressure that is preventing closure, perhaps nutrition or incontinence is the issue. In addition other dimensions including client factors (physical status, number of sores, activities of daily living, autonomy, comfort/ compliance/acceptance, independence); environmental factors (living arrangement, space), caregiver concerns (maintenance/care required of the product and client, manageability, ease of use etc); and product parameters (durability, fit with the overall patient management plan, surface to floor height, weight limit, cost, other associated costs e.g. linen, power etc.) need to be considered.

In terms of pressure, shear and friction assessment and management, each surface with which the client comes in contact must be evaluated. How does the client transfer on to that surface, how long do they spend on the surface, what are the typical activities completed on that surface, and what posture? Regular skin checks should be implemented to help determine which activities and surfaces are creating the most risks. Once the source of the pressure is determined it can be addressed through changes in care routines, and/or adapting the surface with pressure reduction/relief material. One other alternative to consider is whether alternative positioning such as the use of a standing frame can be part of the pressure management plan.

Taking a holistic view of the client, decreasing the use of bed rest and managing pressure through out the client's day will likely result in better client satisfaction as their needs and desires are considered as part of the care planning process.

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Creative Molding Or Why Everything We've Learned Doesn't Always Work

Jill Sparacio, OTR/L, ATP, ABDA

Custom molded seating is often the only seating option for severely involved individuals. When creating surfaces for support, traditional practices revolve around the correction and accommodation of deformities. What has been overlooked for many years are the positioning options that result in tonal balance and comfort for the individual. Frequently, our ideal picture of alignment is imposed on the client, informing parents and caregivers that "this is how they should sit".

Our ideal position of alignment has always included many components. As learned during mat evaluations, the pelvis is usually addressed first. The goal has been to level and straighten the pelvis, moving it out of rotation and obliquity. The head and trunk are then addressed to insure an upright position. Occasionally, respiration and oral motor skills are evaluated to insure proper function. In accomplishing an upright head and trunk position, great force is often needed to provide the contact and support necessary. Molding bags are battled while many hands assist in holding the position. At this point, tone patterns are no longer typical for the client due to the amount of handling and positioning changes provided to them. Although total contact is hopefully provided, pressure issues are ignored. The provision of total contact does not always guarantee proper pressure distribution. Once the pelvis and trunk are in our idea of alignment, the extremities tend to fall where they may. To keep within the bounds of the wheelchair, hips and lower extremities are pressured into a forward position. Arms are an afterthought without regard to positioning. With this approach, alignment may be provided but it is at a cost to the individual's body and ability to function.

To insure that proper alignment and function are available to the individual, a thorough mat evaluation needs to be completed. In addition, simulation of postures needs to occur to identify a balanced position for function. This includes carefully monitoring tone and movement patterns. A change in pelvic position, either leveling an obliquity or decreasing rotation can greatly impact spinal alignment and tone. Subtle rotation in the spine can cause a change in respiration or oral motor skills as well as obviously impacting visual field orientation. Forced changes in alignment can lead to an increased potential for skin breakdown from pressure or sheering as well as the potential for fractures.

By fully evaluating the individual, a position of tonal balance can be obtained. This position however, can include an exaggeration of skeletal asymmetries and an "awkward" presentation away from our "ideal" position of alignment. Some manifestations of this awkward position can include a severe accommodation for a pelvic obliquity, an extremely windswept lower extremity position and re-orientation of the rotational component of the individual's scoliosis. Often, there is concern from the caregivers that their individual "isn't straight". Once these positions are identified, the support surfaces need to be created through the molding process. This process should be of short duration, providing minimal contact and few position changes. Identification of new weight bearing surfaces need to be evaluated to insure that potential risks are eliminated. Once complete, a creative means to install the cushions in the mobility base has to be done. This can include orientation changes in the mobility base as well as re-orientation of the seating on the base. Creative hardware is sometimes needed to allow this to occur.

Once the system is assembled, fitted and delivered, careful monitoring of the individual's overall function needs to be done. Areas to address include skin integrity/pressure, respiratory skills, feeding/oral-motor skills and overall function of the individual. If any areas present with issues, revision is necessary. The process of molding seating is on-going to insure that the system is able to change as the individual changes.

Use of a non-traditional approach to molding can be very beneficial when seating individuals with multiple limitations. Although our tendency is to impose our ideal position of alignment on them, we need to fully understand their tone and movement patterns while taking into consideration their need for support. Although the end result may appear awkward, frequently the individual is able to experience greater comfort, relaxation and most importantly, greater function.

Therapeutic Positioning During Sleep

Kelly G. Waugh, MA, PT

What is Sleep Positioning?
Sleep Positioning is the specific therapeutic positioning of a person's body during sleep.

Why is Sleep Positioning needed for some persons?
1. To prevent or lessen the development of orthopedic deformities
Many individuals with neuromuscular problems are at risk of developing pressure sores, loss of joint range of motion, and orthopedic deformities such as scoliosis and hip dislocation that may lead to costly surgical intervention. Many of these persons spend much of their day and night in destructive, asymmetrical postures which actually facilitate the development of orthopedic deformities and associated health complications.

The concept of therapeutic positioning during the daytime is widely accepted. Many types of wheelchairs, seating systems and other pieces of adaptive equipment are used in order to help individuals with motor impairment maintain symmetrical, stable postures during the day, both to help them function but also to help prevent orthopedic complications. However, these same individuals may be spending 8-12 hours / day in bed, lying in asymmetrical, destructive postures which can negate the benefits of good positioning during the daytime. Therapeutic positioning during sleep can be especially effective because the person is not performing tasks which may increase muscle tone and abnormal movement patterns. Sleep Positioning can therefore be a vital component in the overall 24-hour postural management and care of individuals with severe motor impairment.

2. To promote health and maintain safety during sleep
Some individuals with motor impairment also have significant health problems, and they require frequent attention during the night to keep them safe. For some individuals, basic physiological mechanisms such as breathing and swallowing are influenced by body posture and movement, as well as body position with respect to gravitational forces. Some individuals are even at risk of becoming entangled in bedcovers or pillows because of uncontrolled movement patterns, leading to possible asphyxia.

3. To improve the quality and duration of sleep
Many individuals with physical disabilities have a difficult time sleeping, due to an inability to control their body position, abnormal muscle tone and movement, discomfort or pain, or because of difficulties with breathing or swallowing. This leads to poor sleep quality and duration - essentially sleep deprivation - for both the disabled individual and their caregiver. Restorative sleep is essential for people with physical disabilities in order to help repair soft tissue trauma that may have occurred during the day (from abnormal postures and spasticity), to optimize immune system functioning, to promote normal growth in children and to maximize cognitive and physical performance during the daytime.

What are the potential goals of Sleep Positioning?
In summary, the primary goal of Sleep Positioning is usually to help a person maintain a stable, symmetrical, comfortable sleeping position throughout the night in order to:

- Help maintain joint range of motion and reduce the risk of developing orthopedic deformities by increasing the number of hours the person spends in symmetrical, therapeutic postures

- Decrease joint stiffness and pain which may result from sleeping in asymmetrical postures

- Increase health and safety during sleep by maintaining positions that help to prevent reflux, aspiration, choking and/or positional apnea, allowing for safe swallowing of secretions and optimal respiration throughout the night.

- Increase safety during sleep by preventing persons from becoming entangled in bed covers or pillows.

- Prevent bodily injury from uncontrolled movement patterns

- Minimize pressure areas on the body during sleep in order to improve comfort and sleep duration, as well as to decrease the risk of pressure sores for persons at risk.

- Improve the duration and quality of sleep, in order to promote optimum health and improved physical/cognitive functioning during the day.

The Sleep Positioning Clinic at Assistive Technology Partners, Denver, Colorado

Assistive Technology Partners (ATP) is a joint program between The Children's Hospital of Denver and the University of Colorado Health Sciences Center which serves the assistive technology needs of children and adults, including clinical services in the areas of wheelchair seating and mobility, seated mobility access and training, sleep positioning, computer access, augmentative communication, EADL's, and workstation ergonomics. The Sleep Positioning Clinic (SPC) is ATP's newest program, initiated in August of 2003. The purpose of the Sleep Positioning Clinic is to provide evaluation to determine the need for specific therapeutic positioning during sleep and to recommend appropriate intervention strategies and/or positioning equipment for nighttime use. The evaluation is performed by a physical therapist with expertise in therapeutic positioning and assistive technologies. A report is generated from the evaluation to pursue funding for any recommended equipment, in coordination with a local durable medical equipment vendor. After the equipment arrives, the SPC therapist provides set-up of equipment in the client's home (as needed) and education of caregivers and home treating therapists. The SPC frequently addresses alternative, therapeutic daytime positioning as well, in order to provide 24-hour postural management.

Comparison of Telerehabilitation and in Person Assessments in the Determination of Wheelchair and Wheelchair Accessories Recommendations

Ana Allegretti, MS, OT

People living in remote areas of the U.S. have been experiencing shortages of healthcare professionals and technical resources related to healthcare. Many individuals requiring healthcare find themselves isolated from advancements and technologies used in metropolitan centers. Gaining access to the latest technologies and services can be daunting for a person who has to travel long distances to acquire such services. Technologists and clinicians are investigating ways of bridging the gap between specialized healthcare services and people living in remote areas. Telemedicine has emerged as a useful tool in bridging this gap. In the field of rehabilitation, telerehabilitation (TR), a subcomponent of telemedicine, has been shown to be effective in providing efficient healthcare support, assistive technology assessment and intervention remotely to individuals living with disabilities.

