Seventeenth International Seating Symposium

Seating & Mobility for People with Disabilities

February 22—24, 2001

Rosen Centre Hotel
Orlando, Florida
U.S.A.

Announcing the First Annual

Chris Bar Research Forum

Sponsored by:

- **University of Pittsburgh**
  School of Health and Rehabilitation Sciences
  - *Department of Rehabilitation Science and Technology*
  - *Rehabilitation Engineering Research Center on Wheelchair Mobility (RERC)*
- **Sunny Hill Medical Centre for Children**
- **University of British Columbia**
- **NIDRR -** National Institute on Disability and Rehabilitation Research
- **RESNA -** The Rehabilitation Engineering and Assistive Technology Society of North America

Presymposium Workshops

February 21, 2001
Rosen Centre Hotel
Orlando, Florida

- **Back to Basics and Beyond**
- **The Business Side of Assistive Technology**
- **Funding Wheelchair Seating/ Mobility Technology and Services**
- **Kids vs. Adults: Is There a Difference in Seating?**

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

Seventeenth International Seating Symposium

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February 22-24, 2001

Thursday, February 22, 2001

Friday, February 23, 2001

Track A: Issues in Pediatric Practice— Paper session

Track B: Instructional Courses

Track D: Clinical Forum: Practice and Research— Paper Session

Saturday, February 24, 2001

Paper Session

SpecialSession

Wednesday, February 21, 2001

7:00 am to 6:00 pm • Registration (Registration Desk 2)

Thursday, February 22, 2001

8 :00 am	•	Registration and Continental Breakfast
8:30 am	•	Opening (Junior Ballroom)
9:00 am	•	Sunrise Medical Keynote Address *Bardsley*
10:00 am	•	General Session - Papers (Junior Ballroom)
11:00 am	•	Exhibit Hall opens/Walk-about Lunch
1:00 pm	•	**Instructional Courses** (One Hour) 1.Fisher, Harding 2. Cooper, Dilabio, Broughton, Brown 3. Margolis 4. Pickett, Gunn 5. Saftler Savage 6. Tanguay 7. Tucker
2:00 pm	•	Break
2:30 pm	•	**Instructional Courses** (Two Hours) 8. Bergen 9. Dilabio, Cooper, Broughton 10. Ferguson-Pell, Parry 11. Gallagher, Havard, Shipp 12. Hobson 13. Kangas 14. Sparacio
4:30 pm	•	Adjournment
5:00 pm	•	Welcome Reception (Exhibit Hall)

Friday, February 23, 2001

7:30 am	•	Continental Breakfast (Exhibit Hall)
8:30 am	•	**Track A : Paper Presentations** *Fisher/Liebel, McDonald, Pountney, Taylor*
	•	**Track B : Instructional Courses** (One Hour) 15. Waugh, Schmeler 16. Broughton, Cooper, Dilabio 17. Mogul-Rotman, Fisher, O'Neill 18. Saftler Savage
9:30 am	•	Break (Exhibit Hall)
10:30 am	•	**Instructional Courses** (One Hour) 19. Minkel 20. Denison, Gayton 21. Fitzgerald 22. Hardwick 23. Jones 24. Kangas 25. Schmeler, Tovey
11:30 am	•	Lunch (on your own)/Exhibit Hall Open
1:00 pm	•	**Instructional Courses** (Two Hours) 26. Hobson 27. Fleck, Roesler 28. Mangine, West 29. Hetzel 30. Tucker 31. Walker 32. Cooper, Fitzgerald
3:00 pm	•	Break (Exhibit Hall)
3:30 pm	•	**Track C: Chris Bar Research Forum** Bardsley, *Brienza, Ferguson-Pell, Graebe, Levy, Sprigle, Taylor*
	•	**Track D: Clinical Forum – Practice and Research** *Cohen, Brown, Buning, May*
5:00 pm	•	Adjournment

Saturday, February 24, 2001

8:00 am	•	Continental Breakfast (Ballroom Pre-function Area)
8:30 am	•	Paper Session *Brienza, Fernie, Miller, Frost*
10:00 am	•	Break
10:30 am	•	Special Session – Policy Change *Minkel, Morris, Parry, Thomas, Warren,*
12:30 pm	•	Adjournment

Seventeenth International Seating Symposium

Audience

Assistive technology practitioners (ATP)
Assistive technology suppliers (ATS)
Educators
Manufacturers
People with disabilities
Physicians
Rehabilitation engineers
Vocational rehabilitation counselors

Introduction

Presentations will cover evaluation, provision, research, and quality assurance issues in seating and mobility for people with physical disabilities. The symposium will include scientific and clinical papers, in-depth workshops, panel sessions, and an extensive exhibit hall.

Program Objectives

- Identify seating and mobility interventions for people with physical disabilities
- Discuss service delivery practices
- View current research
- Recognize 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.

Health professionals are awarded up to 1.5 continuing education units (CEUs) for up to 15.0 hours of instruction.

Wednesday, February 21, 2001

7:00 AM - 6:00 PM
Registration ***(Registration Desk 2)***

Thursday, February 22, 2001

8:00 AM
Registration and Continental Breakfast

8:30 AM
Opening ***(Junior Ballroom)***

Clifford E. Brubaker, PhD
Dean, University of Pittsburgh
School of Health and Rehabilitation Sciences

Rory Cooper PhD
Professor and Chairman , University of Pittsburgh
School of Health and Rehabilitation Sciences
Department of Rehabilitation Science and Technology

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

9:00 AM
Sunrise Medical Keynote Address

Zen and the Art of Wheelchair Maintenance –
Experiences On A Journey Through Seating

Geoff I. Bardsley, PhD
TORT Centre, Ninewells Hospital, Dundee, Scotland

10:00 AM
General Session ***(Junior Ballroom)***

Innovations and Findings in Current Seating Research
Shirley Fitzgerald, PhD

Chest Supports: Why They Are Not Working!
Karen Kangas, OTR/L

The Role of the Shoulder During Wheelchair Propulsion
Alicia Koontz, MS, ATP

Development of a Method of Measuring Force Through a Kneeblock for Children with Cerebral Palsy
Rachel McDonald, B.App.Sc.(OT), Post.Grad.Dip.(Biomechanics)

11:00 AM
Exhibit Hall opens ***(Grand Ballroom)***

Walk-about Lunch ***(Exhibit Hall, included in tuition)***

1:00 PM
Instructional Courses ***(One Hour)***

1. **Power Chair: Features & Functions - Demonstration (Center Stage - Exhibit Hall)**
   Kathryn Fisher, B.Sc., OT(C), David Harding

The recent explosion in choice of power wheelchair configurations has increased the opportunity to match a client's needs but has created confusion in the prescription process. This workshop will explore the development of power wheelchair drives and features and apply these options to clinical assessment factors.
****Beginner***

2. **Dynamic Seating Components for Reduction in Spastic Activity and Enhancement of Function**
   David Cooper, M.Sc, RT, Mark Dilabio, RT, Gord Broughton, RT, Dalthea Brown, MS, PT, ATP

Dynamic seating components that allow controlled movement of the user present numerous advantages for people with uncontrolled spasticity and limited function. This workshop will review various approaches of implementing dynamic solutions and describe techniques with successful outcomes.
****Intermediate***

3. When Ethics Isn't Enough – Making Tough Decisions in a Changing Clinical Environment
Simon Margolis, CO, ATS/P

Clinicians, both suppliers and practitioners, are confronted daily with situations in which the ethical thing to do may not be the right thing to do. The presentation/ discussion will address other factors to consider when making clinical service delivery decisions.
Advanced

4. Cervical Flexion Problems and Possibilities ∆
David (Scott) Pickett, CRTS, Michelle Gunn, ATP

This course will explore the problems related to seating and positioning in persons with cervical flexion and cervical flexion with head extension. The selection and applications of positioning interventions to correct or accommodate, will also be discussed.
Intermediate

5. Can Therapeutic Positioning Effect Functional Outcomes?
Faith Saftler Savage, PT, ATP

This workshop will teach how to develop functional outcomes for therapeutic positioning using the Disablement Model from the World Health Organization. Case studies will be used to illustrate the effectiveness of the model.
Beginner/Intermediate

6. Seating Interventions for People with Spinal Cord Injuries with Secondary Orthopedic Complications
Stephanie Tanguay, OTR, ATP/S

Orthopedic changes and surgical interventions result in complex seating needs for spinal cord injured clients. Case studies will illustrate custom systems required by secondary diagnosis such as heterotrophic ossification, hip disarticulation, and hemipelvectomy. Orthotics and molded seating solutions will be shown.
Beginner

7. Slip Sliding Away - Dealing with the Client that Slides
Lois Tucker, OTR/L, ATP

Sliding is one of the most frequently observed patterns in our clients. We will discuss the issues that cause the client to slide out of their optimal positioning, out of their wheelchair, and the positional, postural and functional problems that occur as a result. Prevention techniques and ways to control the perpetual slide from occurring will be explored.
Intermediate

2:00 PM
Break

2:30 PM
Instructional Courses *(Two Hours)*

8. Mat Evaluation - Demonstration (Center Stage, Exhibit Hall)
Adrienne Bergen, PT, ATP, ATS, CRTS

Principles of a mat assessment will be combined with prescription and product options. Persons with disabilities from the Orlando area will serve as clients for the demonstrations.
Beginner

9. Innovative Solutions for Seating and Positioning
Mark Dilabio, RT, David Cooper, M.Sc, RT
Gord Broughton, RT

From inexpensive and simple solutions to elaborate creations, we have it all! Side, prone and supine lyers, slings for turning, walking aids, commode and cycle adaptations, inexpensive tilt, adapted furniture; these are some of the ideas that we would like to pass on. We also have elaborate solutions that address specific needs and will devote time to look at lateral tilt of sitting and recumbent positioning systems.
*** All***

10. Pressure Mapping

Martin Ferguson-Pell, PhD, Emma Parry, SROT, ATP

Pressure mapping is gaining an increasingly important place in the toolkit of the seating specialist. Manufacturers rely upon pressure mapping data to compare their products with competitors. The presenters of this session are working closely with the pressure mapping manufacturers to develop clinical guidelines and supporting educational modules to promote the correct use of the pressure mapping technologies.

Participants in this session will obtain an overview of these guidelines and gain an insight into how they may be incorporated into international standards for "pressure mapping devices".

**** Intermediate-Advanced***

11. Factors for Integrating Wheelchairs and Transportation

Marty Gallagher, MS, LOTR, Ann Havard, LOTR, CDRS, Mike Shipp, MEd, CDRS

This workshop will present methods for accurately measuring the key components in seating systems for clients requiring moderate to maximal positioning and pelvic stability/mobility. Measurement techniques for a variety of seating components will be taught.

****Intermediate***

12. Measuring and Recording Seated Posture - A Proposed Standard

Douglas Hobson, PhD

Standardized terminology and definitions are required in order to be able to accurately measure, record and communicate information about the posture of a wheelchair-seated person. This session will present proposed terms and definitions for an integrated geometric reference system that permits the measurement of a person's seated posture relative to a baseline or neutral posture.

****Advanced***

13. Children in Power

Karen Kangas, OTR/L

All children can be functionally independent in mobility with today's technology of seating and programmable mobility. Changing attitudes, obtaining new technology and expertise, and learning to teach mobility will be discussed using case studies.

****Intermediate/Advanced***

14. The Effects of Seating on Respiratory Function

Jill Sparacio, OTR/L, ATP, ABDA

This course will discuss how to effectively evaluate respiratory patterns and how to impact them through the use of postural supports. It will include strategies used to enhance rather than limit respiratory function that is often compromised by neurological impairments.

****Beginner***

4:30 PM

Adjournment

5:00 PM

Welcome Reception *(Exhibit Hall)*

Friday, February 23, 2001

7:30 AM

Continental Breakfast *(Exhibit Hall)*

8:30 AM

Track A: Paper Presentations
Track B: Instructional Courses

Track A - Paper Presentations

Issues in Pediatric Practice (Junior Ballroom F)
Moderator:
Jessica Presperin Pedersen, MBA, OTR/L, ATP

High Tech Solutions for a Special Needs Client
Kathryn Fisher, B.Sc., OT(C), Gloria Liebel, OT (C)

Parent Versus Therapist: Views Of Their Child's Adaptive Seating System
Rachel McDonald B.App.Sc.(OT), Post.Grad.Dip. (Biomechanics)

A Retrospective Study of the Effect of Postural Management Programmes in the Management of Hip Dislocation and Spinal Curvature in Bilateral Cerebral Palsy
Terry Pountney MA, MCSP

Developing Pre and Post Baclofen Pump Outcome Measures for Seating with Individuals with Cerebral Palsy
Susan Johnson Taylor, OTR/L

8:30 AM

Instructional Courses *(One Hour)*

15. Clinical Use of Simulation - Demonstration (Center Stage - Exhibit Hall)
Kelly G. Waugh, MA, PT,
Mark Schmeler, MS, OTR/L, ATP

Simulation is used clinically to determine optimal posture, facilitate measurement and enable consumers to understand the dynamics of various postural options. Both the process and several products will be highlighted in this session.
****Beginner/Intermediate***

16. Custom Contoured Seating – The Next Step
Gord Broughton, RT, David Cooper, M.Sc, RT, Mark Dilabio, RT

Making custom contoured positioning systems can be enhanced to improve growth potential, adjustability and ease of use by making them modular. This workshop will describe a modular approach to contoured seating that includes separating portions of the moulded shape, and inclusion of orthotic components and malleable sections using both custom and off the shelf componentry.
****Intermediate***

17. Personal Mobility, Vehicle Mobility…Strengthening the Link
Brenlee Mogul-Rotman, B.Sc.OT(C), OTR, ATP, Kathryn Fisher, B.Sc., OT(C), Terry O'Neill

This workshop will describe common problems associated with incompatibility of personal mobility equipment and modified vehicles. Perspectives from a clinician, seating/mobility equipment vendor and vehicle modification specialist will highlight the team approach. Case studies will be used to illustrate problems experienced as well as success in optimizing personal and community mobility.
****Intermediate***

18. Seating for People with Multiple Sclerosis (MS) in a Long Term Care Facility
Faith Saftler Savage, PT, ATP

This course will review the pathology and specific issues that effect the person with MS. Seating interventions will be discussed from basic manual mobility to power wheelchairs with tilt and head control systems. Long term care with multiple caregivers concerns will also be covered.
***Beginner/Intermediate**

9:30 AM
Break ***(Exhibit Hall)***

10:30 AM
Instructional Courses ***(One Hour)***

19. Mat Evaluation (Center Stage - Exhibit Hall)
Jean Minkel, MA, PT

The mat assessment is one of the most critical components of a seating evaluation. An experienced clinician will demonstrate the steps in the assessment process and discuss the prescription implications.
***Beginner**

20. Power Wheelchairs: A New Definition
Ian Denison, PT, Doug Gayton, ATP

This session identifies the factors that contribute to the performance of a powered wheelchair depending on whether the wheel-drive of the chair is a front, center, or rear wheel drive. Strengths and weaknesses of each configuration will be compared in the following environments: indoors, outdoors, and off-road.
***Intermediate**

21. How to Avoid the Pitfalls in Assistive Technology Research
Shirley Fitzgerald, PhD

This workshop is designed to provide an understanding of basic research methods to the clinician. The first part of this session will be an overview to research and then will progress to an interactive session of problem solving research issues. Bring ideas for research projects with you.
***All**

22. The Use of Technological Advances to Evaluate Seating and Positioning in Individuals with Severe Orthopedic and Developmental Disabilities
Karen Hardwick, PhD, OTR, FOATA

Technologies such as Doppler ultrasound, the ABI (Ankle Brachial Index), pressure mapping systems, pulse oximetry, and video fluoroscopy can assist clinicians to effectively evaluate individuals with profound disabilities who cannot communicate verbally. These tools can provide objective measures to make clinical decisions and also provide concrete data for research. This session will present case studies illustrating each of the techniques described.
***Intermediate/Advanced**

23. The Importance of the Therapist in the Wheelchair Decision-making Process for Older Adults
Debbie Jones, PT

With fewer dollars available for durable medical equipment (DME), the final decision-making process needs to include a therapist. Too often wheelchairs are supplied without a complete evaluation of the user to determine individual needs. This can lead to poorly fitted systems or systems that can not be modified as the client progresses. This session will review the evaluation process, with the inclusion of case studies, and explain how to find a therapist that has the knowledge to perform wheelchair evaluations.
***Intermediate**

24. Seating, Access, and Mobility II: Those Children Who Grow Up !
Karen Kangas, OTR/L

With children who are non-speaking, have physical disabilities, and require alternative access for powered mobility and other assistive technology, finally getting these systems to work is empowering. Then they grow and change. Should the system of seating, access, and technology be replicated or, changed with them? This session will explore how to allow this transition to support the continued growth of these children, now young adults, and face the ensuing complicated issues involved.
Intermediate/Advanced

25. The Use of Adjustable Modular Wheelchairs as Fleet
Mark Schmeler, MS, OTR/L, ATP
Elyn Tovey, PT

This presentation will focus on the strategies and outcomes of using a modular manual wheelchair frame as a fleet concept. Outcomes have resulted in being able to better fit people, meet needs in a more timely manner, and have reduced the time and cost associated with repairs and modifications.
Intermediate

11:30 AM
Lunch ***(on your own)***
Exhibit Hall Open

1:00 PM
Instructional Courses ***(Two Hours)***

26. Transport Wheelchairs (Center Stage - Exhibit Hall)
Douglas Hobson, PhD

Industry is responding to the need for wheelchairs that comply with the new industry standards for transport wheelchairs. Models of wheelchairs that meet the standard will be presented and discussion about the special transport features will follow.
Intermediate

27. The Seated Posture and Pressure Ulcer Connection Δ
Cynthia Fleck, RN, BSN, ET, CWS,
Tina Roesler, MS, PT, ABDA

This multidisciplinary session will address pressure ulcer etiology and the direct impact of wheelchair configuration and cushion selection on skin integrity. It will also provide strategies for prevention and treatment of ischemic ulcers in the seated client.
Intermediate/Advanced

28. The Challenge of Optimal Seating for People with Joint Contratures
Marygrace DiStasio Mangine, OTR/L
Cheryl T. West, MSPT

Total body contractures pose problems when determining appropriate seating and mobility systems. This session will introduce low and high technology seating adaptations for maximizing function, increasing independence, and attaining equal weight distribution.
Advanced

29. Back in Style
Thomas Hetzel, PT, ATP

This course will outline the biomechanical principles and clinical indicators to be considered when selecting a back support. Tips on evaluating current technologies in respect to how they address the person to support surface and support surface-to-mobility base interfaces will be covered.
Beginner/Intermediate

30. Linking Clinical Presentation with Power Wheelchair Programming
Lois Tucker, OTR/L, ATP

This workshop will present guidelines and computer software for programming powered wheelchairs based on client diagnosis, driver controller, and environmental needs. Clinical presentations will include discussions related to clients, including those with physical and cognitive challenges.
Intermediate

31. Reimbursement - Rehab 101 — All You Need to Know & More to Get Your Client What They Really Need
Peggy Walker, RN

Basic rules for reimbursement for durable medical equipment, including mobility and seating/positioning equipment, will be presented. Reviewer perspectives, justification wording and custom vs. modification items will be discussed.
***All**

32: Application of Research Findings into Clinical Practice
(One hour only)
Rosemarie Cooper, MPT, Shirley Fitzgerald, PhD

Clinical research has a direct impact on clinical practice. This workshop will use research projects at the Human Engineering Research Laboratories (HERL) to describe how research results have influenced the clinical wheelchair prescription and provision process.
***All**

3:00 PM
Break *(Exhibit Hall)*

3:30 PM

Track C Chris Bar Research Forum
Track D Clinical Forum – Practice and Research

Track C:
Chris Bar Research Forum
Sponsored by ROHO, Inc.

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

Participants:
David Brienza, PhD
Martin Ferguson-Pell, PhD
Robert Graebe Δ
Barbara Levy, PT, ATP
Steven Sprigle, PhD, PT
Geoff Taylor Δ

The 2001 Chris Bar Research Forum will be a British Parliamentary-style Debate on the use of pressure measurement for the prevention and management of pressure ulcers. The motion to be debated is as follows:
This House believes pressure measurement is irrelevant to the clinical practice of preventing and managing pressure ulcers.

Participation in the debate is encouraged

Track D:
Clinical Forum – Practice and Research

Moderator: Lynn M. Bates, MPA, BS

Teaching Clinical Rationale For Seating And Wheeled Mobility Prescription: A Randomized Controlled Trial Of Four Instructional Methods
Laura Cohen, PT

Quantification of Forces Associated with Full Body Extensor Thrust in Children
Dalthea Brown, MSPT, ATP

What Consumer's Bring to Wheelchair Selection:
The Results of a Study
Mary Ellen Buning, OT, OTR/L, ATP

Back Support Options: Functional Outcomes for Persons with SCI
Laura May, PhD

5:00 PM
Adjournment

Saturday, February 24, 2001

8:00 AM
Continental Breakfast ***(Ballroom Pre-function Area)***

8:30 AM
Paper Session
Moderator: David Cooper, M.Sc., RT
Sunny Hill Health Centre for Childern

A Study On The Relationship Between Buttock-Seat Cushion Interface Pressure And Pressure Ulcer Incidence In At-Risk Elderly Wheelchair Users
David Brienza, PhD

Function and Performance of the Rocket Multidirectional Powered Wheelchair ∆
Geoff Fernie, PhD, PEng

The Psychometric Properties of the Seating Identification Tool (SIT)
William Miller PhD, MScOT

The Prevalence and Type of Wheelchair and Seating Needs Among the Institutionalized Elderly
William Miller, PhD, MScOT

Influence of Service Dogs in Psychosocial and Functional Outcomes as Measured by the Rosenberg Self-Esteem Scale and Revised Craig Handicap Assessment and Reporting Technique (Chart)
Karen Frost, MBA

10:00 AM
Break

10:30 AM
Special Session – Policy Change: Can We Make A Difference ***(Junior Ballroom)***

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

Panel Members

Morris (Mickey) Milner, PhD, PEng, CCE
Vice President of Research and Development
Bloorview MacMillan Centre, Toronto, ON, Canada

Emma Parry, SROT
Research Therapist, Centre for Disability Research and Innovation, University College of London, United Kingdom

Peter Thomas,Esq.
Attorney and Disability Advocate, Washington, D.C.

Lori Warren
Artist/Pa*rent, Orlando, FL*

Feeling constrained by service delivery systems? Frustrated by funding problems? Ready to take out a contract on the Director of Special Education? Pondering how to get research dollars in a time of cutbacks and consolidation? There is an old saying, “If you are not part of the solution, perhaps you are part of the problem”. Come and hear this international panel of consumer, lawyer, clinician and administrator/researcher discuss current activities designed to create positive change in systems of service delivery of assistive technology including funding. Each panel member has experience in being part of the solution. Hear about their battles and learn strategies used to effect change.

12:30 PM
Adjournment

∆ *Indicates presentation by a representative of a product manufacturer*

All presenters are from the USA unless other wise indicated.

Seventeenth International Seating Symposium

Faculty

Geoff Bardsley, PhD
Tayside Orthopaedic & Rehabilitation Technology Centre, Ninewells Hospital, Dundee DD1 9SY, Scotland.
E-mail: geoff@tortc.tuht.scot.nhs.uk

Zen and the Art of Wheelchair Maintenance
• Keynote
-Thursday, February 22, 2001, 9:00 AM
Chris Bar Research Forum
• Special Session
-Friday, February 23, 2001, 3:30 PM

Adrienne Bergen, PT, ATP, ATS, CRTS
21 Roosevelt Dr.
Valhalla, NY 10595
E-mail: adee50@aol.com

Evaluation Techniques
• 2 hour Instructional Course
-Thursday, February 22, 2001, 2:30 PM

David Brienza, PhD
University of Pittsburgh
School of Health and Rehabilitation Sciences
Department of Rehabilitation Science and Technology
5044 Forbes Tower
Pittsburgh, PA 15260
E-mail: dbrienza@pitt.edu

Chris Bar Research Forum
• Special Session
-Friday, February 23, 2001, 3:30 PM
A Study On The Relationship Between Buttock-Seat Cushion Interface Pressure And Pressure Ulcer Incidence In At-Risk Elderly Wheelchair Users
• Paper
--Saturday, February 24, 2001, 8:30 AM

Gord Broughton, M.Sc., RT
Sunny Hill Health Centre for Children
Therapy Department
3644 Slocan Street
Vancouver, BC V5M 3E8
Canada

Dynamic Seating Components for Reduction in Spastic Activity and Enhancement of Function
• 1 hour Instructional Course
-Thursday, February 22, 2001, 1:00 PM
Innovative Solutions for Seating and Positioning
• 2 hour Instructional Course
-Thursday, February 22, 2001, 2:30 PM
Custom Contoured Seating - The Next Step
• 1 hour Instructional Course
-Friday, February 23, 2001, 8:30 AM

Dalthea Brown, MS, PT, ATP
University of Pittsburgh
School of Health and Rehabilitation Sciences
Department of Rehabilitation Science and Technology
5044 Forbes Tower
Pittsburgh, PA 15260
E-mail: ddbst11@pitt.eud

Dynamic Seating Components for Reduction in Spastic Activity and Enhancement of Function
• 1 hour Instructional Course
-Thursday, February 22, 2001, 1:00 PM
Development Of A Dynamic Seating System Rigid-Body For Use In The Design Of Dynamic Seating For Children Exhibiting Full Body Extensor Thrust
• Paper
-Friday, February 23, 2001, 3:30 PM

Sheila Buck, B.Sc (OT), ATP
Therapy Now!
811 Graham Bell Ct.
Milton, ON L9T 3T1
Canada
E-mail: therapynow@interhop.net

Back to Basics and Beyond
• Pre Conference Workshop
-Wednesday, February 21, 2001, 8:00 AM

Mary Ellen Buning, OTR, ATP
University of Pittsburgh
School of Health and Rehabilitation Sciences
Department of Rehabilitation Science and Technology
5044 Forbes Tower
Pittsburgh, PA 15260
E-mail: mbuning@pitt.edu

What Consumer's Bring to Wheelchair Selection: The Results of a Study
• Paper
-Friday, February 23, 2001, 3:30 PM

Corrinne Carriere
Carriere Consulting
532-268 Lakeshore Blvd.
Oakville, ON L6J 7S4
Canada
E-mail: cc_in_ca@fastmail.ca

The Business Side of Assistive Technology
• Pre Conference Workshop
-Wednesday, February 21, 2001, 8:00 AM

Laura Cohen, PT, ATP
University of Pittsburgh
School of Health and Rehabilitation Sciences
Department of Rehabilitation Science and Technology
5044 Forbes Tower
Pittsburgh, PA 15260
E-mail: ljcohen@flash.net

Teaching Clinical Rationale For Seating And Wheeled Mobility Prescription: A Randomized Controlled Trial Of Four Instructional Methods
• Paper
-Friday, February 23, 2001, 3:30 PM

David Cooper, M.Sc., RT
Sunny Hill Health Centre for Children
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3644 Slocan Street
Vancouver, BC V5M 3E8
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Dynamic Seating Components for Reduction in Spastic Activity and Enhancement of Function
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• 2 hour Instructional Course
-Thursday, February 22, 2001, 2:30 PM
Custom Contoured Seating - The Next Step
• 1 hour Instructional Course
-Friday, February 23, 2001, 8:30 AM

Rory Cooper, PhD
University of Pittsburgh
School of Health and Rehabilitation Sciences
Department of Rehabilitation Science and Technology
Director, Human Engineering Research Laboratories, VA Pittsburgh Healthcare System
5044 Forbes Tower
Pittsburgh, PA 15260
rcooper@pitt.edu

Funding Wheelchair Seating & Mobility Technology and Services
• Pre Conference Workshop
-Wednesday, February 21, 2001, 8:00 AM

Rosemarie Cooper, MPT
VA-Pittsburgh Healthcare System
HERL, Building 4
7180 Highland Drive
Pittsburgh, PA 15206
E-mail: cooperr@msx.upmc.edu

Application of Research Findings into Clinical Practice
• 1 hour Instructional Course
-Friday, February 23, 2001, 1:00 PM

Ian Denison, PT
G F Strong - Vancouver Hospital, A Health Sciences Centre
4255 Laurel Street
Vancouver, BC V2Z 2G9
E-mail: idenison@vanhosp.bc.ca

Power Wheelchairs, a New Definition
• 1 hour Instructional Course
-Friday, February 23, 2001, 10:30 AM

Gerry Dickerson, ATS, CRTS
A&J Care Inc.
8000 Cooper Avenue
Glendale, NY 11385
E-mail: gdcrts@aol.com