The objective of this study was to analyze the use of TR as a clinical tool to provide recommendations based on a wheelchair seating assessment. Four licensed clinicians with experience in seating and mobility assessed each subject. Subjects physically located at Humana Engineering Research Laborites (HERL) received an assessment, via the Center for Assistive Technology (CAT) using TR, this situation is known as CAT TR. The same subject, received an in person (IP) assessment at HERL, this situation is knows as VA IP. When the model patient was physically located at the CAT received an assessment, via HERL using TR, this situation was known as VA TR, and when he/she received an in person assessment at the CAT, this situation is known as CAT IP. The order was randomized to assure that equal subjects were seen at each location, and to assure that the order of the assessments at each location was balanced. In both TR assessments there was an assistant to guide the clinician during the physical motor assessment.

For hypothesis #1, a Kappa analysis was used to calculate the level of agreement between IP and TR assessments for the types of wheelchair recommended and accessories. Results showed an excellent level of agreement between IP and TR related to the wheelchair general recommendation category. There was also an excellent level of agreement found across all sites in the recommendations made for the wheelchair accessories categories in 2 out of 13 variables: type of frame and type of joystick.

For hypothesis #2, Fischer's Exact was used to determine the association between physical motor assessment and wheelchair final recommendation. There were two variables out of twenty-eight found to have significance across all sites: 1) the subject has a caregiver, and 2) tone is a problem. It is therefore likely that these two variables are related to type of mobility device prescribed.

Possible limitations in this study include the fact that the clinicians did not complete the questionnaire correctly or with consistency, the sample size was small, assistants were not clinicians, and the inherent limitation of using a two-dimensional camera system. However, given the cost-efficiency and access to improved specialized treatment to an individual in remote areas, TR may still be a useful tool in a clinical setting. Therefore, future research should investigate further the use of TR as a clinical tool in the field of seating and mobility.

Custom Body Support Using the 2nd Generation Matrix System

Steve Cousins, PhD, SRCS
Denis May, PhD
Ron Clarke

Introduction

The concept of structural matrices for use in rehabilitation (1,2,3) has lead to worldwide fittings of over 30,000 matrix seating systems (a type of sitting orthosis). The concept was to "design a universal structure, or structural matrix … defined as an array of small components that can be linked, shaped and locked to form a strong enclosing or supporting structure." Additionally the "matrix approach takes advantage of mass-production techniques for producing standard components." The vision was that the "frequency of patient visits may be reduced, as changes to the shape and strength of the orthosis can be made while the patient waits. The comfort of the patient will be increased by the provision of lightweight and cool structures that conform and respond to their needs." The concept was later restated (4) "to speed production, lower costs and reduce the reliance on skilled technicians for the custom fitting processes in orthotics and prosthetics, it was proposed to divide support surfaces into load bearing, interlockable, segmented structural elements that could be mass produced."

From this worldwide experience design improvements were proposed. This paper reports on component re-design and the resulting laboratory and clinical evaluations. The re-designed (2nd Generation vs Original Matrix) components are thinner (about 25%), flatter (three times the surface area), stronger (nearly 3 times), lighter (due to less framing and material changes), simpler (6 parts down to 3) and more corrosion resistant (stainless steel). The new components have true 3D forming capability (2-ball) by adding a translatory degree of freedom to the ball and socket joint. The 3mm thick cladding allows reinforcement to be applied anywhere on the Matrix shell compared to the old bulky frame.

Evaluation

Pre-production evaluation was conducted on 10 patients followed by post-production evaluation with 60 patients, 20 full shell and 40 back support fittings using indirect (casting) and direct (to the patient) fitting methods. In parallel destruction testing of nearly 450 structural elements before and during all stages of the design's evaluation were undertaken. A further detailed retrospective measurement was made of eight casts and finished shells of the Original Matrix to determine part orientation and the distribution of custom components. The direct fitting method was improved by taking eight 'orthotic' measurements that results in a reduction of patient fitting time to about 30 minutes. From a workshop perspective the new design reduces fabrication and subsequent alteration time by about 30 to 40%. Equally, post delivery re-shaping times were reduced.

Conclusions

(1) Increased strength means,
- (a) less framing with reduced weight and bulk (improved cosmesis), decreased production/adjustment time,
- (b) flexible components now possible because slippage is eliminated,
- (c) 'off the shelf' back supports – no custom frame.

(2) 3D capability
- (a) speeds the production process (less special threaded connectors),
- (b) strengthens the final product (metal core to 2-ball), (c) allows major adjustments directly on the patient at fitting and post delivery,

(3) Cladding allows
- (a) reinforcement to be easily added anytime,
- (b) a thinner and more cosmetic structure.

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Client Satisfaction of a Wheelchair and Seating Program: An evaluation of alternative methods of service delivery

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Laura Titus, OT Reg. (Ont.)
Jan Miller Polgar, PhD, OT Reg. (Ont.)

Introduction

An seating and mobility clinic that provides outpatient services to adults identified a number of process issues that affected the efficiency of the service. Program evaluation was undertaken to determine the efficacy of this service in addressing clients' needs and to identify opportunities to improve service quality. This paper presents the results of a client satisfaction survey that comprised part of this program evaluation.

Method

The study design was a pre and post evaluation of alternate methods of service delivery using a self-administered client satisfaction survey. The survey was developed to produce quantitative data to describe participants' satisfaction with the seating program's service delivery in terms of participants' appointments, impact on quality of life, wheelchair /seating goal achievement, overall impressions, demographics and additional comments. The data analysis was completed through a comparison of pre and post test findings using descriptive statistics and frequency percentages. The Mann Whitney U Test, a non-parametric statistical test was used to compare scores of the pre and post group with a significance level of .05. Data were analyzed based on individual survey questions, in addition to an analysis of groupings of questions in each section. The qualitative data (i.e. written responses) were collated verbatim per question and themes were identified. To ensure reliability and consistency in data analysis, a step-wise replication strategy was used to identify themes, whereby two researchers analyzed the data separately and then came together to compare results (Krefting, 1991).

Participants for this study were selected from a database of clients who were assessed and discharged from the seating program. To meet the inclusion criteria participants had to have been involved in the entire intervention process, from the initial assessment to the final fitting. Individuals were excluded from this study if receipt of a survey would be emotionally distressful or if the client had no means of responding to the survey. A total of 123 surveys were mailed to potential participants and 55 surveys were returned including 36 in the pre group and 19 in the post group. Surveys were colour coded to indicate group membership.

Results

Sample Fink (2003) indicates that a 20% response rate for an unsolicited survey is quite typical and with follow-up the response rate can be increased to 70%. For this study a response rate of 44.7% was achieved after a follow-up postcard reminder was sent to participants. The pre group (n=36) and post group (n=19) were generally similar in terms of age, gender, diagnosis, type of dwelling and urban vs. rural living demographic characteristics.

Participants' Appointments Participants were asked to rate their level of satisfaction with their appointment with the seating program on a 1 to 3 scale with 3 indicating satisfaction. A modal score of 3.00 suggested that generally respondents were satisfied with their appointments. Respondents of both groups were most satisfied with the respect and courtesy of the staff and the staff concern for them as a person.

Goal Achievement Participants were asked to rate the extent to which their goals were achieved through their involvement with the seating program. These goals included to: 1/ reduce skin breakdown, 2/ change one's wheelchair or seating equipment, 3/ obtain new equipment,4/ improve comfort, 5/ improve posture or positioning in the wheelchair, and 6/ improve mobility. Goal achievement was rated on a scale of 1 to 3 with 3 indicating the goal was achieved. Generally, both the pre and post group indicated that they had achieved their goals with mean scores for the pre-group ranging from 2.60 to 3.00 and mean scores ranging from 2.40 to 2.69 for the post group. Less than 6% of both the pre and post groups rated their goals as having not been achieved. For goals 2&3 the pre and post groups differed significantly using the Mann-Whitney U test, at $U=141.50$ and $U=92.00$, $p<.05$ respectively.

Impact on Quality of Life Participants were asked to rate the effect the wheelchair/seating equipment use had on their quality of life. With the exception of 1 participant in each group, all participants indicated that their wheelchair had a positive effect on their quality of life to at least some extent.

Overall Impressions Participant's overall impressions of the co-ordination and quality of their care, and the education provided about their wheelchair or seating equipment were evaluated by rating on a scale of 1 to 5 with 5 indicating excellent. The modal score for both the pre and post group was 5.00.

Comments Section Data generated from these comments were coded for themes. Frequency was examined across groups. Two major themes were identified: 1/ service delivery methods and 2/ the wheelchair or seating product.

A/ Service Delivery Methods

Four major themes relating to the method of service delivery emerged:

1/ Staff Performance: Both the pre and post groups included comments on staff performance using words such as friendly, knowledgeable, caring, and helpful when commenting on the performance of staff at the seating program.

2/ Patient involvement in the decision-making process: Varying degrees of comments were given by both groups relating to how they were involved in the process.