Funding Wheelchair Seating & Mobility Technology and Services
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Mark Dilabio, RT
Sunny Hill Health Centre for Children
Therapy Department
3644 Slocan Street
Vancouver, BC V5M 3E8

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Marygrace DiStasio Mangine, OTR/L
Magee Rehabilitation
2216 South Clarion Street
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The Challenge of Optimal Seating for People with Joint Contratures
• 2 hour Instructional Course
-Friday, February 23, 2001, 1:00 PM

Ann Eubank, OTR, ATP
Permobile INC
3729 Humphrey
St. Louis, MO 63116
E-mail: anneubank@aol.com
Funding Wheelchair Seating & Mobility Technology and Services
• Pre Conference Workshop
-Wednesday, February 21, 2001, 8:00 AM

Martin Ferguson Pell, PhD
University College of London
Center for Disability Research & Innovation
Stanmore, United Kingdom HA7 4LP
E-mail: m.ferguson-pell@ucl.ac.uk

Pressure Mapping
• 2 hour Instructional Course
-Thursday, February 22, 2001, 2:30 PM
Chris Bar Research Forum
• Special Session
-Friday, February 23, 2001, 3:30 PM

Geoff Fernie, PhD, PEng
Centre for Studies in Aging
Sunnybrook & Women's College Health Sciences Centre
U-B, 2075 Bayview Avenue
Toronto, ON M4N 3M5
Canada
E-mail: geoff.fernie@swchsc.on.ca

Function and Performance of the Rocket Multidirectional Powered Wheelchair
• Paper
-Saturday, February 24, 2001, 8:30 AM

Kathryn Fisher, B.Sc, OT(C)
Therapy Supplies
104 Bartley Drive
Toronto, ON M4A 1C5
Canada
Power Chairs Features & Functions
• 1 hour Instructional Course
-Thursday, February 22, 2001, 1:00 PM
High Tech Solutions for a Special Needs Client
• Paper
-Friday, February 23, 2001, 8:30 AM
Personal Mobility, Vehicle Mobility...Strengthening the Link
• 1 hour Instructional Course
-Friday, February 23, 2001, 8:30 AM

Shirley Fitzgerald, PhD
University of Pittsburgh
School of Health and Rehabilitation Sciences
Department of Rehabilitation Science and Technology
and, VA-Pittsburgh Healthcare System Center of
Excellence for Wheelchairs and Related Technology
5044 Forbes Tower
Pittsburgh, PA 15260
E-mail: sgf9@pitt.edu

Innovations and Findings in Current Seating Research
• Paper
-Thursday, February 22, 2001, 1000
How to Avoid the Pitfalls in Assistive Technology Research
• 1 hour Instructional Course
-Friday, February 23, 2001, 10:30 AM
Application of Research Findings into Clinical Practice
• 1 hour Instructional Course
-Friday, February 23, 2001, 1:00 PM

Cynthia Fleck, RN, BSN, ET, CWS
Crown Therapeutics
1538 N. Leavitt ST, BF
Chicago, IL 60622

The Seated Posture And Pressure Ulcer Connection
• 2 hour Instructional Course
-Friday, February 23, 2001, 1:00 PM

Karen Frost, MBA
VA-Pittsburgh Healthcare System
Center of Excellence for Wheelchairs and Related
Technology, and
University of Pittsburgh
School of Health and Rehabilitation Sciences
Department of Rehabilitation Science and Technology
5044 Forbes Tower
Pittsburgh, PA 15260
E-mail: kfrost+@pitt.edu

Influence Of Service Dogs In Psychosocial And Functional Outcomes As Measured By The Rosenber Self-Esteem Scale And Revised Craig Handicap Assessment And Reporting Technique (Chart)
• Paper
-Saturday, February 24, 2001, 8:30 AM

Marty Gallagher, MS, LOTR
Louisiana Tech University
711 S. Vienna
Ruston, LA 71270
E-mail: marthag@coes.latech.edu

Factors for Integrating Wheelchairs and Transportation
• 2 hour Instructional Course
-Thursday, February 22, 2001, 2:30 PM

Doug Gayton, ATP
G F Strong - Vancouver Hospital,
A Health Sciences Centre
4255 Laurel Street
Vancouver, BC V2Z 2G9
E-mail: dgayton@vanhosp.bc.ca

Power Wheelchairs, a New Definition
• 1 hour Instructional Course
-Friday, February 23, 2001, 10:30 AM

Michelle Gunn, ATP
Whitmyer Biomechanixs
1833 Junwin Ct.
Tallahassee, FL 32308
E-mail: spickett@whitbio.com

Cervical Flexion Problems and Possibilities
• 1 hour Instructional Course
-Thursday, February 22, 2001, 1:00 PM

David Harding
Motion Specialties
101 Bartley Drive
Toronto, ON M4A 1C9
Canada

Power Chairs Features & Functions
• 1 hour Instructional Course
-Thursday, February 22, 2001, 1:00 PM

Karen Hardwick, PhD, OTR, FOATA
Austin State School
2203 West 35th Street
Austin, TX 78730
E-mail: karen.hardwick@mhmr.state.tx.us

The Use of Technological Advances to Evaluate Seating and Positioning in Individuals with Severe Orthopedic and Developmental Disabilities
• 1 hour Instructional Course
-Friday, February 23, 2001, 10:30 AM

Ann Havard, LOTR, CDRS
Louisiana Tech University
711 S. Vienna
Ruston, LA 71270

Factors for Integrating Wheelchairs and Transportation
• 2 hour Instructional Course
-Thursday, February 22, 2001, 2:30 PM

Thomas Hetzel, PT, ATP
Aspen Seating
1032 E. Northampton Ct.
Highlands Ranch, CO 80126
E-mail: hetzel@bouldernews.infi.net

Back in Style
• 2 hour Instructional Course
-Friday, February 23, 2001, 1:00 PM

Douglas Hobson, PhD
University of Pittsburgh
School of Health and Rehabilitation Sciences
Department of Rehabilitation Science and Technology
and
RERC on Wheeled Mobility
5044 Forbes Tower
Pittsburgh, PA 15260
E-mail: dhobson@pitt.edu

Measuring and Recording Seated Posture - A Proposed Standard
• 2 hour Instructional Course
-Thursday, February 22, 2001, 2:30 PM
Transport Wheelchairs
• 2 hour Instructional Course
-Friday, February 23, 2001, 1:00 PM

Susan Johnson Taylor, OTR/L
288 East Ranney Ave.
Vernon Hills, IL 60061
E-mail: staylor@rehabchicago.org; taylorotr@aol.com

Developing Pre and Post Baclofen Pump Outcome Measures for Seating with Individuals with Cerebral Palsy
• Paper
-Friday, February 23, 2001, 8:30 AM

Debbie Jones, PT
5225 S.W. Joshua Street
Tualatin, OR 97062

The Importance of the Therapist in the Wheelchair Decision-making Process for Older Adults
• 1 hour Instructional Course
-Friday, February 23, 2001, 10:30 AM

Karen Kangas, OTR/L
R.D. 1
Box 70
Shamokin, PA 17872
E-mail: kmkangas@ptd.net

Chest Supports, Why they are not working!
• Paper
-Thursday, February 22, 2001, 10:00 AM
Children in Power
• 2 hour Instructional Course
-Thursday, February 22, 2001, 2:30 PM
Seating, Access, and Mobility II: Those Children Who Grow Up !
• 1 hour Instructional Course
-Friday, February 23, 2001, 10:30 AM

Alicia Koontz, MS, ATP
VA-Pittsburgh Healthcare System
Room 151R-1
7180 Highland Drive
Pittsburgh, PA 15206
E-mail: amkst63@pitt.edu

The Role of the Shoulder During Wheelchair Propulsion
• Paper
-Thursday, February 22, 2001, 10:00 AM

Barbara Levy, PT, ATP
Thoms Rehabilitation Hospital
Seating & Mobility Clinic
68 Sweeten Creek Road
Asheville, NC 28803

Funding Wheelchair Seating & Mobility Technology, and Services
• Pre Conference Workshop
-Wednesday, February 21, 2001, 8:00 AM
Chris Bar Research Forum
• Special Session
-Friday, February 23, 2001, 3:30 PM

Gloria Liebel, OT (C)
Bloorview MacMillan Centre
35 Rumsey Road
Toronto, ON M4G 1R8
Canada

High Tech Solutions for a Special Needs Client
• Paper
-Friday, February 23, 2001, 8:30 AM

Simon Margolis, CO, ATS/P
National Seating and Mobility, Inc
PMB 577
4190 Vinewood Lane #111
Plymouth, MN 55442
E-mail: smargolis@nsm-seating.com

When Ethics Isn't Enough - Making Tough Decisions In A Changing Clinical Environment
• 1 hour Instructional Course
-Thursday, February 22, 2001, 1:00 PM

Laura May, PhD
University of Alberta
Dept. of Physical Therapy
2-50 Corbett Hall
Edmonton, AB T6G 2G4

Back Support Options: Functional Outcomes for Persons with SCI
• Paper
-Friday, February 23, 2001, 3:30 PM

Rachel McDonald, B.App.Sc.(O.T.), Post.Grad.Dip.(Biomechanics)
The Institute of Child Health and Great Ormond Street
Hospital for
Children NHS Trust
The Wolfsom Centre
Mecklenbergh Square
London, WC1N 2AP
E-mail: r.mcdonald@ich.ucl.ac.uk

Development Of A Method Of Measuring Force Through A Kneeblock For Children With Cerebral Palsy
• Paper
-Thursday, February 22, 2001, 1000
Parents versus Therapists Views of their Child's Adaptive Seating System
• Paper
-Friday, February 23, 2001, 8:30 AM

William Miller, PhD. MScOT
School of Rehabilitation Science
University of British Columbia
School of Rehabilitation Sciences
Faculty of Medicine
T325-2211 Wesbrook Mall
Vancouver, BC V6T 2B5
Canada
E-mail: bcmiller@biostats.uwo.ca

The Prevalence And Type Of Wheelchair And Seating Needs Among The Institutionalized Elderly
• Paper
--Saturday, February 24, 2001, 8:30 AM
The Psychometric Properties Of The Seating Identification Tool (Sit)
• Paper
--Saturday, February 24, 2001, 8:30 AM

Morris Milner, PhD, P.Eng., CCE
Bloorview-MacMillan Centre
350 Rumsey Road
Toronto, ON M4G 1R8
E-mail: ortcmmi@oise.utoronto.ca

Policy Change: Can We Make a Difference
• Special Session
--Saturday, February 24, 2001, 10:30 AM

Jean Minkel, MA, PT
MinkelConsulting
112 Chestnut Avenue
New Windsor, NY 12553
E-mail: jminkel@aol.com

Mat Evaluation
• 1 hour Instructional Course
-Friday, February 23, 2001, 10:30 AM
Policy Change: Can We Make a Difference
• Special Session
-Saturday, February 24, 2001, 10:30 AM

Brenlee Mogul-Rotman, B.Sc., OT(C), OTR, ATP
Toward Independence
34 Squire Drive
Richmond Hill, ON L4S 1C6
E-mail: brenleemogul@sympatico.ca

Personal Mobility, Vehicle Mobility...Strengthening the Link
• 1 hour Instructional Course
-Friday, February 23, 2001, 8:30 AM

Cathy Mulholland, OTR
Mulholland Positioning Systems, Inc
P.O.Box 391
Santa Paula, CA 93061
E-mail: cathyotr@aol.com

Kids Vs. Adults, Is There a Difference in Seating
• Pre Conference Workshop.
-Wednesday, February 21, 2001, 8:00 AM

Terry O'Neill
Kino Mobility Inc
301140 Sheppard Avenue West
Toronto, ON M3K 2A2

Personal Mobility, Vehicle Mobility...Strengthening the Link
• 1 hour Instructional Course
-Friday, February 23, 2001, 8:30 AM

Emma Parry, SROP, ATP
University College of London
Center for Disability Research & Innovation
Stanmore, HA7 4LP
E-mail:

Pressure Mapping
• 2 hour Instructional Course
-Thursday, February 22, 2001, 2:30 PM
Policy Change: Can We Make a Difference
• Special Session
--Saturday, February 24, 2001, 10:30 AM

Corrine Parver, J.D., P.T.
Dickstein Shapiro Morin & Oshinsky, LLP
2101 L Street NW
Washington, DC 20037

The Business Side of Assistive Technology
• Pre Conference Workshop
-Wednesday, February 21, 2001, 8:00 AM

David (Scott) Pickett,
Whitmyer Biomechanixs
1833 Junwin Ct.
Tallahassee, FL 32308
E-mail: spickett@whitbio.com

Cervical Flexion Problems and Possibilities
• 1 hour Instructional Course
-Thursday, February 22, 2001, 1:00 PM

Terry Pountney, MA, MCSP
Chailey Heritage Clinical Services
Beggars Wood Road
North Chailey, Lewes
East Sussex, BN8 4JN
E-mail: Teresa.Pountney@chh1sdh.ccmail.sdht-tr.sthames.nhs.uk

A Retrospective Study of the Effect of Postural Management Programmes in the Management of Hip Dislocation and Spinal Curvature in Bilateral Cerebral Palsy
• Paper
- Friday, February 23, 2001, 8:30 AM

Jessica Presperin Pedersen, MBA, OTR/L, ATP
Presperin Pedersen Associates
5816 N. Moody Avenue
Chicago, IL 60646
E-mail: prespeders@aol.com

Issues in Pediatric Practice
Moderator - • Paper Session
-Friday, February 23, 2001, 8:30 AM

Kathleen Riley, BS, PT, ATS
National Seating and Mobility
113 Teaberry Ct.
Mooresville, NC 28115
E-mail: kriley1949@aol.com

Kids vs. Adults, Is There A
• Pre Conference Workshop
-Wednesday, February 21, 2001, 8:00 AM

Tina Roesler, MS, PT, ABDA
Crown Therapeutics
1538 N. Leavitt ST, BF
Chicago, IL 60622
E-mail: tlroesler@aol.com

The Seated Posture And Pressure Ulcer Connection
• 2 hour Instructional Course
-Friday, February 23, 2001, 1:00 PM

Faith Saftler Savage, PT, ATP
74 Cottage Street
Natick, MA 07160
E-mail: fsaftler@bigplanet.com