3/ Time efficiency of service (pre-group only): A wide range of comments were provided. For example, participants identified how very thorough the staff were in examining the patient and knowing what the patient required. Other participants identified that the 2 to 4 month wait for an appointment was too long. Although efficiency of time was mentioned by participants of the post group, it only presented as a major theme for the pre group. This might suggest that changes to the methods of service delivery have improved time efficiency of the service.

4/ Follow-up (post group only): Participants commented on the need for "re-evaluation to make sure all modifications made are done adequately" and "regular appointments…to be sure those changes are still working."

B/ Product Received

The major themes identified by both the pre and post groups relating to the product they received included variable comments on posture and positioning, and skin breakdown.

Discussion

Overall, participants of this study have indicated that they are satisfied with the level of service provided both in the pre and post groups. One might conclude that the seating program has at least maintained its service quality, as the implementation of alternate methods of service delivery did not negatively affect client satisfaction. The comments provided help to highlight some important issues which may exist within the service delivery process or the product provided that impacts on client satisfaction. Interestingly, both groups commented on staff performance and patient involvement in the decision making process suggesting some consistency in participants' impressions on these factors. Time efficiency, a major theme in the pre group but not in the post group might suggest that time efficiency has improved. Follow-up services, a theme identified by the post group may suggest a need for further evaluation in this area. Overall, the results of this study would support the continuation of the alternate methods of service delivery with on-going evaluation of its outcomes.

Two limitations may affected the integrity of the results. A discrepancy exists between the number of respondents in the two groups. This discrepancy affects the ability of the researcher to treat the two groups as entirely equivalent samples when making comparisons. As well, participants in the pre-implementation group had a longer time period from discharge to completion of the survey which may affect their memory of the seating intervention process. Continued use of the this seating survey will increase the sample size and improve the integrity of the results.

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Living With the iBOT: a Functional and Vocational Profile of iBOT Users in the First 6 Months

Martin Ferguson-Pell, PhD

The iBOT is an advanced new technology for powered mobility and is intended to improve access to environments with poor accommodations for people with disabilities and to increase the independence and self esteem of the user. This is achieved by using advanced technologies that overcome common barriers, by increasing participation in activities often considered inaccessible to wheelchair users and by promoting a positive self-image of the iBOT user.

In the UK the iBOT is supplied directly by Independence Technology following a specialist mobility consultation with an occupational therapist of the ASPIRE Centre for Disability Sciences (ACDS) which is under contract to Independence Technology. ACDS assesses potential users to ensure that they would be safe and effective operators of the iBOT and then trains and certifies each user. Coupled with these service delivery elements of the contract with Independence Technology, ACDS is also undertaking a project to assess the ways in which the iBOT meets the expectations of the user and may facilitate the reintegration of people who sustain a spinal cord injury.

The purpose of this project is to establish:

ß good clinical practices for the assessment of people considering purchase of the IBOT mobility system
ß good clinical practices for training to ensure safe and effective users of the iBOT Mobility System
ß establish and demonstrate methods to assess the benefits of using this new technology to improve mobility and access for people with disabilities
ß establish and demonstrate ways in which the use of this technology can reduce the costs of care and increase opportunity for reintegration for people with recent spinal injuries

To date 27 assessments have been undertaken at ACDS with 13 so far being converted to certified and trained users. The large number of assessments and users associated with a single centre is unparalleled, offering an opportunity for high quality information on the impact of the iBOT on quality of life to be collected. The protocol being used, which has received approval from the local ethics committee, employs the PIADS and PSFS questionnaires, as well as information and events downloaded from the iBOT's 'Long Term Accumulators'. These store the parameters pertaining to time usage of functions, odometer data for functions, counts of functions entries, and power cycles. The Long Term Accumulators provide information about usage patterns, but not specific faults that are recorded using other data logging components which record adverse event and alarm data.

Case Study 1 - Billy
- Male
- 28 yrs old
- MS onset 1996
- Independent in transfers
- Uses manual and powered chair
- Drives a car
- Lives in London in a flat shared with partner
- Uses iBOT generally outside
- PSFS - previous manual chair - could not talk to people in bars.

The total distance travelled in the iBOT after seven months was 1073 km and the balance function was predominately the function that he used. Billy reported that he only uses his iBOT outside. Billy rarely used 4-Wheel and standard functions. The 'Long Term Accumulators' also recorded the number of times that the wheel clusters rotated to effect a transition in/out of balance or to climb stairs (see Figure 1).

Case Study 2 - Mary
- Female
- 61 years old
- MS
- Standing transfers
- uses a manual wheelchair also
- lives in a city outside of the UK
- Lives alone
- Uses chair indoors and outdoors
- Predominately uses iBOT indoors and outdoors

The distance travelled by Mary's was approximately half that of Billy. Mary did not use balance as much, but used 4 wheel function quite regularly which could indicate a difference in the environment of the community either hilly or rough terrain. Standard function was used about 1/4 of the total distance travelled and this was probably when indoors. The number of rotations of the wheel clusters indicate a relatively frequent need to climb curbs.

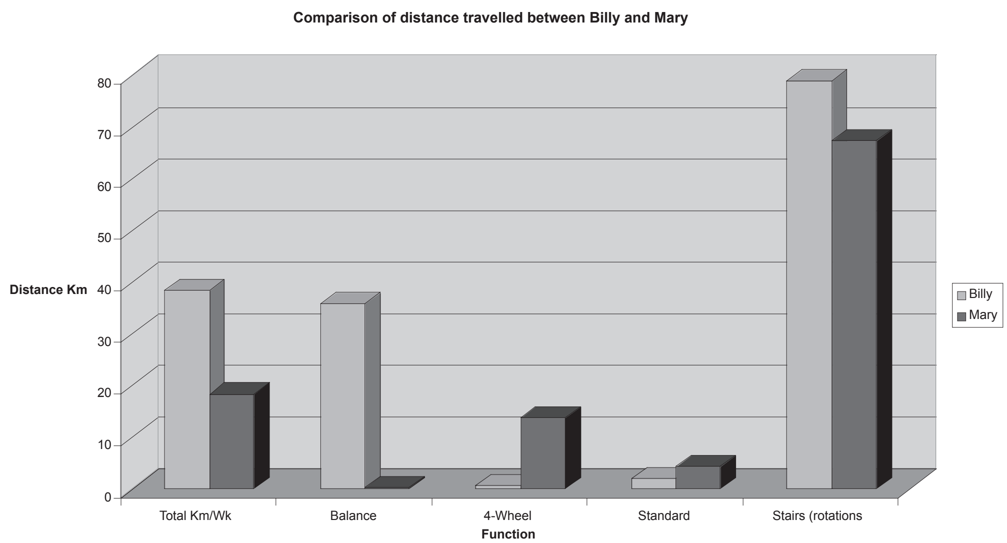

Figure 1 Comparison of iBOT use patterns for two iBOT users

Sharing Research Results – What is the Scoring System of the FIM™ Really Measuring?

Jean L. Minkel, PT

Increasingly, and very appropriately, professionals are being asked to provide the evidence to support their practices. This call for Evidence Based practice is being heard across disciplines and includes hands-on therapies as well as the recommendations for assistive technology devices.

A tool frequently cited as a bench-mark outcome measurement tool is the FIM™ - Functional Independence Measure1. The FIM™ is a well developed, well validated and widely used tool. The developers set out to design a tool that would be easily administered to document the functional change of a person from initial admission to the facility, at discharge and at follow-up post-discharge. The developers determined the factor that could be measured, and likely to be effected by an inpatient stay at a rehabilitation facility was the need for assistance (burden of care). Further, the developers chose to quantify burden of care as both the use of a device to complete a task, as well as amount of assistance provided by another person, or assistant. Fully independent completion of a specified task results in a score of seven (7). Completion of the task using a device scores a six (6) and completion with the assistance of another person result in a score ranging from Score 5 (Supervision or Set-up) to Score 1 (Total Assistance).

The FIM™ instrument has subsections, representing key activities of daily living. One subsection is named Locomotion. This section tests the persons mobility within a typical home environment including going up and down stairs. The most commonly seen items in this section test the person's ambulation ability. There are instructions included for persons who are using wheeled mobility as their primary form of mobility. These instructions outline nine mobility tasks to be tested while the person is using a wheelchair. These task range from 150 feet of propulsion, ability to turn right and left to negotiating carpeting, door threshold and maneuvering next to a toilet and a bed. Undoubtedly, these mobility tasks are the baseline skills a wheelchair riders will need to learn to successfully complete basic ADLs. Considering the functional mobility skills of a person 1 week post CVA (cerebral vascular accident / stroke) or a person month post SCI (Spinal Cord Injury); one can appreciate the FIM™ locomotion subsection is a sensitive tool to detect the change from essentially "chair and bed-confined" to being able to get around one's home to complete ADLs. As conceived by the developers, the tool works in the given application of inpatient rehabilitation.

Caution is encouraged when on attempts to use the tool in a different setting. As part of a research project, the author used the locomotion subsection of the FIM™ to document changes in functional mobility for persons living in the community, comparing their own device to a test device. The caution comes from the analysis of results.