Can Therapuetic Positioning Effect Functional Outcomes?
• 1 hour Instructional Course
-Thursday, February 22, 2001, 1:00 PM
Seating for People with Multiple Sclerosis in a Long Term Care Facility
• 1 hour Instructional Course
-Friday, February 23, 2001, 8:30 AM

Jack Sanders III, ATS
Clear Choice Health Plans
Bend, OR
E-mail: jsanders@coihs.com

Funding Wheelchair Seating & Mobility Technology, and Services
• Pre Conference Workshop
-Wednesday, February 21, 2001, 8:00 AM

Mark Schmeler, MS, OTR/L, ATP
University of Pittsburgh, School of Rehabilitation Science and Technology
Department of Rehabilitation Science and Technology;
Center for Assistive Technology, UPMC Health System
3010 Forbes Tower
Pittsburgh, PA 15213
E-mail: schmelermr@msx.upmc.edu

Funding Wheelchair Seating & Mobility Technology, and Services
• Pre Conference Workshop
-Wednesday, February 21, 2001, 8:00 AM
Clinical Use of Simulation
• 1 hour Instructional Course
-Friday, February 23, 2001, 8:30 AM
The Use of Adjustable Modular Wheelchairs as Fleet
• 1 hour Instructional Course
-Friday, February 23, 2001, 10:30 AM

Mike Shipp, MEd, CDRS
Louisiana Tech University
711 S. Vienna
Ruston, LA 71270

Factors for Integrating Wheelchairs and Tansportation
• 2 hour Instructional Course
-Thursday, February 22, 2001, 2:30 PM

Jill Sparacio, OTR/L, ATP
4600 Roslyn Road
Downers Grove, IL 60515
E-mail: OTSpar@aol.com

The Effects of Seating on Respiratory Function
• 2 hour Instructional Course
-Thursday, February 22, 2001, 2:30 PM

Stephen Sprigle, PhD, PT
Center for Rehab Technology
Helen Hayes Hospital
Route 9W
West Haverstraw, NY 10993
E-mail: gogators@compuserve.com

Chris Bar Research Forum
• Special Session
-Friday, February 23, 2001, 3:30 PM

Martin Szmal
Pride Mobility Products, Corp.
182 Susquehanna Ave.
Exeter, PA 18643
Email: mszmal@pidemobility.com

Funding Wheelchair Seating & Mobility Technology, and Services
• Pre Conference Workshop
-Wednesday, February 21, 2001, 8:00 AM

Stephanie Tanguay, OTR, ATP/S
National Seating and Mobility
721 North Vermont
Royal Oak, MI 48067
E-mail: nsm33@nsm-seating.com

Seating Interventions for Spinal Cord Injuries with Secondary Orthopedic Complications
• 1 hour Instructional Course
-Thursday, February 22, 2001, 1:00 PM

Geoff Taylor
Verg, Inc
120 Maryland Avenue
Winnipeg, MB R3G 1L1
Canada
E-mail: taylor@verg.com

Chris Bar Research Forum
• Special Session
-Friday, February 23, 2001, 3:30 PM

Peter Thomas, Esq
Powers, Pyles, Sutter *& Verville
1875 I Street NW
Washington, DC 20006-5409
E-mail: PThomas@ppsv.com

Policy Change: Can We Make a Difference
• Special Session
--Saturday, February 24, 2001, 10:30 AM

Elaine Toskos, OTR, ATP
Rusk Institute for Rehabilitation Medicine
400 East 34th St.
New York, NY 10016-4998

Funding Wheelchair Seating & Mobility Technology, and Services
• Pre Conference Workshop
-Wednesday, February 21, 2001, 8:00 AM

Elyn Tovey, PT
UPMC Rehabilitation Hospital
1405 Shady Avenue
Pittsburgh, PA 15217
E-mail: toveyes@msx.upmc.edu

The Use of Adjustable Modular Wheelchairs as Fleet
• 1 hour Instructional Course
-Friday, February 23, 2001, 10:30 AM

Lois Tucker, OTR/L, ATP
National Seating & Mobility
436 White Road
Mineopla, NY 11501
E-mail: tuckor23@aol.com

Slip Sliding Away - Dealing with the client that slides
• 1 hour Instructional Course
-Thursday, February 22, 2001, 1:00 PM
Linking Clinical Presentation with Power Wheelchair Programming
• 2 hour Instructional Course
-Friday, February 23, 2001, 1:00 PM

Peggy Walker, RN
U S Rehab - Division of VGM
1063 Langford Road
Blythewood, SC 29016
E-mail: walkerP321@aol.com

Reimbursement - Rehab 101 — All You Need To Know & More To Get Your Patient What They Really Need
• 2 hour Instructional Course
-Friday, February 23, 2001, 1:00 PM

Lori Warren
7608 Apple Tree Circle
Orlando, FL 32819
E-mail: warrenlw@aol.com

Policy Change: Can We Make a Difference
Spec Session
--Saturday, February 24, 2001, 10:30 AM

Kelly Waugh, MA, PT
Children's Specialized Hospital, Mountainside, NJ
37 Valentine Rd.
New Providence, NJ 07974
E-mail: kgwaugh@home.com

Measuring and Recording Seated Posture - A Proposed Standard
• 2 hour Instructional Course
-Thursday, February 22, 2001, 2:30 PM
Clinical Use of Simulation
• 1 hour Instructional Course
-Friday, February 23, 2001, 8:30 AM

Cheryl T. West, MSPT
Magee Rehabilitation
2216 South Clarion Street
Philadelphia, PA 19148
E-mail: twestpt@aol.com

The Challenge of Optimal Seating for People with Joint Contratures
• 2 hour Instructional Course
-Friday, February 23, 2001, 1:00 PM

Hotel Floor Plan

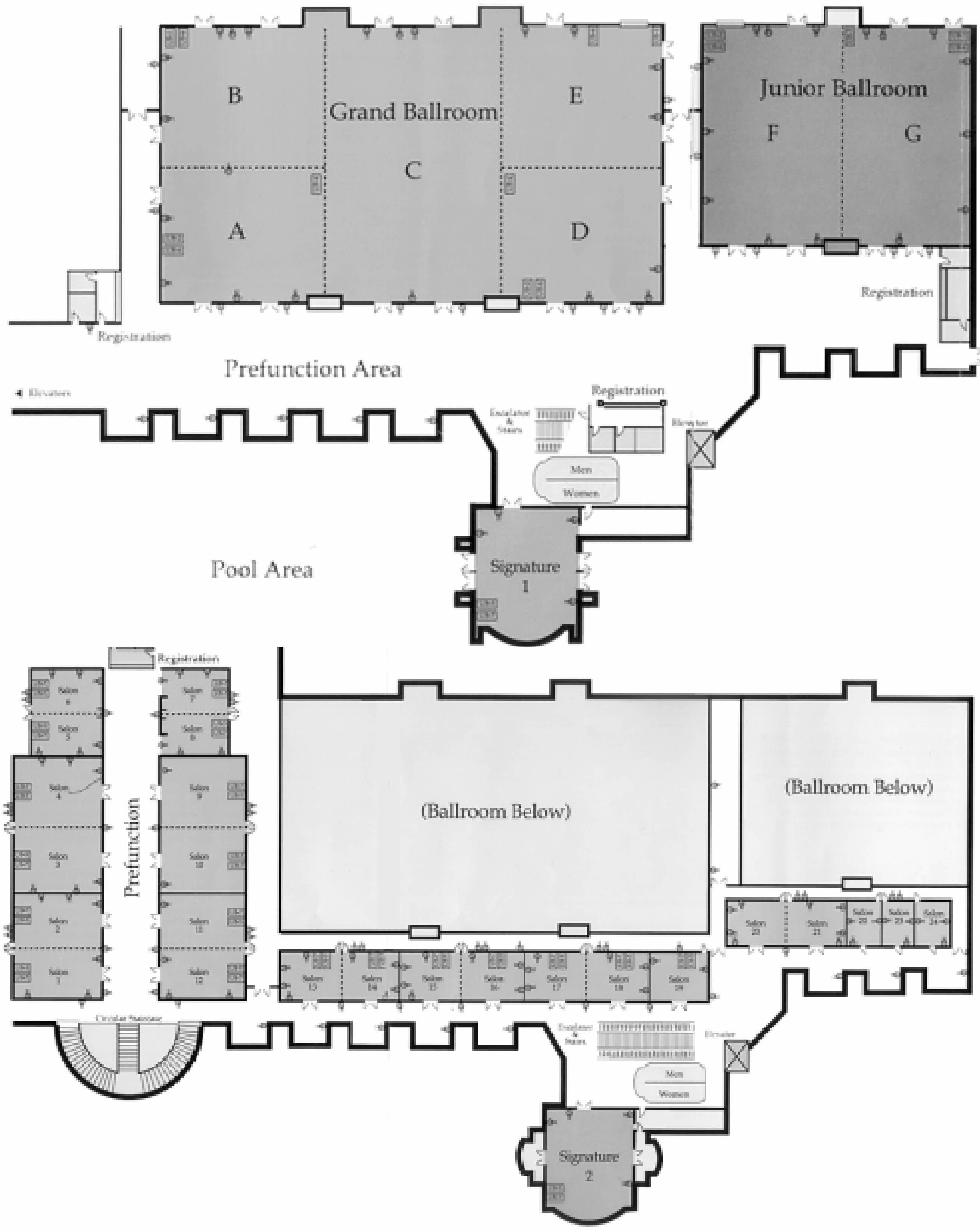
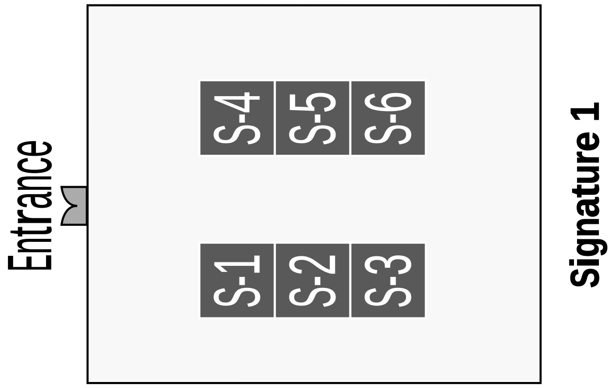
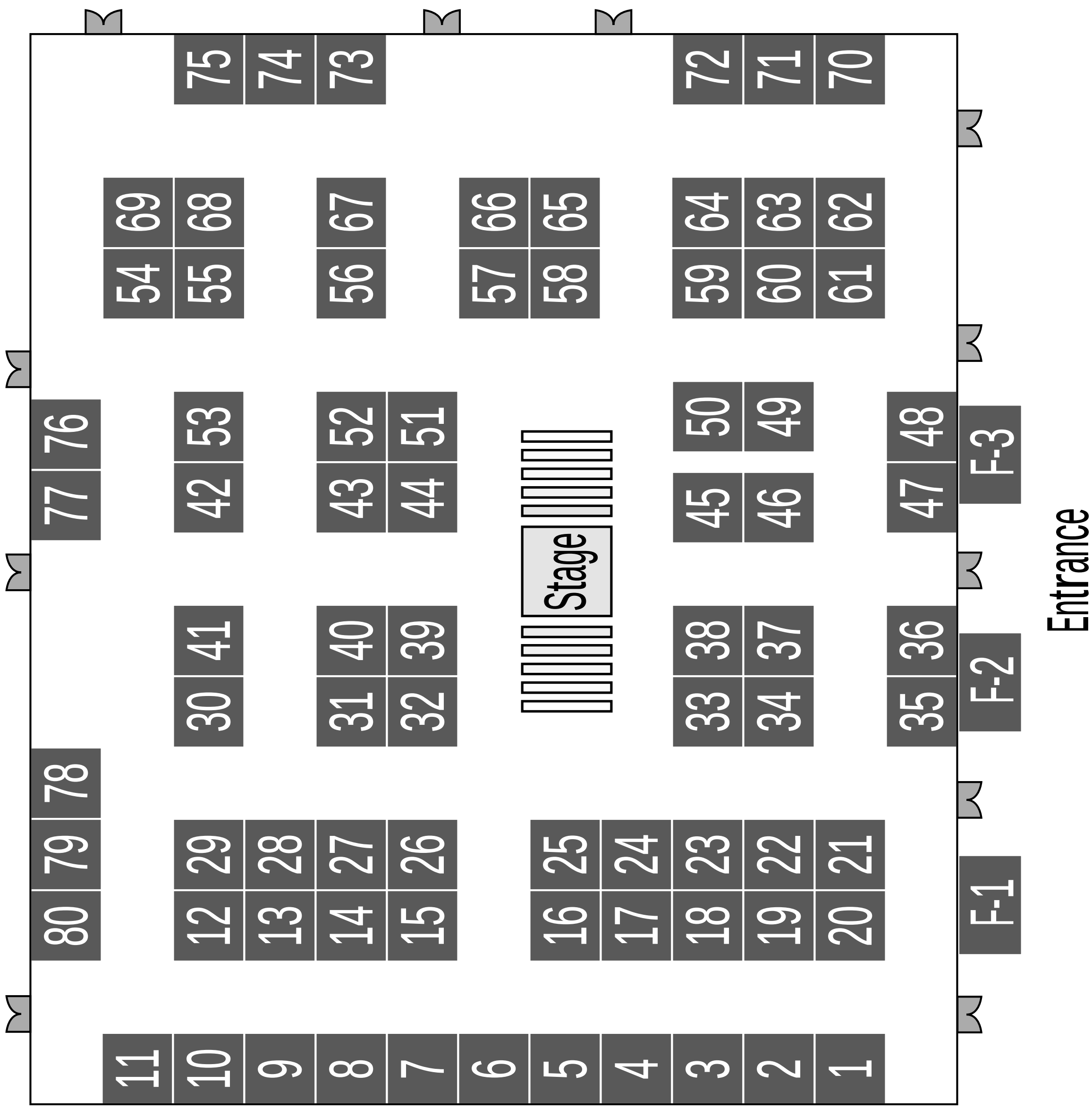


Exhibit Hall Floor Plan





Seventeenth International Seating Symposium

Exhibitors

Accelerated Rehab Design
32025 Industrial Park Drive
Olathe, TX 77362
Randy Potter
Phone: 888-397-4063
Fax: 888-397-0307
Booth Number: 18

Action Products, Inc.
22 North Mulberry
Hagerstown, MD 21740
Fred Nelson
Phone: 800-228-7763
Fax: 877-732-2073
Booth Number: 9