Three different groups of subjects were identified as part of the project: Slow manual users, Skilled manual user and Power (including scooter users). Persons were classified as Skilled user if they were able to propel at least 10 feet in a wheelie and routinely propelled at or greater than walking speed. When the data of 9 wheeled mobility tasks from the FIM™ was analyzed there was a ceiling effect detected. All subjects scored the highest score, regardless of type of chair used or the ability to "pop a wheelie". The FIM™ accurately detected that each of the subjects had independent in home mobility, but could not distinguish between the three subject groups.

Because our interests extended beyond basic "in the home" mobility, we added additional mobility tasks to be tested involving tasks routinely found in a community environment. We continued to use the FIM™ scoring system to document the level of effort by the rider and/or an assistant to complete the task. The key additional items included climbing a 2" curb (up and down) and negotiating soft terrain like gravel. Persons able to propel in a wheelie rarely, if ever, needed assistance while slow manual riders were able to complete the task with the assistance of one person. Persons using power chairs were often unable to climb the curb or get thorough the gravel with the total assistance of one person.

A second observation from this study was the mismatch between measuring level of assistance need by another person (burden of care) and a clinician's need to document safety when evaluating use of a wheeled mobility device. Is the power chair candidate who needs "stand-by supervision" to prevent injuring others more or less "care" than the manual wheelchair rider who can direct a passer by how to assist them up a 2" curb (each providing 50% of the effort).

Objective measurement of the effectiveness of our interventions are critical in validating and supporting our practices. The FIM™ demonstrates the power of that data when collected in multiple centers over many years. The "moral" of the story is be sure you a tool that measures what you think you are changing. Using the wrong tool will not produce the data, which is so critically needed.

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A Randomized Controlled Trial (RCT) to Compare the Effectiveness of an Individualized Therapeutic Seating Intervention with the Conventional Seating System

Ms. Anna Wu, MSc in HT, MPH, PDOT
Eric Tam, PhD

Abstract:
Elderly seating is a major area of clinical problem in health care. Chair bound induced problems are the priority area to overcome in daily caring practice. The most common problems encountered by care taker included: poor seating posture in terms of leaning to one side, sliding out of chair and pressure sores. This study aims to investigate the difference in treatment effect of three commonly used model of seating interventions. These include seating in standard wheelchair, geriatric chair and Occupational Therapist prescribed chair. Their effect would be measured in terms of postural measurements including frontal shoulder line, frontal trunk line, frontal pelvic line and sliding forward distance as well as peak seating interface pressure.
This was a randomized controlled single Blinded crossover trial carried out in a local hospital, Caritas Medical Centre. Twenty-six patients with diagnosis of stroke were recruited and randomized to receive the three different chair designs. Crossover to receive another chair was conducted according to a randomized sequence. Sitting posture data involved measurements of "Frontal Shoulder Line (FSL)"; "Frontal Pelvic Line (FPL)" and "Frontal Trunk Line (FTL)". Peak seating interface pressure was measured using a seat pressure measurement system (Tekscan USA). The data collected were analyzed using General Linear Model (GLM) – multivariate analysis to check whether "chair design" would affect significantly the outcome of interest and Post hoc multiple comparisons for observed means would be used to differentiate the sub-group effect.

Background:
The current trend of population growth in Hong Kong suggested that more people lived longer. The percentage of elderly aged 65 or above had been rising from 10.3% (6.7 millions) in 1997 to 11.4% (7.7 millions) in 2002. In a review of functional profile conducted by Leung in 2000, he found that out of 933 residents random sampled from private nursing homes in Hong Kong East region, around 24% of them were found to be chair bound.

Various authors had identified and reported problems associated with wheelchair seating for elderly residents of nursing homes (Krasilovsky 1993; Raible 1995; Redford 1993; Taylor 1987). Redford et al. (1993) and Krasilovsky (1993) pointed out that pelvic obliquity was the most common problem in sitting experienced by these elderly and "leaning to the side" problem was closely related to pelvic obliquity. When seated, the sites on the body that were at high risk of developing pressure sores were those with relatively thin layer of tissue directly over a bony prominence such as the sacrum, ischial tuberosities and greater trochanters (Cooper 1998; Harms 1990).

In Caritas Medical Centre, three major seating models were used in clinical settings. They were namely, the ordinary wheelchair, the geriatric chair and therapist prescribed chair. In this study the two conventional seating interventions under investigation were ordinary wheelchair and geriatric chair. Therapist prescribed chair (TPC) was referred to special seating prescription provided by Occupational Therapist.

Method:
This study was a single center randomized controlled crossover trial with single blind design. Patient entered the project would be randomly assigned to sit in the three different chairs according to the sequence drawn from an envelope with all three chair models included. A blinded assessor was responsible for taking both the postural and pressure mapping data. One-month intensive training was provided. Before participating in the research, the blinded assessor had to pass the final assessment conducted by the investigator with at least 95% agreement of all the measurements.

In order to measure the effectiveness of different chairs, outcomes in terms of posture and peak seating interface pressure would be measured. Posture was defined using body landmark system to represent shoulder obliquity, pelvic obliquity and trunk alignment. For frontal plane, frontal shoulder line (FSL) was the line passing through bilateral acromioclavicular joints (ACJs) to represent the shoulder obliquity. Frontal trunk line (FTL) was defined as the line passing through the Upper Sternal Notch and the mid-point between bilateral anterior superior iliac spines (ASISs) (ISO 1684-1) to represent the degree of trunk leaning onto one side. Frontal pelvic line (FPL) was defined as the line passing through the right and left ASISs (ISO 1684-1) to represent pelvic obliquity. For sagittal plane, measuring the distance slide forward was adopted as an alternative approach to document the sagittal posture change. Distance between seat front-edge to lateral epicondyle of lower limb was taken as the postural displacement of the body in sagittal plane. For posture, three instruments were used to measure postural change. They were PALpation Meter (PALM), digital inclinometer and adapted ruler. For seating interface pressure measurement, a pressure measurement system (Tekscan, USA) was used.

In-patients of geriatric rehabilitation and infirmary ward were recruited. They were medically stable and were unable to sit independently with Physical score between 2 to 4. Patients who were independent sitter or presented with severe trunk and limbs deformities were not recruited into the study. Patients with disturbing or violent behaviors were also excluded from the study.

Two experienced Occupational therapists with more than two years experience in special seating were assigned to provide seating assessment and special seating prescription. The patients would be assessed for mental state, seating assessment, Norton score, physical score, modified Barthel Index. Based on the assessment results, the therapists would then prescribe seating treatment with following items: i.) wheeled base, ii.) dropped seat, iii.) seat cushion, iv.) back support and cushion, v.) pelvic belt and vi.) Chest harness. (Note: In the study, table top was not included into the TPC for the ease of postural measurement.) When the TPC was ready, the patient could proceed with the study. They would be randomly assigned to sit in the three different chairs, the ordinary wheelchair, the geriatric chair and the therapist prescribed chair according to the

Challenges and Solutions to Providing Assistive Technology for the Bariatric Client

Elizabeth Cole, MSPT

Material not available at time of printing.

The Henry Ford Approach to Custom Made Seating and Back Support

Steve Cousins, PhD, SCRS
Richard Hannah, MSc

Introduction
Henry Ford pioneered the use of mass production techniques to produce identical cars (in any colour as long as it was black!) In this Course we will explore the structural matrix concept, the opposite of the Henry Ford approach, that is, the use of mass-produced components for one-off, custom shaped, non-identical products (that can also be made in black).

The concept of structural matrices was proposed for use in rehabilitation1,2,3 about 25 years ago. About 5 years later serious clinical application of these concepts was started with a 125 patient trial with a 5 year follow-up4, which has lead to worldwide fittings (about 23 countries at one point) of over 30,000 matrix seating systems. The concept was to "design a universal structure, or structural matrix … defined as an array of small components that can be linked, shaped and locked to form a strong enclosing or supporting structure." The concept was later restated4 "to speed production, lower costs and reduce the reliance on skilled technicians for the custom fitting processes in orthotics and prosthetics, it was proposed to divide support surfaces into load bearing, interlockable, segmented structural elements that could be mass produced."

Developments
The concept of Structural Matrices will be described using seven designs that fall into two categories:
• Rigid, lockable segments
• Flexible, lockable segments
The subsequent clinical compromise that results from these design choices are that you can have (1) a flexible system that shapes well to the body, but is inherently structurally weak, or (2) you can have a rigid system that will support the loads on it (and/or impart corrective forces) but does not fit as easily to the body contours. Part of the reason for the improved design, the 2nd Generation Matrix, is to overcome these difficulties.

Components
The supply of a Matrix seating shell or back involves five processes. These are, generally, (1) assessment, (2) fitting, (3) reinforcement, (4) finishing and (5) re-adjustment. The system is composed of four main elements: (1) Clamp and 4-ball repeating structural elements, (2) Flexible 4-ball interconnectors in soft, medium and hard grades, (3) 3D, 2-ball connectors, and (4) Cladding reinforcement. Examples of how these components are combined to produce a finished seating system are described using pictures of completed systems.