Adaptive Engineering Lab, Inc.
17907 Bothell-Everett Hwy.
Mill Creek, WA 98012
Donald Wanet
Phone: 800-327-6080
Fax: 800-368-0785
Email: donaldw@aelseating.com
Booth Number: 31-32-39-40

Adaptive Equipment Systems
6224-A Preston Avenue
Livermore, CA 94550
Don Gordon
Phone: 800-611-4237
Fax: 800-511-4237
Booth Number: S 1-2-3

Altimate Medical Inc
P.O. Box 180
Morton, MN 56270
Jackie Kaufenberg
Phone: 507-697-6393
Fax: 507-697-6900
Booth Number: 24

Aquila Corporation
206 1st Avenue NE
Clarks Grove, MN 56016
Steve Kohlman
Phone: 888-878-1141
Fax: 507-345-3816
Email: spkohl@smig.net
Booth Number: 13

Artsco, Inc
9535 Route 30
Irwin, PA 15642
Mark Malagodi
Phone: 724-863-1160
Fax: 724-863-3559
Email: artsco@telerama.com
Booth Number: 23

Aurora Ministries
P.O. Box 621
Bradenton, FL 34206
Scott Mosher
Phone: 941-748-4100
Fax: 941-748-4100
Booth Number: 8

Barrier Free Lifts, Inc.
9230 Prince William Street
Manassas, VA 20110
Teresa Kirk
Phone: 800-582-8732
Fax: 703-361-7861
Booth Number: 25

Bodypoint Designs, Inc.
Suite 300
Seattle, WA 98104
Elisa Louis
Phone: 206-405-4555
Fax: 206-405-4556
Email: elisa@bodypoint.com
Booth Number: 56

Broda Seating
385 Phillip St.
Waterloo, ON N2L 5R8
CANADA
David Heap
Phone: 519-746-8080
Fax: 519-746-8616
Booth Number: 48

CF Rehab
1003 International Drive
Oakdale, PA 15071
Jerry Clarke
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Email: gcclarke@email.msn.com
Booth Number: 78

Chauffer Mobility/Electric Mobility
591 Mantua Blvd.
Sewell, NJ 08080
Joe Schwab
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Fax: 856-468-1703
Booth Number: 62-63

Clarke Health Care
1003 International Drive
Oakdale, PA 15071
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Booth Number: 80

Cleveland Medical Devices, Inc.
Suite 130
Cleveland, OH 44106
Bernard Tarver
Phone: 216-791-6720
Fax: 216-791-6739
Booth Number: 16

Convaid, Inc.
2830 California Street
Torrance, CA 90503
Gina Wornson
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Fax: 310-618-8811
Email: gina@convaid.com
Booth Number: 61

Crown Therapeutics Inc./
Roho International, Inc
100 N. Florida Avenue
Belleville, IL 62221
Julie Repp
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Email: julier@crownthera.com
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Tyler Robuck
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Fax: 805-583-2840
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Frog Legs
P.O. Box 465
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David Kaufman
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Graham-Field, Inc./Everest & Jennings
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Bay Shore, NY 11706
Charlene Albrecht
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Fax: 631-439-5637:
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Homecrest Healthcare
140 Madison Avenue
Wadena, MN 56482
Gary Hanson
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Email: ghanson@homecrest.com
Booth Number: 19

Independence Providers, Inc. - LifeStand
29A Marble Avenue
Pleasantville, NY 10570
Pat Conlon
Phone: 914-741-0350
Fax: 914-741-0354
Booth Number: 76

InterCo GmbH
(Gesellschaft für Planung und Vertrieb von Reha-Hilfen)
Im Auel 50
53783 Eitorf
GERMANY
Ute Markwald
Phone: 49 2243 4001
Fax.: 49 2243 4003
E-Mail: IntercogmbH@t-online.de
Booth Number: 47

Invacare
One Invacare Way
Elyria, OH 44036-2125
Shawn Vinson
Phone: 800-333-6900
Fax: 800-678-4682
Email: svinson@invacare.com
Booth Number: 33-34-37-38

KCI
8023 Vantage Drive
San Antonio, TX 78230
Cyndi Erp
Phone: 210-255-6364
Fax: 201-255-6981
Booth Number: 5

LEVO USA
140 Howell Road, Suite E
Tyrone, GA 30290
Tracy Dorwarth
Phone: 770-486-0033
Fax: 770-486-6096
Booth Number: 10

MedBloc, Inc.
Suite 112
Tonawanda, NY 14150
Ann DeWitt
Phone: 888-433-6818
Fax: 716-447-0030
Email: medbloc@pce.net
Booth Number: 73-74

Metalcraft Industries, Inc.
399 N. Burr Oak Avenue
Oregon, WI 53575
Bob Jones
Phone: 608-835-3232
Fax: 608-835-9180
Email: mtlcrft@hotmail.com
Booth Number: 28

Moving Solutions, Inc
2550 Wisconsin Avenue
Downers Grove, IL 60515
Mark Niedbalek
Phone: 630--963-9693
Fax: 630-963-4212
Booth Number: S 6

Mulholland Positioning Systems, Inc.
P.O. Box 391
Santa Paula, CA 93061
Cathy Mulholland
Phone: 805-525-7165
Fax: 805-933-1082
Email: cathy@mulhollandinc.com
Booth Number: 75

NRRTS
National Registry of Rehabilitation Technology Suppliers
P.O.Box 4033
Lago Vista, TX 78645
Judy Vance
Phone: 512-267-6832
Fax: 512-267-6833
Email: nrrts@ctsinet.com

Nimble Inc.
201 Millway Avenue
Concord, ON L4K 5K8
CANADA
Phone: 905-760-8744
Fax: 905-760-8746
Booth Number: 11

Otto Bock Rehab
300 Xenium Lane
Minneapolis, MN 55441
Debbie Pickar
Phone: 763-519-6186
Booth Number: 49-50

Permobile Inc.
6 B Gill Street
Woburn, MA 01801
David Iammarino
Phone: 800-736-0925 Ex 255
Fax: 800-231-3556
Email: david.i@permobilus.com
Booth Number: 54-55-68-69

Position Dynamics
2636 289th Place
Adel, IA 50003
Shawn O'Toole
Phone: 515-993-5001
Fax: 515-993-4172
Booth Number: 6

Prairie Seating Corp.
7515 Linder Avenue
Skokie, IL 60077
Karin Trenkenschu
Phone: 847-568-0001
Fax: 847-568-0002
Booth Number: 67

Pride Mobility Products Corp.
182 Susquehanna Avenue
Exter, PA 18643
Mary Beth Gillespie
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Fax: 800-800-1636
Email: mgillespie@pridemobility.com
Booth Number: 70-71-72

Rehab Management Magazine
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Los Angeles, CA 90045
Jody Rich
Phone: 310-642-4400
Fax: 310-641-0831
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1700 N. Moore Street
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Phone: 703-524-6686
Fax:: 703-524-6630
email: info@resna.org
Booth Number: F 3

Sammons Preston
4 Sammons Court
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Seventeenth International Seating Symposium

Thursday, February 22, 2001

Zen and the Art of Wheelchair Maintenance – Experiences On A Journey Through Seating

Geoff I. Bardsley, PhD

Abstract
What follows is based on actual occurrences. Although much has been changed for rhetorical purposes, it must be regarded in its essence as fact. However, it should in no way be associated with that great body of wisdom relating to orthodox Zen Buddhist practice. It's not very factual on wheelchairs either.

Reviews

'*Bardsley is not propounding a brand new philosophy for our acceptance or rejection. He is rediscovering an ancient and universal tradition, illuminating it by his own very peculiar method, and restating it in terms which he hopes will strike home effectively …. All I can really say is that he struck with brilliantly enlightening effect on the mind of this reviewer.*'
Auchtermuchty Herald

'*A miracle ……….. sparkles like an electric wheelchair*.'
Forfar Village Voice

'*Bardsley is the nut at the still centre of the turning wheel*'
Crianlarich Chronicle

'*You should read this paper on the road, on a mountainside, at the bottom of the ocean. It should be a set paper in any serious course of any study, so multi-applicable are its intentions. For instance, if you wanted to be a wheelchair mechanic it should be read before any technical material. If you wanted to be a man of God, it should be read before you decide to be. And if you wanted to write a book, it should be read before you invest in a word processor…. Read the goddam thing and you'll see what I mean. The very heart of things - that's where Bardsley is coming from*'
Dundee Street Life

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Innovations and Findings in Current Seating Research

Shirley Fitzgerald, PhD

In today's healthcare arena, clinicians are under stress to treat patients with the most appropriate and up to date care. One way to get this information is to read professional journals targeted for assistive technology, mobility and seating. Unfortunately, due to demands imposed upon the clinician from the healthcare system, clinicians need to care for more patients in a shorter period of time, resulting in less time spent in reading professional journals. Therefore, the purpose of this session is to review literature that has been published from January 1999 to December 2000 (2 years) that focused on seating research and advances.

Literature searches were conducted within MEDLINE and CINAHL. Other search engines were used as well, but with no new articles were found. Keywords used to identify possible articles included wheelchairs, seating, seating systems, cushions, posture, pressure sores, spasticity, tone and kyphosis. Combinations of the key words allowed for limiting the search to relevant articles. The same search strategy was completed in all search engines. In addition, proceedings that were available to the author from RESNA and other conferences (years 1999, 2000) were also reviewed to identify relevant findings within the wheelchair seating research. Although every effort was made to make the list all inclusive, it is possible that relevant research has been published, but has not been identified due to the varied keywords that authors use to identify their work. *Should I have missed some work, it is purely by accident, and no intent to neglect research.*

In December of 2000, numerous articles were identified by both MEDLINE and CINAHL that had been published in the past 2 years encompassing different aspects of seating, wheelchairs and mobility. Upon review of the information available (title, abstract), a decision was made about the inclusion of the article in this presentation. If the focus of the article was seating related it has been included. If the focus of the article was more product related (informational only) or was a review article concerning seating issues, the reference was noted, but has not been included for review within this talk. Table 1 shows the focus of articles that will be presented.

Table 1: Focus of Articles

- Seating: Pressure Ulcers; Cushions
- Seating – Posture
- Spasticity and Tone
- Wheelchairs : Transportation
Mobility issues
Biomechanics

Seating with respect to pressure ulcers, management of pressure and the integration of cushions to aid in pressure relief have had the greatest amount of research completed on it in the past several years. Included in these research findings are studies that have examined comparisons between different types of cushions and amount of pressure, cushions versus tilt-in-space chairs to relieve pressure, and mattresses designed to aid in pressure relief. Somewhat interrelated, research has also been conducted on pressure and posture with different wheelchair seating systems. For example a wheelchair with different types of leg rests may modify posture but also decrease pressure for the individual. Some research has examined the use of individualized programs to retrain subjects on how to sit, thereby helping with seated posture.

The research conducted in spasticity research has focused primarily on injections of Botulinum toxin. Various studies have shown that injections can reduce spasticity in both children and adults. Other studies have encompassed the validity of the pendulum test for assessing spasticity and treating spasticity with an exercise regime.

Research on wheelchairs has included issues in transportation (i.e. stability of SCI subjects in dynamic settings, wheelchair restraint systems), new types of wheelchairs such as the power assisted manual wheelchairs, as well as the biomechanics of wheelchair propulsion.

Studies will be described with results and limitations emphasized. This review of the literature should be beneficial to all clinicians who have little time to read, and yet want to be more knowledgeable for their patients concerning the research that has been completed.

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Chest Supports: Why They Are Not Working!

Karen Kangas, OTR/L

Introduction:

I am not talking about patients who have had a spinal cord injury or a muscular atrophy or dystrophy. Chest supports for them are critical in holding up a body which is losing control. This paper is focusing on children and adults with cerebral palsy, traumatic brain injury, and other motor cortex dysfunctions.

For many individuals with hypertonicity, or combined hyper and hypotonicity, chest supports are not working. The adult or child can be readily observed to be hanging on the chest supports, collapsing their trunks into the support, rather than being assisted by the support to remain upright.

These individuals often exhibit sensory processing problems (not to be mistaken with sensory loss, nor loss of sensation). Allow me to share some assessment and equipment strategies which can assist in you with a better understanding of how the body is interpreting its postures in order to support an upright posture.

Adaptive Seating as is currently implemented:

When we see children or adults who demonstrate hypertonicity we may often at closer examination determine lower tone in their trunks with increased tone in the extremities. We may see increased hyperextension, or what may appear as obligatory primitive reflex responses, like an asymmetrical tonic neck reflex, or a symmetrical tonic neck reflex.

Our “job” in seating was to create seating which would decrease or control this tone, to allow them to sit in an upright posture.

We presumed that an upright posture was the posture needed to then be able to do things.

As the general “rule” we created a particular type of seating which decreased tone, or we hoped would. (This was a result of the belief that the tone was involuntary and reflexive in nature, preventing the individual from controlling her body). Some of these “rules” were and are:

When extensor tone is demonstrated, the body of the patient is flexed. This is primarily done at the pelvis and hips, wedging the seat, to place the knees higher than the pelvis. This type of seat may also be referred to as an “anti-thrust” seat. The underlying theory here is that to stop the extension, flexion at the hips will be provided by the seat, thus “breaking up” the tone. Often when this is accomplished the trunk will then collapse onto the thighs, or move forward. Trunk lateral supports and a chest strap (varying ones are used, “butterfly” configurations, “H-straps”, “X” straps) are then used to assist in pulling the trunk back up and against a planar back. The head is then supported with a head rest.

For many individuals with high tone, or increased extensor tone, this works for just about as long as the seating clinic visit takes. However, in less than an hour, the patient is “hanging on” to the chest supports, falling or almost pushing forward onto them, or hanging on to the chest support, while pushing out at the pelvis (“thrusting”).

The next solution has been to increase the angle or wedge of the seat, add a pommel of indeterminate size (to add abduction as well as hip flexion), increase the size or curve of the trunk laterals, and increase the size or weight of the chest straps, or add scapular retractors (bars from the back of the top of the back which are padded and go over the top of the shoulder and land at the collarbone on the front).

With many patients, this still does not assist in head control, but rather then head then slides into a hyperextended posture, with the occiput resting on the upper back. At this point we place them often, into a tilt-in-space chair and tilt the chair almost to its full 45 degrees of tilt, and leave them there all day. Or, if the individual is brought up to an upright posture, it is only for a few short minutes until the trunk “falling forward” occurs.

Unfortunately, this reasoning is flawed. This seating does not work, and certainly the patient is not able to be in an upright posture.