In summary, the four main system elements give the following benefits:
General Features: (compared to original system)
• About 4 mm thinner (25%) and 2.3 times stronger
• About 20% lighter (less reinforcing framework needed)
• 3 vs 6 components in the clamp (production speed improvement)
• Larger flat surfaces (pressure risk reduction)

Flexible Components:
• Spasm trigger reduction
• More responsive shell
• Hinging for spinal de-rotation
• Dynamic mounting

3D Capability:
• Better fit to compound curves
• Improved production speed
• Easier post delivery adjustments
Reinforcement Cladding:
• Reinforcement where needed (without planning ahead)
• Thin, cosmetic reinforcement (if needed)
• Reinforcement if shell is split, seat from back

Fitting Techniques
Of the fitting techniques in use the three most basic are, (1) indirect, using a evacuated bean bag and plaster cast, (2) direct shell fitting (on the patient) of a one piece Matrix seat, in a fitting frame, and (3) direct back fitting (fitting only to a patient's back) with a prefabricated Matrix back using special mounting hardware, in a wheelchair.

Indirect Fitting Method: By using a bean bag system, where the shape can be captured by drawing a vacuum separately on at least the seat and back, a corrected shape can saved with a plaster bandage cast. The Matrix sheet can be draped over the cast (suitably reinforced) and screwed in place along the centreline (each Matrix sheet has a green centreline; the remaining material is black). This helps maintain symmetry (if the patient is symmetrical) during fabrication. Any corrections can be made at an intermediate fit or delivery stage.

Direct Fitting with Pre-measurements Method: Seven measurements can be taken from patient and, with suitable formulae, transferred to a Matrix sheet laid out on a table. The resulting shaped sheet can be formed up into a seating shell and suspended in an adjustable fitting frame (with or without bean bag seat cushion). The patient sits directed on the pre-shaped shell and it is tightened around them.

Direct Back Fitting Method: This technique is similar to the one above but the backs are all pre-shaped and selection is made by one patient measurement, the ASIS to top of shoulder. The other difference is that the back is mounted to hardware that allows it to be fitted to the patient's wheelchair. The direct fitting of the back to the patient is started at the pelvis, shaped up the back and out to the laterals. The Matrix is then tightened in columns starting from the centreline and working outward (medial to lateral tightening).

Specific Assessment
In addition to all the normal special seating assessments techniques that professions use to arrive at a prescription, a 'decision support' rating scale can be used to help in selecting general special, custom-made seating system. For example, it would help you choose between a foam carved system and a structural matrix. This tool is still under development. The score of the Physical and General Factors are added together to give the Special Seating Rating Scale total.

Physical Factors

1. Pelvis – impact of deformity, tone, sensation on:
   Score up to 6
   •Obliquity
   •Posterior tilt/Anterior tilt

2. Hips - impact of deformity, tone, sensation on:
   Score up to 6
   •Unequal flexion
   •Flexion less than 90

3. Lower Limbs - impact of deformity, tone, sensation on:
   Score up to 8
   •Abduction/Adduction/Windsweeping
   •Leg length discrepancy

4. Trunk - impact of deformity, tone, sensation on:
   Score up to 16
   •Lateral flexion
   •Scoliosis
   •Kyphosis
   •Increased/decreased lordosis
   •Rotation

General Factors

1.Postural deformity management	Score up to 3
2.Medical condition	Score up to 2
3.Continence	Score up to 2
4.Agitation/Excessive movement/Insecurity	Score up to 2
5.Current Weight	Score up to 2
6.Future Weight	Score up to 2
7.Growth	Score up to 2
8.Autonomic function	Score up to 2
9.Others?	

•Sitting ability (eg. inverted Chailey Sitting Scale)
•Postural competence (eg. Pauline Pope's assessment)

Possible 'decision support' from rating scale:

Score < 20	Custom seating not indicated
Score 21 – 30	Foam Carve indicated
Score >31	Matrix indicated
Trunk Score =>6	Matrix Back indicated

Case Study
Objectives: For this 39 year old male, with a diagnosis of Cerebral Palsy, our objectives were to provide a wheelchair and seating system that will, at minimum risk:

- Accommodate fixed deformities
- Provide lower limb alignment
- Accommodate knee flexion difference
- Accommodate plantar flexion

Patient Details: He was admitted to the hospital in 1991, initially to a rehabilitation and subsequently transferred to a continuing care ward. He has been throughout severely disabled by a dense, spastic tetraplegia, kyphoscoliosis with rotation of the trunk, choreo-athetoid movements of the upper limbs, head and neck, and tongue with repetitive facial grimacing and epilepsy. His disabilities arise from congenital athetoid cerebral palsy. Some basic and physical information is listed below:

Contraindications	Epilepsy
Medication	Carbamazepine; Bisacodyl
Height	1.64m
Current Weight	57.9kg (this is an increase of nearly 10kg since

1999. NB: this weight has been stable for 12 months+)

Target Weight	55-60kg
BMI	21.5 kg/m2
Method of propulsion	Attendant pushed
Visual status	Can inconsistently track objects
Auditory status	Normal auditory stimuli response
Communication	None established
Cognition	Follows verbal commands inconsistently, low concentrations levels
Respiratory status	No problems noted
Sitting tolerance	6-8 hours
Skin integrity	Intact
Ability to pressure relieve	None
Method of transfer	Hoist
Continence	Doubly incontinent
Feeding / swallowing	PEG fed
Transportation issues	Travels in a wheelchair in an ambulance/ adapted vehicle
Environment	Indoor and outdoor
Future placement	Long term care facility

Pelvis
- Raised and forwards on the Right – fixed
- Fixed in posterior tilt
- Unequal weight distribution

Hips
- Bilaterally adducted and internally rotated – limited correction
- Resting angle of Right hip is 120º but can achieve 110º
- Resting angle of Left hip is 110º

Knees
- Left rests at 50º flexion
- Right rests at 45º flexion but can achieve 90º

Feet
- Bilaterally plantar flexed – Right can be corrected to plantar grade but Left is fixed

Trunk
- Left convex scoliosis – see photographs
- Flexed lower and upper spine

Shoulder Girdle
- Bilaterally protracted
- Rotated forwards on the Right

Upper Limbs
• Active but non-functional movement
• Left arm rests in a flexed and pronated position
• Right arm tends to rest in extension

Head / Neck
• Flexed
• Rotated to the Left
• Good passive ROM
• Good active head control

Discussion: He was admitted with a MSI (one piece moulded seating insert – vacuum formed). He has had two Matrix sitting shells (Original Matrix) made during his stay in the continuing care facility with a new system (2nd Generation) completed recently. His 24-hour physical management will be discussed, supported by a review of his physical condition and treatment all in conjunction with a review of the recent seating systems (with photographs).

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Measuring Wheelchair Seat Comfort:
Research Methodology and Application to Clinical Practice

Barbara Crane, PhD, PT, ATP

Wheelchair seating discomfort is an important but poorly understood negative outcome for long duration wheelchair users. A major impediment to the study of this problem is the lack of a validated tool for quantification of wheelchair seating discomfort. The goal of this research was to develop and validate an assessment tool appropriate for the quantification of wheelchair seating discomfort among long duration (> 8 hours per day) wheelchair users. This was accomplished through the completion of three research phases. Phase I consisted of a qualitative research study involving in-depth interviews with experienced wheelchair users. Data from these interviews resulted in the development of the Tool for Assessing Wheelchair (dis)Comfort (TAWC) a three-part tool to allow wheelchair users to quantify their level of seating discomfort. Phase II of the research assessed the reliability and concurrent validity of this assessment tool through a test/re-test reliability study. Intra class correlation (ICC) coefficient scores ranged from 0.83 to 0.97, indicating adequate reliability of the two discomfort scores in the TAWC. Internal item consistency, assessed using Cronbach's alpha scores, indicated that all items were relevant and not redundant, with scores ranging from 0.82 to 0.92. Pearson product-moment correlations were used to assess the concurrent validity of the TAWC and all of these correlations were significant at a minimum of $p < 0.05$ level, with many significant results at the 0.01 and 0.001 levels. These results indicated good concurrent validity of the TAWC. In Phase III, the TAWC was evaluated for its ability to show changes in discomfort over time and with the introduction of novel, user adjustable wheelchair seating. Both the General Discomfort Assessment score (GDA) and the Discomfort Intensity Score (DIS) were sensitive to changes in seating discomfort level and were adequate for use in detecting differences associated with duration of sitting as well as those associated with use of different seating equipment. Results of this final phase indicated that the TAWC is a useful tool for evaluation of wheelchair seating discomfort in a research or clinical environment.

Introduction and directions:
This questionnaire has been developed as a way of determining the level of discomfort you experience while you are sitting in your wheelchair.
There are three parts to this questionnaire:

- Part I asks you to provide general information that is important in evaluating seat discomfort.
- Part II asks you to rate your level of agreement with several statements about comfort and discomfort.
- Part III asks you to assign a number on a scale from 0 to 10 to describe a discomfort level for each region of your body.