This reasoning is reasoning of anatomy, and some bio-mechanics, which based on physics, is perhaps understandable, but human beings are not bio-mechanical, nor anatomical, but rather are neurophysiological.

That means that at any moment in time multiple systems are integrated and functioning regulating, and changing, always moving, always changing, always working. These systems adjust internally and externally, and it is no wonder we have had difficulty interpreting the body, we are still trying to understand these processes at all. They include biological, chemical, electrical, magnetic, as well as force, levers, and time. (I don’t have enough time to go into all of this, but wanted to simply make the point of the complication here.)

I want to today, simply bring it some increased information about the sensory system, its integration in the body, and how it directly relates to upright postural control.

Integration of Systems in the Body:
Upright trunk (and subsequent head) control is based on sensory integration rather than on “motor” control. Motor control is in fact, sensory integrative control in nature. In short, muscle stimulation and regulation is based on information not just simply to the motor cortex, but also the integration of the vestibular/equilibrium system (the body’s relationship to gravity) and the tactile/kinesthetic/proprioceptive systems (the body’s relationship to its internal structures to the external ones)

Seating systems must support these principles and often chest supports do not.

Individuals who are not mobile and not ambulatory have little active, STRONG, experience with gravity, and are most often asked to remain even more “stable” by “not moving.” These individuals have difficulty learning how to integrate various sensory-motor skills, especially upright postures for adequate body postural use and extremity isolation.

Why does this matter? In human beings within earth’s gravity, body control is interpreted and performed when the body understands its relationship to gravity, primarily through the activation of the vestibular system, its ability to weight bear (interpreted through motor proprioceptors), and to stably, yet dynamically react to gravity. This requires weight bearing through the pelvis, through the thighs, through the knees, through the calves, through the feet. In order to weight bear, the body must hold itself. It cannot be totally supported. Total support asks the body to “give up” or “give in” to the surface, as if to rest or sleep, as we all do, or attempt to do each night. This giving in or giving up of righting reactions, is necessary for rejuvenation of our very active vestibular and equilibrium systems needed all waking day long.

We all move from holding ourselves up, to giving in a little, to regaining upright postures, to giving in a little. Imagine yourself at a desk, working at a keyboard, as I am now, writing this paper. As you concentrate your body moves forward, on the chair, the trunk especially, holding the hands up over the keyboard, the feet holding on the the floor, the pelvis slightly anteriorly tilted. When a sentence is completed, and new thoughts are created, and the hands lift from the keyboard, a rest occurs. This resting posture, is a giving up of uprightness. The pelvis shifts posteriorly, the trunk collapses, and the back finds the back of the chair. The legs are no longer weight bearing, and the pelvis itself, is now leaning against the back of the chair. When work begins again, the trunk and pelvis simultaneously, almost, lift up, and move forward, and the hands work some more.

This is weight shifting, and upright posture. It occurs without furniture support. It occurs at the front of the chair, controlled by the body and the person’s intent.

If a seatbelt were added to my desk chair, and a shoulder harness, I would have a great deal of difficulty getting this paper done. I would end up hanging on the straps as I rested.

This is what is happening and should happen to all human beings. We collapse with rest, we move into uprightness to work, and this shifting is critical to the entire range of control of the process of uprightness. Postures are not snapshots, they are videos. Posture is always changing, reacting, and moving, working with gravity, working, and moving.

Now, with children and adults who not only have a lack of experience of mobility and ambulation (the strongest range of postures of uprightness) and whose bodies are already having some difficulty interpreting data, another reaction comes into play. This is an involuntary trunk collapsing, protective in nature, like most reflexes. When any pressure is placed on the chest, the trunk moves into the pressure. It is as if, the support is telling the body to come to it. (I think that this is another form of the "snuggle" response, seen in young infants, when the child is supported, the tactile/kinesthetic system is activated the the infant moves into, closer to, mother).

Reflexes are always managed by active weight bearing and equilibrium. The vestibular system is so powerful, that its control of the body almost always super-imposes itself on all other systems. In short, active and voluntary control, and purposeful movement control reflexes, or overpower their control of the body.

Let me try a quick summary. We are providing too much support, and support in the wrong places, if we want seating to assist in an individual's control of upright postures, especially at the trunk and head. Its really as simple as that.

Recognizing this postural insecurity in the trunk is not difficult. It is obvious in observation of the patient in their seating system. What is needed, are strategies which truly provide support, rather than a hindrance to upright posture.

Treatment and Equipment Strategies:

In order to hold one's self in an upright posture, weight bearing must be active, and obvious. The pelvis must be able to weight shift, be mobile, and be weight bearing. The hamstrings and quadriceps must also be weight bearing, not overly holding, or overly shortening. (This can be easily felt when treating the patient, by a certified therapist, physical or occupational. A weight bearing limb is actively holding, while an overly holding limb, can be demonstrating increased spasticity, NOT weight bearing.) The body must have tone, and use tone to hold itself, so power and tone must be evident.

In general, I use a process of assessment. I will work on a bench or a mat table depending on the size of the patient. The height of the bench or table must be identical to the leg length of the patient when seated. I then place the patient in a seated posture, at the edge of the bench (or mat table). My own trunk will become the back support of the chair, and will move the patient forward into a seated posture, placing weight bearing onto the pelvis, and the lower extremities. I can readily tell when there is weight bearing, or collapsing, where the point of controls are, and how the patient is able to react to moving into a seated posture, and then back out of it. If the patient's trunk collapses onto my hands as I assist her in an upright posture, or I have great difficulty getting the patient into an upright posture, as the head and neck do not appear to extend, or the opposite, there is so much extension that the patient almost "pops" out of my hands, I know that I am seeing postural insecurity, and probably a lack or experience or ability in activating the weight bearing and equilibrium systems, with an over dependence on the tactile system.

If the patient is a child, I will first add a "barrier" vest. This is just what it sounds like. A vest which prevents my hands from being felt on the trunk. No singular point of contact can be felt, and the patient can then be moved throughout treatment, or into an upright posture easily, without trunk collapse. I work with orthotists and construct a plastazote vest. This vest is then NOT strong enough to totally support the patient, it is simply a hard barrier within which the patient can have experiences of moving without feeling hands, or other objects which create their "tactile" reaction. 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. This vest is firm, yet not hard. It can then be tolerated by the body readily, and does not take over support from the body. The body must do the work, but this vest prevents a tactile reaction.

This works well with smaller children. The vest can be used in therapy, and within a standard seating system. It is used for short periods frequently, or worn all day, for time of less than 6 months. It is used to simply allow the body to learn to do what it already knows to do, but hasn't had the opportunity to do because too much stuff has been in the way.

The vest is then used for the trunk, the wedge is removed from the seat, as well as any pommel. The trunk is brought forward, a bit in front of the pelvis, and a slight (very small) anterior tilt may be added under the ischial tuberosities on the seat. This system is mounted on a tilt in space chair, so that when the chair is tilted at about 10-15 degrees, the child will be able to "rest." No seating position is right if it is the ONLY position, we must develop seating systems that allow a range of movement and support to occur.

Powered tilt on a powered chair is even better, as the child can learn to control the support independently. The vest is used during tasks, when the child is forward. It is a treatment technique not adaptive seating equipment. It is to be used temporarily, with treatment. It is a method by which the child can learn to use her body herself. This is NOT an answer to trunk control. It is a method by which the individual learns trunk and by the way, head control.

With larger children, or with adults, a vest is not able to be used, (with the exception of an individual who has a scoliosis, orthotic jacket for spinal control already, then treatment with it on, can occur and seating changes can use it, too), as the type of material I prefer would collapse and to make it "harder" would then prevent them from controlling their bodies, and would simply take over for them.

Instead, bilateral trunk supports from the rear, long enough to touch the pelvis to the scapulae, NOT curving around to the front, can be used, with again, a flatter seat, an anteriorly tilted seat, no pommel, and an ACTIVITY to be participated in, especially with the head. This position can be simulated with firm towel rolls or blanket rolls, make just to fit. The support is then all along the spine, with no single point of contact, and subsequently the body is not stimulated to use a tactile response. To stimulate the vestibular system, this person then, with me, is most often, provided with a powered mobility system with head access, so that control of an activity is obvious, and movement is occurring to them, as well as them controlling it.

Summary:

It is so difficult to try and explain a difficult concept in a short space and time. I hope I have at least peaked your curiosity, and have assisted you in looking much further into the range of human postures. I have been honored to have the best teachers in the world, my patients. They have taught me how the body works, and that it best works when it is unencumbered, supported (but not restrained) and actively involved in interesting tasks. Seating, to me, as learned through them, is a process of movements, not a chair, and the supports needed, must be flexible, and allow them to learn control of their bodies, through experience with life and its control of activities. We are a complicated species, and our understanding, even of ourselves, is just beginning.

The Role of the Shoulder During Wheelchair Propulsion

Alicia Koontz, MS, ATP

Shoulder pain and injury is prevalent in high percentages among individuals who use manual wheelchairs (1-3) and for many it seems that early signs of shoulder micro trauma may be unknowingly present. In a study conducted by Lal on the shoulders of 53 patients with spinal cord injuries 72% had radiological evidence of degenerative shoulder changes but only 11% complained of pain in the shoulders (4). In the group that demonstrated shoulder injury, the acromioclavicular joint was predominantly affected. In a prospective magnetic resonance imaging (MRI) study of the shoulders of 18 wheelchair users shoulder abnormalities about the coracoacromial arch (formed by the acromion, corocoacromial ligament, and coracoid process) were common and were not always associated with pain (5). The average ages of the patients in these studies were 37 and 35 years respectively. While further shoulder pathology is expected with advanced age, exposure to putative mechanical forces from pushing a wheelchair and weight bearing activities will likely increase one's risk in developing shoulder abnormalities.

With the repetitive upward loading of the shoulder that occurs when weight bearing or when pushing a wheelchair, counteractive forces from the shoulder depressors are necessary to prevent displacement of the humeral head superiorly from the glenoid cavity of the scapula. Most researchers agree that muscle imbalance is an additional factor in the development and perpetuation of shoulder injury. Burnham and colleagues in their study of wheelchair athletes with paraplegia and unimpaired athletes found that the ratio of shoulder abduction to adduction strength was significantly higher in the athletes with paraplegia suggesting a relative weakness of shoulder adduction to abduction as compared to the unimpaired athletes (6). The ratio of strength for abduction/adduction was even further exaggerated among the wheelchair athletes who showed signs of impingement. Without the counteracting force of the shoulder depressors, the deltoid will pull the humeral head upwards into the coracoacromial arch compromising the space available for the rotator cuff tendons which further increases the likelihood of an impingement problem. Athletes with paraplegia who showed signs of impingement were also significantly weaker in internal and external rotation as compared to those without impingement. Hence, an effective preventative method for balancing muscle strength among wheelchair users may involve a strength training regime emphasizing strengthening of the shoulder adductor muscles (latissimus dorsi, teres major and lower fibers of the pectoralis major) and the internal rotators (subscapularis and anterior deltoid) and external rotators (infraspinatus and posterior deltoid).

Shoulder joint pain and injury may also result from the repetitive application of forces when pushing a wheelchair. In Lal's study, a positive relationship was found between individuals with a higher level of wheelchair activity and beginning signs of degenerative changes in the shoulders (4). While weight-bearing and pressure relief maneuvers involve very large impact loads on the shoulder, the loading does not occur as frequently as in wheelchair propulsion. With subsequent application of low shoulder stresses, the shoulder cartilage repair mechanism is likely disturbed resulting in the beginning signs of micro trauma as indicated previously. Then when the weakened shoulder is subjected to a very large impact load like what generally occurs when performing a transfer, a more serious injury like a rotator cuff tear may occur.

Recent studies have focused on identifying key wheelchair propulsion variables associated with shoulder injury among MWUs. Propulsion forces at the pushrim have been significantly linked to magnetic resonance imaging evidence of shoulder dysfunction in 26 MWUs (7). The strongest correlation was between the vertically directed force component and the MRI scores for coroacoacromial ligament edema and thickening. The coracoacromial ligament is located slightly anterior and superior to the head of the humerus. The vertical force component tends to push the humeral head up further into the joint applying increased pressure against the ligament resulting in the subsequent signs of trauma. Fourteen wheelchair users from this prospective study returned after two years and were tested under the same protocol (8). Seven of these wheelchair users showed an increase in their shoulder MRI abnormalities. Interestingly, this group also used greater forces to propel their wheelchairs at each speed tested the first time they were evaluated. Moreover, individuals who propelled with a peak weight normalized force of greater than 5% were significantly more likely to have increased shoulder abnormalities over time. This finding suggests that altering propulsion technique or using devices that reduce the amount of shoulder injuries.

During wheelchair propulsion at the extreme ends of its range of motion, the shoulder is subjected to peak loading conditions (9). It is at this point that the shoulder may be the most susceptible to injury. Modification of propulsion technique, optimization of the user's wheelchair configuration as well as appropriate seating and positioning may improve the biomechanics of propulsion and reduce the prevalence of shoulder problems. Boninger and colleagues found that individuals whose shoulders were further behind the rear wheel axle contacted the pushrim behind the top dead center of the rim (10). At this position, stronger muscles can be recruited to deliver power to the rims which ultimately leads to a reduction in frequency of the applied forces. While moving the rear wheel axle further forward compromises stability of the chair and user comfort, it was shown to decrease stroke frequency, increase contact angle, and reduce the rate of loading on the hand which all are factors that may aid in the reduction or prevention of shoulder pain and/or injury.

The impact of shoulder pain/injury is both personal and financial. The personal impact can range from curtailing one's activities to near total dependence on others. The financial impacts are also not insignificant. Understanding the mechanisms of shoulder injury can help to identify MWUs who are at risk for developing shoulder abnormalities. Interventions among MWUs should focus on strength training of the opposing muscles groups, provision of wheelchair training, and optimization of the biomechanics of wheelchair propulsion through appropriate wheelchair prescription and set-up. Current investigations on wheelchair propulsion biomechanics are leaning toward longitudinal studies which are necessary to identify injurious biomechanical factors related to early shoulder joint abnormalities among MWUs and to evaluate the effectiveness of intervention.