Part I: General Information:

1. What time did you first transfer into your wheelchair today? __________ am/pm
2. How much assistance do you need to transfer?
   - _____ I transfer completely by myself
   - _____ I require assistance from another person to help me transfer
   - _____ Another person transfers me, I am unable to help
   - _____ Another person uses a mechanical lifting device to transfer me
3. If someone assisted you in transferring, were you positioned properly in you chair after being transferred?
   - _____ yes _____ no
   - Describe problems if any occurred (anything out of the ordinary):
   ____
4. What time is it now? __________ am/pm
5. In the last 4 hours, have you asked anyone to help you change your position in your wheelchair?
   - _____ yes _____ no
   - 5a. If yes, how many times have you asked someone to reposition you?________
6. In the last 4 hours, have you changed your own position?
   - _____ yes _____ no
   - 6a. If yes, how many times have you changed your own position? ________
7. What types of activities have you done in your wheelchair in the last 4 hours? (check all that apply)
   - _____ moved around in the house
   - _____ went outside of the house
     - ______ into the yard (grassy or rough surface)
     - ______ onto a deck or paved driveway
     - ______ traveled on a sidewalk surface
   - _____ traveled somewhere in a van or car
   - _____ went to work in my wheelchair
   - _____ went to school setting in my wheelchair
8. How many car lengths would you say you drove your wheelchair in the last 4 hours? ______
   (a typical car is 12 feet long)

Tool for Assessing Wheelchair (dis)Comfort (TAWC)

Think about how you have felt while seated in your wheelchair:

Part II: General Discomfort Assessment

Please rate your answer on the following scale: (place a mark in the appropriate box)	**Strongly disagree**	**Disagree**	**Partly disagree**	**Neither agree nor disagree**	**Partly agree**	**Agree**	**Strongly agree**
While seated in my wheelchair…							
…I feel poorly positioned							
…I feel like I have been in one position for too long							
…I feel like I need to move or shift my position							
…I feel aches, stiffness, or soreness							
…I feel pressure in some part or parts of my body							
…I feel too hot or cold or damp							
…I seek distraction to relieve discomfort							
…I feel uncomfortable							
…I feel no pain							
…I feel stable (not sliding or falling)							
…I feel comfortable							
…I feel good							
…I feel able to concentrate on my work or activities							

Part III: Discomfort Intensity Rating

On a scale of 0 to 10, **0 being no discomfort** and **10 being severe discomfort**, please **RATE and DESCRIBE** the amount of discomfort you feel for each body area listed below.

This rating should reflect the intensity of your discomfort for the time you were in your wheelchair:

Body Areas	Rating:	Please describe the discomfort (for example: aching, burning, pressure, instability, or others)
Back		
Neck		
Buttocks		
Legs		
Arms		
Feet		
Hands		
Overall Discomfort Level (General discomfort level)		
Other areas? Please list:		

Non-Traditional Roles for Clinicians

Kay Koch, OT, ATP

As a clinician, more and more options out of the clinic have opened up in our field. During this hour, you will complete a short journey around the buffet table of these options. This session will also introduce a guideline for the foundation necessary to venture out of the clinic. The pro's and the con's to choosing a non-traditional role as well as some thought provoking ideas to help you guide your way will be included

I. Traveling Therapists
II. Healthcare Recruiter
III. Sales Reps/ Account Executives
IV. Education
V. Consultant
VI. Case Managers/Life Care Planning
VII. Product development and /or design
VIII. Research

Traveling Therapists-

1. Short Term assignments - 6 months or less
2. Long Term assignments

Healthcare Recruiter-

1. Clinical settings
2. Industry positions

Sales Rep/ Account Executives -

1. Direct Manufacturers
2. Durable Medical Equipment Companies
3. Independent Manufacturer's Reps

Education -

1. Manufacturers programs
2. Industry Organizations
3. Publications
4. Web Sites/ Web Design
5. Guest lectures at University

Consultant-

1. Independent contractor to manufacturer
2. Independent workshops and seminars
3. Funding sources and Insurance Companies
4. Industry organizations

Case Managers/Life Care Planners-

1. Independent
2. In practice group
3. Insurance companies or other funding
4. Rehab facility

Product development and/or design-

1. Manufacturers
2. Product needs assessments
3. Tech support
4. Product development company

Research-

1. Academic
2. Clinical
3. Policy
4. Laboratory

Who Needs Power?

Gloria Leibel, OT (C)
Kathryn Fisher, BSc, OT Reg (Ont.)

There are a number of common misconceptions that may concern families when considering the option of power mobility for their child:

- Using a power wheelchair is an essential form of exercise
- People look more disabled when using a power wheelchair
- If you drive a power wheelchair you will never walk
- Walking with a walker is more functional than using a power wheelchair
- If you have a power wheelchair you will not use any other equipment ie. Manual wheelchair, tricycle etc.
- Driving a power wheelchair makes you less independent
- Power wheelchairs have more difficulty with environmental accessibility

Although these "myths" may derive from some truth, it is important to educate clients, families, and caregivers as to the long-term consequences of choosing (or not choosing) power. Each individual situation (diagnosis, environment, and social network) will present challenges therefore it is important to identify priorities for mobility and seating options. Considering the client's condition is essential. It is important for the family to understand the progression of the condition and the role mobility equipment will play in enabling the child's function.

Three common conditions where power mobility offers significant benefits for independence are as follows:

- Spina Bifida
- Muscular Dystrophy
- Cerebral Palsy

Spina Bifida

Spina Bifida is defined as the incomplete formation of the spine and spinal cord.This occurs between birth, on the 24th day of gestation and results in paralysis, loss of sensation of the legs, and affects the functioning of the bowel and bladder. Approximately 85-90 percent of these clients also have hydrocephalus (increased collection of cerebrospinal fluid in the brain due to blockage). Hydrocephalous can affect vision, hearing and learning abilities and often requires surgical intervention. An average of one in seven hundred and fifty children in Canada are born with spina bifida but this trend is seen to be reducing.
Types of presentations seen in clients with spina bifida are:

- Myelomeningocele (severe form): Bones fail to close around the spinal cored at the site of the lesion and the meninges and the spinal cord protrude to forma a sac. This results in failure of development of the cord resulting in spinal nerve damage. This sac contains cerebral spinal fluid and can be transparent with no skin coverage.

- Meningocele (less severe): Bones do not close around the spinal cord at the site of the lesion resulting in the meninges being pushed through the opening to form a sac. The sac is often covered with skin.

- Lipomyelomeningocele: Protrusion of abnormal fatty tissue through a defect in the vertebrae. This results in damage to the nerves as a result of compression by the mass or due to an abnormal formation of the spinal cord.

- Occulta (mild): A small hole in the lower segment of the spine. There is no sac at the site of the bony deformity. The area may be marked by a dimple or tuft of hair.

Why choose power?

- Size of wheelchair may make manual wheelchair difficult to set up for effective propulsion and wheel placement for shoulder joint protection as these clients often present with large trunks requiring larger wheelchairs.
- Chronic strain injuries for the client who is dependent on upper extremity function for all activities of daily living.
- Positioning the client within the wheelchair due to deformities in the trunk and spinal area. Often clients can have severe kyphosis and lordosis which will affect balance, stability and manoeverablility in a manual wheelchair. Seating that is required for these clients also can be heavy and take up depth in the wheelchair.
- Independence in positioning and re-positioning for activity and rest. Often clients have limited ability to maintain and upright posture due to dysraphism (altered attachment of the trunkal muscles).
- Cognitive issues may affect a client's perception, judgement, and confidence having an affect on safety in driving.

Cerebral Palsy

Cerebral Palsy (CP) occurs in every 2/1000 to 2.5/1000 live births. It is an "umbrella" term covering a group of non-progressive, but often changing, motor impairment syndromes secondary to lesions or anomalies of the brain arising in the early stages of development. The result of this motor impairment is a disorder in the development of gross motor function. Clients with CP present with different patterns of movement, primitive reflexes, sensory issues and various cognitive abilities. These clients tend to be categorized in terms of distribution of affected motor function: tetraplegia, hemiplegia or diplegia as well as type of tonal affect: spastic or athetoid.

Why choose power?

- Spacticity and poor coordination affect bilateral activities, range of motion and strength which limits a client's ability to propel a manual wheelchair effectively.
- Seating requirements for body alignment, tone management, trunkal stability and correction/accommodation of deformity and unbalanced muscle forces add weight to the wheelchair and may reduce freedom of movement.
- Foot positioning may be affected by hamstring tightness requiring the need for tighter wheelchair footrests which may be limited by turning front casters.
- Transfers may affect the type of footrests required (swingaway) but a client's tone may affect durability.
- Independent tilt for repositioning during the day to allow a client to rest between periods of activity, to manage fatigue and maintain posture, to change position when encountering different types of terrain and allow for independent weight shift.

• Limited strengh of upper extremities for wheeling a manual wheelchair over long distances and rough terrain.
• Cognitive and perceptual issues may affect a client's independence in safe driving.
• Seizure disorders may limit a client's safe driving ability.

Muscular Dystrophy

Duchenne's Muscular Dystrophy is an inherited sex-linked recessive neuro-muscular disorder affecting predominantly males. It is one of the most common and severe forms of muscular dystrophy. Progression of the condition varies slightly among individuals but generally follows a predictable course. Muscle weakness begins proximally in the muscles of the pelvic girdle and shoulders and gradually extends distally. Diagnosis is usually identified between the ages of 3 and 5 when the symptoms become evident. At approximately age 10 boys lose the ability to walk and become dependent on a wheelchair for independent, functional mobility. In the non-ambulatory phase muscle weakness, contractures and spinal deformities progress. Motor function lessens affecting cardiac and pulmonary complications. Recent clinical studies investigating the use of steroids (Deflazacote and Prednisone) have had positive results on increasing the ambulation phase of the disease sustaining independent walking until age 11 or 12.