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Development of a Method of Measuring Force Through a Kneeblock for Children with Cerebral Palsy

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Introduction

Many of the adaptive seating systems used in the United Kingdom with children with cerebral palsy use a sacral pad and kneeblock system to control the pelvis. The system has been developed along biomechanical principles, and the aim to stabilise the child's pelvis and lower body in order for them to attain and uphold an erect trunk posture. There is a strong belief among practitioners that these systems are effective. However objective evidence to back up clinical practice is lacking. Secondly, the amount of force necessary both to achieve the clinical effect and acceptable to the child is not known. This paper discusses a method to measure the force/pressure relationship including a pilot study with children with cerebral palsy and a pilot study with normal children. The overall aim of the larger project is to gather objective information about the efficacy of this seating system for children with cerebral palsy

Background

The objective of this type of seating system (using a sacral pad and kneeblock) is to apply forces to the pelvis to create a 'moment' (turning effect) by the sacral pad to push the pelvis into a neutral position, which is then balanced and maintained by an opposing counterforce at the kneeblock (Green & Nelham, 1991, Mulcahy et al, 1988). At present, published information about the efficacy of this type of system is of a descriptive nature only (Reid & Rigby, 1996).

Research Questions

1. Are the forces applied through a kneeblock and the resultant pressure measured at a sacral pad proportional to each other?
2. Are the force and pressure consistent over time for children with cerebral palsy?

Method

A force transduction device was developed. This consists of strain gauges attached to the normal kneeblock and was developed in conjunction with Kings College Hospital Medical Engineering and Physics Department (London UK). Pressure at the sacral pad was measured using a commercially available skin interface pressure device (The Oxford Pressure Monitor) is used. In order to ensure that the position of the device exactly mimics that of the child's own kneeblock, a jig has also been developed which measures the exact position of the child's kneeblock, which is then reproduced in the force transducer device.

Initially four children with cerebral palsy were seen on twice, over two days. The children's age ranged from 8 to 12 years and all children had four limb involvement, of either predominantly dystonic or predominantly spastic type. Two of the children wore spinal jackets

Seven normal children also took part in the pilot project. They ranged in age from 4 to 12 years of age, and spent a morning or afternoon session using the special seating system. Data was collected at several different points.

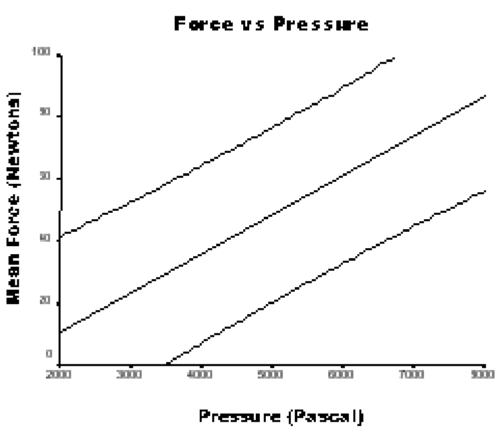
Results and Future plans

The initial data collection with children with cerebral palsy showed no identifiable relationship between the amount of pressure measured at the sacral pad and force applied through the kneeblocks. The force applied was found to range between 5 and 25 newtons in the children and was not consistent in either amount or direction over the two days. It was then decided to pilot the sacral pad and kneeblock measurement system with children who did not have postural difficulties to establish a model of the relationship between force at the kneeblocks and pressure at the sacrum.

Mean force and mean pressure were collected and analysed together in the normal children and consistent relationship was found. Regression analysis was performed and a positive correlation of .777 between Force and Pressure was shown. The relationship can be expressed as:

$$\text{Mean Force (N)} = -15 + 0.01 \text{ Pressure (Pa)}$$

The relationship, together with 95% Confidence Interval is shown below



Having found a linear relationship with normal children, the next stage of the project is to explore this further with the main cohort of children with cerebral palsy who use this system, and assess this relationship over time. How children of different type and distribution of muscle tone respond to the system will also be determined. The results may then have implications for individuals using the system, and together with the other measures used in the project, may influence clinical practice for seating clinicians.

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Power Chair: Features & Functions

Kathryn Fisher, B.Sc, OT(C), David Harding

Power wheelchair drive configurations have been greatly expanded in the past few years. It is important for both clients and prescribing therapists to understand how differences in drive configurations affect maneuverability and drivability. The goal of this workshop is to provide the prescribing therapist with a greater awareness of these designs in order optimize the matching of equipment to the needs of the client.

Performance Characteristics These performance characteristics must be considered in the assessment process: Speed Torque Turning Radius Stability Maneuverability and Tractability Slope Transition Capability Suspension

This workshop will examine only those characteristics that affect a client's ability to negotiate their environment.

Rear-, Front-, Mid-Wheel Drives There is a great deal of controversy surrounding the criteria by which we categorize drive locations. In general, a mid-wheel drive will have the system center of gravity (C of G) somewhere over the drive wheels. A rear-wheel drive will have the C of G well ahead of the drive wheels and a front-wheel drive will have the C of G well behind the drive wheels. There are several problems associated with trying to apply these criteria as a means of categorizing drive locations. First, the system C of G is determined by the combination of the client and the chair. Many current designs allow for fore/aft adjustment of the seat frame, thereby changing the C of G. One chair might have the C of G directly over the drive wheels for one client but have it well behind the drive wheels for another, depending on body mass distribution and seat frame location. C of G can also be affected by tilt/recline systems, ventilators and seating.

Initiating Turns The location of the drive wheels determines how soon a turn needs to be initiated. In general, the turn has to be started at the point where the drive wheels are sufficiently far enough into the space into which the turn is being made. Consider, for example, a 90º left turn from one hallway (A) into another (B) where the left drive wheel will be stopped while the right will be going forward. The chair must be driven forward until the drive wheels are a few inches past the leading edge of the intersecting hallway. When the chair is turned sharply, it will pivot 90º around the left drive wheel. The point of pivot(the center of the tire's contact patch(must be sufficiently past the left wall of the intersecting hallway 'B' so that there is enough clearance for the parts of the chair that protrude laterally from the pivot point. This will include 1/2 of the width of the drive tire, any other chair parts such as arm pads, joystick box, etc., plus sufficient clearance between the chair and left wall. With a rear drive chair, most of the chair's length will be beyond the intersecting hall's leading edge when the turn is initiated. This means that hallway 'B' must be wide enough to allow the length of the chair(measured diagonally from the pivot point to the front, right corner(to clear the far corner of the intersection of the hallways. With a front-drive chair, most of the chair will be behind this point. This requires that hallway 'A' be wide enough to accommodate the swing of the rear end of the chair. This is the distance from the pivot point to the right, rear corner of the chair. With a mid-drive configuration, hallway 'A' must be wide enough to allow the swing of the portion of the chair measured from the pivot point to the right, rear corner and hallway 'B' must accommodate the distance from the pivot point to the front, right corner. Other turning strategies will affect maneuverability. Veering and multi-point turns will be necessary for some situations.

If a similar left turn is made such that the right drive wheel rotates forward and the left backward, the chair must be driven further past the leading wall of the intersecting hallway since the pivot point of the turn will be mid-way between the two drive wheels.

Front and Rear End Swing Much of a chair's maneuverability can be defined by the layout of the environment within which the chair is driven. A rear-drive chair is characterized by the front end swinging during a turn. A front-drive chair swings the rear end. Mid-drive chairs swing both front and rear. No one design can be said to turn more sharply than another. What makes one design more maneuverable than another is dependant on the clearances and obstacle locations within the turning space. As noted above, clearance for front- and rear-end swing is an important factor in determining a chair's maneuverability. Mid-drive chairs, in general, have better maneuverability because the protrusion of the front and rear ends is to a lesser degree outside the length (in plan) of the seated occupant and the drive wheels are within this length. A rear-drive chair, in contrast, will typically be set up with the occupant wholly in front of the drive wheels. The portion that swings during a turn will include the entire occupant length. A turn such as one from hallway 'A' to hallway 'B' will be easily accomplished if hallway 'B' is wide enough to allow the front end to swing, otherwise a multi-point turn will be necessary. A front-drive chair typically has a considerable length of frame behind the occupant. The same turn from 'A' to 'B' will require hallway 'A' to be wide enough for the rear end to swing. A mid-drive configuration will be able to complete this turn more easily since the length of the chair is more or less equally proportioned between the front and rear. This means that neither hallway needs to be wider than the other.

Suspension Suspension is provided on wheelchairs for two reasons: to provide shock absorption and to maintain wheel contact on uneven surfaces. Any drive configuration that allows the front and rear non-drive wheels to contact the ground simultaneously during normal driving will require some form of suspension. Such is the case with virtually all mid-drive designs. On changes in slope, for example, the drive wheels can lose traction if the suspension travel is insufficient to provide uninterrupted contact with the ground. Many mid-drive designs suffer from inadequate suspension and, consequently, hang up on ramps, curb cuts, thresholds and other surface irregularities.

Slope Transition When a power chair is driven from one plane to another, where there is a rapid transition, there can be a tendency for the drive wheels to lose traction. This is caused by the inability of the front and rear wheels (either casters or anti-tippers) to accommodate for the change in grade. This accommodation is usually made through the design of the suspension. True front-wheel drive chairs do not have front anti-tippers and therefore will not have this problem.

Anti-Tippers Anti-tippers are required when the design of the chair allows for the center of gravity to move beyond (either forward or rearward) the base of support (contact points) of the chair. This can be caused by driving on inclined surfaces or because of inertia (during hard braking or when popping 'wheelies' during acceleration). Mid-drive chairs require either caster or anti-tip wheels at the front since they have a tendency to rock forward during deceleration. Front-drive designs may need front anti-tippers if the rear portion of the chair is not sufficiently weighted to prevent forward tipping. Rear-drive chairs usually have rear anti-tippers to prevent the chairs from flipping over backwards while accelerating or while on inclines.

Other Client Considerations Design features that affect the optimization of the prescription involve seating needs and cognitive factors.

Seat Frame Flexibility The degree of seat frame adjustability may be a factor that will affect the performance of a power chair. A large seating system, for example, may require the seat frame to be moved rearward in order to keep the C of G within the desirable range. A mid-drive chair with the C of G too far forward will tend to pitch forward during braking or deceleration. A rear-drive chair with a disproportionate load on the casters will experience steering resistance and reduced traction. Many power chairs offer the ability to adjust the seat frame fore and aft.

Cognition Some users with cognitive impairment may find rear-wheel drive designs easier to learn because the part of the chair that swings is within view. Front-drive chairs, in particular, may pose problems because of the degree of obstructed movement of the chair.

Foot Position In general, front-drive chairs and some mid-drive chairs more easily allow for 90º foot position since the casters are in the rear. Because casters require a space within which they swivel, this area is not available for foot placement. Mid-drive configurations such as the various Jazzy models and the E&J Solaire utilize rear casters and non-swivel front anti-tip wheels. This design, like front-drive designs, provides ample clearance for 90º footrests. The Quickie 424 has casters at the front. Foot placement at 90º is somewhat restricted to allow for the caster swivel. The Rocket casters are placed far forward, thereby eliminating the possibility of 90º footrests. In general, rear-drive designs utilize front casters and are unsuitable for 90º footrests.

Dynamic Seating Components for the Reduction of Spastic Activity and Enhancement of Function

David Cooper, M.Sc., Mark Dilabio, RT,
Gord Broughton, RT, Dalthea Brown, MS, PT, ATP

Dynamic Seating Components for the Reduction of Spastic Activity and Enhancement of Function

David Cooper, M.Sc., Mark Dilabio, Gord Broughton,Elaine Antoniuk PT, and Janice Evans, PT

Dynamic seating components that allow movement in a controlled manner have the potential of reducing the strength and duration of uncontrolled spasms. They also reduce the harm that might be caused by posture controls during spastic activity. Others have reported promising results with the implementation of dynamic back supports, (Conner 1997, and Ault et al 1997), and our clinical observations in 13 of 14 cases have been very positive. Similar results have occurred with a few applications of dynamic head supports. Dynamic supports have also been used successfully for improving controlled head and arm movement where there is purposeful functional movement but assistive support is needed.

The types of supports we are reporting on allow movement of the client while providing support. In this context, dynamic does not mean 'adjustable' and it does not include support systems that allow the client to move within the system. A portion of the clients we serve need posture control systems that allow movement while providing direction and control to the movement, then return or assist return to the preferred posture. The clients we are using these systems with are predominantly ones with severe neuromuscular impairment, typically a strong adolescent with spastic quadriplegia and the asymmetry and contracture problems associated with it.

Several manufacturers have produced components with dynamic function. For example Whitmyer Biomechanix has a forehead strap that allows rotation while supporting the head from falling forward and there are a variety of shoulder straps/ chest harnesses with elastic webbing or neoprene that allow forward flexion of the trunk with assistance to return to upright. These components

are not widely applicable as dynamic systems. For many they are used as a non-dynamic support. But for those that can utilize the dynamic component, the benefits can be appreciable. Care must be taken when recommending these systems. They have potential harmful effects. Case in point is spring loaded footrest hangers that introduce a rotation movement as the person extends. For the wrong client this could have damaging effects.

Dynamic back supports

Dynamic back supports enable the client to extend, pushing the back support rearward with resistance. When the client relaxes, the back support returns the client to the upright position. Freedom Designs and Product Design Group both have dynamic back features in their product line.

We have provided 14 dynamic back supports over the last three years. They have been provided to adolescents with strong extensor spasm. Several of the clients were using rigid or semi-rigid pelvic bars. The problems being addressed included excessive full body extension requiring management. The clients had severe comfort or pressure problems due to the excessive forces on either their scapular region or due to their pelvic controls. The dynamic backs have been beneficial for all but one client. In each case the strength and duration of the spasms were reduced. The one client it did not help was not relaxing after the extension, remaining fully extended. The system would not return her to her more upright sitting posture.

The dynamic back systems were of two basic types:

Wheelchair modification: The first method involved modification of the client's wheelchair by allowing it to articulate where the back uprights attach to the seat rails, (figure 1). Most of these systems were added to Action and Quickie tilt manual wheelchairs. These modifications were relatively simple and did not require permanent change to the wheelchair. In its later incarnations it included the addition of springs, the hardware to hold them, movement limits (stops) for upright and back, and a lockout mechanism to remove the dynamic action when desired. The spring tension and movement ranges were fine tuned for each client.

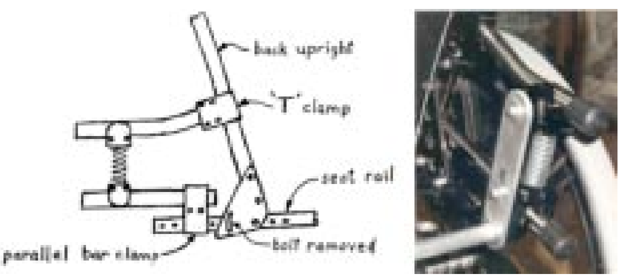

Figure 1: Wheelchair modification to provide dynamic back mechanism. Both sides of the wheelchair were modified. Left: without the movement limits or lockout mechanism. Spring tension adjustment was by a combination if sliding the 'T' clamp down the wheelchair uprights and sliding the springs along their mounting tubes.