Why choose power?

• Independent mobility and the need to keep up with peers.
• Energy conservation vs. fatigue.
• Prevention of falls for client safety and to prevent injury.
• Orthopedic alignment through use of seating technology and tilt which may be too heavy and cumbersome to allow for a lightweight chair that a client can self-propel.
• Maintenance of independent function through technology not just for mobility but also environmental and computer access.
• Flexibility of equipment to allow for modular components to be added as the disease process progresses.
• Client readiness to accept power and realize the benefits in allowing independence in daily activities vs social stigma's.

The decision to prescribe power mobility can be a difficult and complex one.

When do you make the decision to choose power? Who are appropriate clients? What are the elements that go into the decision making process? It is important to consider not only the client's diagnosis and it's impact on long-term function but to explore the needs of the client, family and caregivers, the environments where the equipment will be used, the social experiences that the client will encounter and the opportunities that will be provided for the client in developing their lifestyle.

Getting it Right the First Time!

Tina Roesler, MSPT, ABDA
Josh Anderson

Material not available at time of printing.

Impossibility or Probability? EADLs in a Long-Term Care Facility

Faith Saftler Savage, PT, ATP

About The Boston Home
Founded in 1881, The Boston Home is a nursing care residence for adults with multiple sclerosis and other progressive neurological diseases.
Our mission is to be a leader in developing, organizing, and providing residential health and related services for adults with physical disabilities through innovative and expanded services to support individual needs. The Boston Home seeks to provide residents with the maximum possible independence, in order to support the best possible quality of life for each individual.

The Boston Home completed construction and major renovations in August 2003 that included the addition of 12 new single rooms with T10 wiring and a dedicated Cyber Café to provide residents with the ability to link with the "outside world". Other modifications in the facility include a card reader system to allow residents with the ability to open doors independently and operate the elevator without touching a button.

Who Chooses The Boston Home, and Why
When younger adults whose disabilities make it impossible for them to live at home are faced with the need to transfer to an institution, usually the only options are geriatric nursing homes that are not tailored to the needs of younger adults. People severely disabled by progressive neurological diseases or injuries need intensive physical care for activities of daily living. Yet, many are cognitively intact, capable, alert, and creative. Most facilities are not accustomed to providing this mix of care. That is why people faced with this situation push for the opportunity to move to The Boston Home.

The Boston Home is one of only a handful of similar facilities in the U.S.: providing optimal care within the context of optimal independence for young and middle-aged adults severely disabled by neuro-degenerative diseases. The average age of The Boston Home residents is 55; most are single, low-income individuals; most are from eastern Massachusetts. Three-quarters of the residents are female. Average length of stay is six years. The Boston Home organizes its support for residents around the home care model, encouraging each resident to partner with staff to make individual decisions about care, treatment, comfort, activity, and lifestyle.

Description of Project: Developing Innovative Applications for Assistive Technology
• Problem To Be Addressed: Severely disabled adults with neuro-degenerative and related diseases/injuries face increasing isolation and dependence as their capacities for communication and mobility deteriorate. Although their symptoms may not be reversible, any methods of decreasing isolation and increasing independence improve their quality of life.

Assistive technology is available to assist residents in TV control, telephone usage, nurse call buttons, etc., but there is not one universal system or interface to make use of all the devices simple and efficient for individuals with a variety of problems and changing needs. The result is a tangle of device-specific equipment that must be configured and maintained separately, leading to disorganization of adaptive aides and a decrease of usefulness.

• Solution: Develop an Assistive Technology Plan: Staff and residents were interviewed to assist The Boston Home in developing an assistive technology plan. The key criteria for this plan include the following characteristics:

- Equity of access to assistive technology
- Optimal "fit" between each resident and the technology s/he uses
- Organizational efficiency in effective utilization of assistive technology
- Economic feasibility for the organization and for individual residents

The Boston Home developed a "Technology Vision" that incorporates the perspectives of the many members of The Boston Home technology team. The goal of this vision (see addendum diagram for Technology Vision) is to support all residents, either when they are in bed or in their wheelchair to be as independent as possible in the following areas:

- Personal Comfort (e.g., nurse call button, TV, VCR, CD player, tape player, radio, heat, fan, lights)
- Intellectual, Creative, and Recreational Engagement (e.g., computer, Internet, TV, VCR, CD, radio, tapes, ham radio)
- Communication (e.g., phone, voice amplifiers, speech output devices, computer, email, ham radio)
- Mobility and Access (e.g., door openers, elevator call readers)

The challenge to achieve this goal is the extent of disability that residents demonstrate. Due to the progressive nature of their disabilities, an individual might have the ability to use their hand and operate a standard TV control when they are first admitted to the facility. But, 1 to 3 years later, they may have lost this function and be unable to control the TV independently any longer. The best access may be voice control. The physical disability a resident may demonstrate when first being admitted may change at any time with decrease in skills that affect all the above areas of independence.

The Boston Home is committed to maximizing the independence of all individuals using all types of assistive technology. Assistive technology refers to devices that enhance independence, functional capacity and quality of life. The term includes wheelchairs, computers and computer-operated technologies, wireless technology, radio technology and telecommunications, among others. Adaptive design, as a component of assistive technology, refers to adaptations made to the design of existing objects in order to make them more accessible to a disabled individual. EADLs (electronic aides to daily living) is just one component of assistive technology that needs to be addressed at The Boston Home.

Individual needs will focus on maintaining the following:

- Independence in wheelchair mobility including use of hand, head, single switch systems and sip-n-puff systems.
- Assessing the need for EADLs in order to maintain independence in operating nurse call, TV, phone etc by use of hand, head, sip-n-puff or voice activation.
- Training and maintaining independence in computer use by hand, head or voice activation.

Facility use will focus on video teleconferencing, wiring systems for optimal speed/access to internet system, networking computer system, developing locator system for residents when outdoors, wireless technology and maintaining upkeep of call readers and the various technologies in the facility.

• Methodology – The Boston Home strives to keep technology and its operation as simple as possible. This means insisting on integration between different pieces of technology equipment, so that many technologies can be operated by the same set of controls, batteries, or mounts. Technology selection must always be preceded by a thorough evaluation of the fit between the resident and the technology. Technology purchases must be guided by interaction and approval from funding sources. Technology utilization can only be achieved with high levels of staff buy-in, support expertise and coordination.

Areas to highlight in order to bring quality-of-life benefits to residents include the following:
Staff Support – Staff training and staffing levels are extremely important to ensure appropriate use of all technologies at The Boston Home. Direct care staff must understand how to set-up a system for ease of use by residents. They need to ensure system is charged properly on a regular basis so a resident always has access to system. Technology staff must understand the best method for training and set-up. They must be able to perform repairs and programming to assist residents in independence.

Centralized Planning – An Assistive Technology Task Force is needed to determine priorities and identify costs and funding sources. A Technology Evaluation Team is needed to identify appropriate technologies and to implement usage with all residents. These teams will establish protocols to ensure equity of access including determining training methods to ensure appropriate use of equipment.

Funding – Medicaid and private insurance companies usually do not cover the cost of computers, EADLs and other equipment beyond wheelchair technology. Alternative outside funding and partnerships are needed to support Assistive Technology acquisition.

Research and Development – Partnerships are needed to assist in promoting progress in the field of assistive technology and its application in the long-term care setting for adults. Collaborations with outside partnerships in areas of medicine, therapeutic services, schools, engineering, high-technology companies and/or investment entrepreneurs will be extremely important to attain the long-range goals of The Boston Home. The goal should be to develop technology that has a broad application, rather then technology that is exclusively utilized within the long-term care facilities for adults with neurological disorders. Many of the technologies that are helpful to the Boston Home population could also be applied to people with other disabilities and the elderly.

• Summary – Assistive technology is a relatively new and rapidly changing field. To date, adoption of assistive technology at The Boston Home has been promising, ambitious and innovative – and it already has yielded demonstrated results in improved quality of life. The next task is to harness these ideas and establish priorities and a work plan, while allowing for flexibility to be responsive to new needs, ideas, and technology as they develop in the future.

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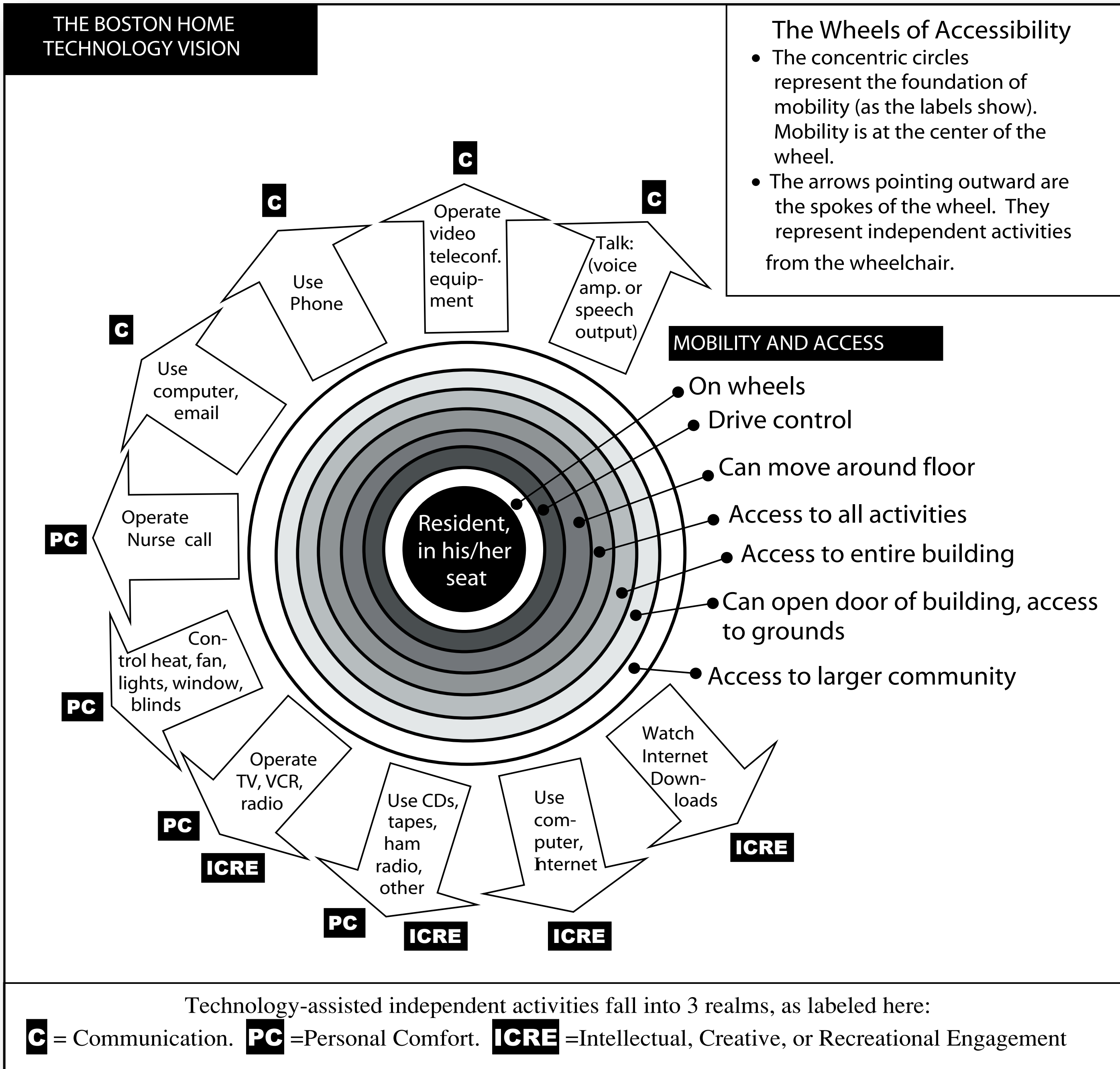

Figure 1: The Boston Home Technology Vision: Boston Home residents spend their time in one of two locations: in their wheelchairs or in their beds. Our goal is for each resident to be as independent as possible in each location.

Just as this diagram places the wheelchair at the center, a similar diagram could be drawn with the bed at the center, indicating the individual resident's capacity to operate all the same elements of Communication, Personal Comfort, and Intellectual, Creative, or Recreational Engagement from his/her bed. A sub-element of this concentric circles diagram would focus on each specific component of independence. For example, a focus on Communication would position the resident's Voice (either natural or augmented by technology) at the center. Concentric circles would indicate his/her capacity to speak with progressively more distant individuals and groups: health care providers and personal care assistants; other people on their floor; others in the building; personal acquaintances (family, friends, business counterparts) outside the building; and the larger world outside

Dream On !
Service Delivery Challenges Around the Globe

Geoff Bardsley, PhD
Martin Ferguson-Pell, PhD
Ray Fulford, P.Eng, MSc
Jean Minkel, MA, PT
Sheila Buck, BSc (OT), Reg (Ont.), ATP

Funding?
Location?
Unique population?
Payment?
Technology Limits?
Government Directives?

What is it that is giving you a headache?

This panel of experts from many parts of the world will set the scene for an interesting discussion on what can be done to overcome some of the problems we have in providing service delivery.

Share your own perspective in the discussion period.

Then go back home and make it work!

Geoff Bardsley

Highlights of Wheelchair / Seating Service:

1. This service is part of the National Health Service (NHS) of Scotland and consequently is free of charge to all users

2. The service is one of a range of integrated services including Electronic Assistive Technology, Prosthetics and Orthotics

3. The aim of the service is to meet the wheelchair mobility and associated seating needs of the entire population of Tayside (population 400,000). This includes all diagnoses and all ages of people with disabilities.

4. The service provides a wide range of devices including manual wheelchairs, powered wheelchairs and the seating systems necessary to be able to use these wheelchairs. The range is based on Nationally agreed criteria to promote consistency across Scotland whilst remaining within available resources. National contracts are in place to purchase devices at highly economic rates based on National commitment.

5. The service has a range of technical staff and facilities to enable it to maintain, repair and refurbish wheelchairs and to fabricate / adjust devices specifically for individuals' needs.

6. A training programme for powered wheelchair users is in place to ensure that they know how to use these devices safely and effectively. The programme culminates in a road test administered by local police road safety officers.

7. The service has developed its own database to facilitate its operations. This database incorporates functions for patient records, device records, appointments, work tracking, finance control, automated letters, service monitoring, etc.

8. The service is based on a multi-disciplinary approach employing therapists, technicians, professional engineers, nurses, IT staff and clerical staff.

9. Preliminary work on identifying and testing outcome measurements (quality of life, patient satisfaction) has been carried out and is about to be incorporated in parts of the routine service delivery.

Martin Ferguson-Pell

We do not operate a traditional service delivery programme in seating and wheelchair mobility. Instead we undertake projects that are designed to substantially enhance the way Seating and Mobility Services are delivered. Our SCAMP project provided state of the art clinical assessment for volunteers with complex needs. We compared the cost of the best practice solution with available resources through the National Health Service. We found the gap in provision for people with complex needs to be in excess of 3:1. Our WOWSUP! project is investigating why over 40% of newly injured spinal cord injured persons in UK abandon the wheelchair supplied by the National Health Service in the first year post discharge. We are using sophisticated objective seating and positioning assessment techniques to determine whether there is functional or biomechanical evidence for changes in the needs of spinal injured persons in this time period, and what factors in wheelchair provision are failing to meet users' needs. Qualitative research methods are also being used to gather user information and opinions so that a change in the way that wheelchairs are supplied to newly spinal injured persons can be considered.

Ray Fulford

The Society for Manitobans with Disabilities (SMD) manages a recyclable pool of new and used wheelchairs for the Province of Manitoba, Canada. Individuals with disabilities who meet eligibility criteria are provided wheelchairs at no cost (including all repairs) on a "long term loan" basis. Currently about 3,000 manual and 200 motorized wheelchairs are issued annually and about 2,500 manual and 100 motorized wheelchairs are returned for recycling consideration. At the present time we have about 11,000 wheelchairs (manual and motorized) in service in a geographic area that stretches 250 miles east to west and 1000 miles from the U.S./Canada border in the south to small first nations communities in the northern regions of Canada. The population of Manitoba is about 1,000,000 people.

Jean Minkel

After eight years of directing a facility-based service delivery program in seating and mobility, I was afraid a pink slip was in my future. Healthcare reform was in full bloom and I was involved in a labor-intensive (often poorly reimbursed service delivery program). So I developed my own "exit strategy" and founded an independent consulting company.

In 2001, I was contacted by a "non-profit organization assisting people with disabilities to live independently". This "non-profit" operates a managed care plan for Medicaid eligible adults living in New York City. My initial thoughts, "Medicaid, managed care – run the other way!" However, during my initial conversation with the staff, I had a real sense these folks were different. Self-described, members of the management team are "Children of the sixties who still think they can make a difference." While not quite a "child of the sixties" myself, I knew I liked the sentiment.

I am now a part time, paid consultant to the managed care organization, providing community based care to persons living in their own homes. They pay me to assess the seating and mobility needs of their members – in their homes and in the community. The philosophy of the organization is to build a specialized system of care to support a member's full participation in community life. This group really gets it. The criteria for recommendation is not "medical necessity", rather functional need for the purpose of community participation.

There is a real irony that "managed care system", which I considered a threat to my facility based work, is (in this very special case) the vehicle which allows me to practice with full support of my own convictions – It's about function, stupid!

I must admit that I need to pinch myself ever once in a while to really check that I am not dreaming. The program is now five years old and is planning an expansion into Brooklyn. It may be too good to be true, but I am enjoying every minute of it, while it lasts!

Sheila Buck

In Ontario, Seating and Mobility products are provided to clients on a partially funded basis through government funding. Eligibility status varies based on basic and essential needs for a time frame requirement greater than 6 months. The system is challenging as it varies based on equipment prescribed. In such, high end power rehab products with power tilt, recline or elevating legs are prescribed through a central equipment pool, where the remaining items are provided through a vendor of (client)choice. Assessments are completed by a therapist who is authorized through the government to complete this service. The service is provided either through a home care therapist (government funded), or on a private pay basis.