The amount of movement was small. The top of the back would move a maximum of two inches. This was fortunate since the pivot of the mechanism was not aligned with the anatomical pivot. Since the movement was slight there was no problem with relative height changes between the back support and client's back.
Integrated dynamic back: The second method, (figure 2), involved a joint incorporated into the posture control system. The spring action came from either a flat spring across the hinged joint or elastic material, (foam), between the two boards of the backrest. With this system it was possible to place the joint to coincide with an approximation of the anatomical extension point. Therefore, the pelvis remained relatively immobile while the trunk above it extended back. Typically this system was used with clients with weaker extensor spasm.

Figure 2: The integrated version of the dynamic back, during construction.

One of the limitations with both these systems was the return force. Since we were reliant on springs for the return force, it could not be greater that the extension force. It was felt that in some instances that the action would be more appropriate if there was a way to monitor the forces involved and when the extension spasm was finished the system would return the back to upright regardless of the forces required.

The initial systems did not have a lockout mechanism. This was a problem with the 'wheelchair modified' system for caregivers when pushing the chair on rough ground or over obstacles such as curbs. This was not a problem with the 'integrated' system since the wheelchair frame was not altered.

Dynamic head support systems were used for extension and rotation of the head. In two instances they operated similar to the dynamic back supports; i.e.: for periods of strong extensor spasm, (figure 3). In two instances they were configured to enhance controlled head movements. With weak springs it allowed the headrest to move back as the person extended or rotated their head. This allowed a more natural movement than would happen with a rigid headrest. In another application the headrest was spring loaded to absorb the shocks of a young child banging his head backwards. Freedom Designs now has a spring loaded headrest that provides this shock absorption function.

Figure 3: Dynamic headrest to allow the head to move back during strong extension.

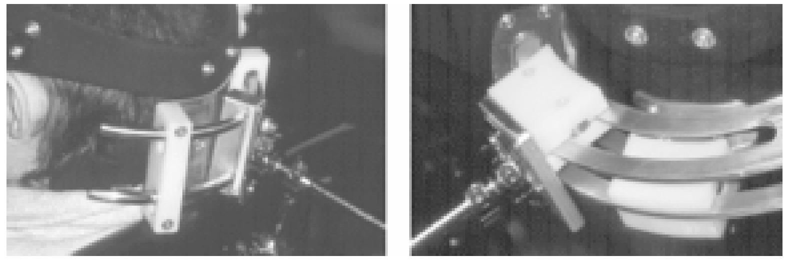

Figure 4: Left: the initial version of the rotating headrest allowed 45 degrees of rotation both ways while holding the head securely. Right: the second version a double sliding track that allowed a full 90 degrees of rotation both ways.

In 1994 we did extensive work to come up with a headrest that would keep the head upright while allowing the person to rotate his head. To this end we held a design contest for the 10th International Seating Symposium in Vancouver. Other than the rather ingenious work being done by Jody Whitmyer and colleagues there was next to no work being done in this area. Quickie came out with a rotating headrest shortly after that but it had a limited range of movement. We came up with two versions of a headrest that provided full support and effectively locked the head in the position we wanted while allowing rotary movement, (figure 4).

The problem with our head support systems was that even though we achieved the objective of isolating a certain movement it was too restrictive. The two children we were working with had increased function. But the movement they had voluntary control of was not restricted to the single axes of rotation that we had imposed. Though we had achieved our initial goals the applications failed.

Dynamic arm supports

Dynamic arm supports improve the client's function by enabling them to reach more effectively. There are commercially available products, (e.g.: ErgoRest and Otto Bock), that provide forearm support that allow movement. A modification that we find useful for the Otto Boch components is to add a sliding mechanism that allows the forearm support to move forward while it rotates. With this system the client has a supported reach.

Summary

Dynamic components have shown a lot of promise for the reduction of spastic activity. Many of the clients using these systems are also undergoing other treatments for their spastic activity. Therefore, we must be careful not to jump to any conclusions as to their effectiveness. A rigorous study of the effect of blocking and allowing movement with spasm is required before any conclusions can be made. None the less, there seems to be some benefit of allowing movement with resistance in lessening the detrimental effects of spasm. The addition of dynamic components to gain this effect is not complex. The use of dynamic components to increase a client's function is very specific to the client and the application.

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Conner, P.S. (1997). A Bit of Freedom For Full-Body Extensor Thrust – A Non-Static Positioning Approach. In proceedings of the Thirteenth International Seating Symposium, Pittsburgh, p185-187.

Manufacturers:
Freedom Designs Inc. www.freedomdesigns.com 2241 Madera Road, Simi Valley, California, 93065

Product Design Group www.prodgroup.com 8385 St. George Street, Suite #10, Vancouver, BC, Canada,V5X P3,

Whitmyer Biomechanix Inc. www.whitbio.com 1833 Junwin Court, Tallahassee, Florida, 32308

ErogRest www.ergorest.comErgonomic Logic Inc. 9370 Gateway Dr., Reno, Nevada 89511

Intelec Marketing Inc 2455 Ste-Marie, Mascouche, Quebec , J7K 3C2

Otto Bock Orthopedic Industry www.ottobock.com 3000 Xenuim Lane North, Minneapolis, MN 55441

2897 Brighton Road, Oakville, Ontario L6W 5S3

Current Status in Dynamic Seating Components

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Introduction
Sitting is a dynamic activity that requires a variety of postures and postural adjustments. The maintenance of static postures over a long period of time results in postural stress, fatigue, agitation, discomfort, pain, and tension. In special populations it also can result in an increase in spasticity and over time can lead to muscle contractures. Occupational Safety and Health Administration (OSHA) classifies “maintaining the same posture” and “sitting for long periods of time” as conditions that are ergonomic risk factors contributing to musculoskeletal disorders (MSD) (OSHA, 2000). The recommendation to prevent such incidences from occurring is frequent posture changes, but for many people who sit in wheelchair this is an impossible task. To compound the problem, current seating technology is not designed to permit movement within the system. In fact the opposite applies. Lapbelts and anterior trunk supports are designed to fit snuggly to provide support and prevent movement. But movement is “essential for maintaining physical fitness and perceptual alertness. It provides the sensory feedback and feedforward mechanisms necessary for the development of visual, vertical, directional and temporal orientation and the perception of touch” (Ward 1994).

Dynamic Seating Technology Available to Consumers
While clinicians are approaching the issue of allowing movement within the system on a case-by-case basis (Conner 1996), (Ault, Girardi et al. 1997), Tables 1 and 2 show dynamic technology that are produced and marketed for a broader base of end users. Many were produced initially for a specific person but favorable results and continued requests for special modifications lead manufacturers to the realization that it may be worth their time and effort to mass-produce these once “one of a kind” items. Information obtained from product literature reviews on seating technology designed to permit movement can be seen in Table 1. The Bentley wheelchair by PDG utilizes an extra long and wide wheelchair base equipped with shock absorbers in the seat and back to take more abuse and/or heavy loading than most other chairs (Mundy 1999). The seat is low to the ground so that it can be foot propelled even while tilted. The Homecrest’s Rock N’ Go is a wheelchair designed to rock, providing comfort while also offering mobility (Homecrest 1999). The Rocker X 2001 (Crown Therapeutic Inc Distributor) is a marketed as a “kinetic motion” wheelchair. It was developed to prevent pressure ulcers (Eyer 1999). The chair has multiple position rocking so that rocking can occur through a 1/2 to 3/4 of an inch range anywhere in the rock cycle. Freedom Design’s does not market its Spectrum as a dynamic chair, but there is a small degree of movement of the back panel (Freedom Designs 2000). Rifton is the only manufacturer that has modified a positioning classroom chair with an option to place it on a mobile base. The spring in the seat allows the chair to tilt forward taking advantage of the more active anterior tilt of the pelvis. It also tilts backwards when a more relaxed leisure activity or rest is the goal. It can also be locked to prevent movement if so desired (Thompson 1999).

Table 1 - "Dynamic" Seating Technology available to consumers

Manufactured Dynamic Equipment	Produce Design Group (PDG)	Homecrest	Rx Rocker Corporation	Freedom Designs	Rifton
Equipment	Bentley Wheelchair	Rock 'N Go Wheelchair	RX "30001" Wheelchair for Kinetic Therapy	Spectrum wheelchair	Positioning Chair for home and classroom
Suggested End-user	Huntington's Chorea, Agitated clients, dementia, Alzheimer's and athetosis	Elderly, clients with dementia and Alzheimer's	Post surgical Intensive Care patients	No specific end-user suggested	Children
Dynamic Component	Spring loaded back and seat to accommodate repetitive movements	Rocking Mechanism	Leaf Spring for friction free motion	Free floating ring used as hardware that attaches the back panel of the seating system to the back canes of the wheelchair	Spring-like motion allowing chair to respond to child's movements within a 12 degree range
Benefits of using equipment	1. Reduces potential for user injuries associated with repetitive rocking	1. Reduce need for restraint, promotes wellness (shifts body weight reducing seating pressure)	1. Provides mobility (wheeled mobility base), 2. Provides therapy (reduce seating pressure, promote movement of body and legs, and improve circulation, and mild exercise) 3. Provides comfort (freedom of movement decreasing fatigue, gentle motion can add emotionally soothing benefit)	1. No benefits suggested	1. Allows children who have trunk stability to utilize their available movement patterns and strategies

Table 2 - "Dynamic" components available to the consumer

Manufactured Dynamic Components	Miller's Adaptive Technologies	Miller's Adaptive Technologies	Bodypoint	Bodypoint	Adaptive Engineering Lab (AEL)	Adaptive Engineering Lab (AEL)	Daher	Whitmyer Biomechanix, Inc (WBI)
Equipment	Shock absorbing dynamic footrest device	Gas Spring Dynamic Footrest	Ankle Huggers	Dynamic Shoulder Harness Straps	Dynaform Foot & Ankle Positioners	Dynaform Posture & Chest Supports	Flexible Chest Harness	Dynamic Forehead Strap (DFS)
Suggested End-user	Individuals with increased muscle tone and spasms	People with high muscle tone in their legs and feet	No specific end-user suggested	No specific end-user suggested	No specific end-user suggested	No specific end-user suggested	No specific end-user suggested	Individuals who cannot control their vertical head position
Dynamic Component	Heavy duty coil spring, attached between upper and lower footrest components	Gas spring available in 3 levels of resistance: 10 lbs., 20 lbs. and 40 lbs.	Lower body positioner that stabilizes the feet without blocking movement	Elastic straps that attach to shoulder harness as upper body positioners	Foot positioners made from Lycra and Nylon covered Rubatex[1] material	Anterior trunk & chest supports made of Lycra and Nylon covered Rubatex	Chest Support made from Rubatex material with lycra	Pulley system that allows the forehead band to move with the user
Benefits of using equipment	1. Allows downward & rotational movement of footrest to external force 2. Reduce stress to decrease damage and premature failure of footplate, upper hanger locking mechanism or side frame	1. Allows downward extension of footplate of approximately 2 inches in response to increased force 2. Prevents breakage of w/c components 3. Increases comfort and sitting tolerance	1. Leaves the foot free to shift naturally 2. Soft, contoured pad 3. Reduces joint stress 4. Easy to fit, install, and adjust	1. Permits the shoulder harness user to lean forward 3" to 4" 2. Allows easier breathing and increased arm movement 3. Act as "shock absorbers" for added comfort	1. Conforms to the shape of the foot 2. Allows dynamic stretch and movement	1. Provides comfortable support 2. Stretches enough to give client some freedom of movement	1. Provides comfortable support that does not totally restrict movement	1. Provides light head support 2. Freedom of head movement with comfort and safety

[1] Rubatex is similar to what is used in divers' wet suits. Neoprene rubber on one side with soft terry cloth on the other. Incredibly stretchy and soft to the touch. (Whitmyer 1997)

The end users suggested by most of the manufacturers were individuals with some type of movement disorder. Mostly elderly clients and individuals with dementia and/or Alzheimer's was the suggested clientele. PDG also directed their product towards individuals with Huntington' Chorea and others with athetoid movements. The RX Rocker Corporation is also directing it's modified WMD at post-surgical intensive care unit patients.

The movement allowed by each of these devices is that of a rocking motion. The description of the dynamic component of most utilized some combination using the word "spring", whether it was "spring-like" (Rifton), spring loaded (PDG), heavy duty coil or gas spring (Miller's) or "leaf spring" (Rx Rocker). Rock 'N Go (Homecrest) is the only WMD that uses a rocking mechanism. The movement in the Freedom Design's system is a cephalo-caudal glide provided by the free-floating ring that attaches the back panel of the seating system to the back canes of the wheelchair. Extension of the sitter results in the attachment ring sliding upward, which produces a small increase in the seat-to-back and knee extension angles of the seating system and its occupant. The Freedom Design's is the only system that results in a change in the open hip angle, however slight it may be.

The reported benefits of using the equipment essentially fell into 6 categories. Categories 1 and 2 included promoting the use of available movement patterns (Rifton) and reducing the potential for injury to client (PDG). Category 3 included preventing equipment breakage (Miller's) while justification number 4 included providing comfort (Homecrest, and RX Rocker). Category 5 included therapy through the ability to move and mobility (Rx Rocker) while category 6 included reducing the need for restraint (Homecrest.).

Table 2 represents dynamic components that are being added to wheelchairs. Miller's footrest permits movement not only in a downward direction but also allows a small degree of rotation as well. The positioning accessories by Bodypoint, AEL and Daher permit movement of the user but restricts the amplitude of that movement as a result of the materials used in the fabrication of the components. The lycra and nylon covered rubatex material allows the accessories to conform to and move with the body. Whitmyer Biomechanix Inc (WBI) is the only manufacturer to tackle positioning of the head. The dynamic forehead support (DFS) strap attaches to WBI's soft head support system by a pulley system and crosses over the forehead to provide the needed anterior head support. The DFS is not compatible with all WBI head supports.

CONCLUSION

Clinicians and manufacturers are strategizing how to incorporate movement into systems that traditionally have been focused on stabilizing an individual so as to prevent movement in certain parts of the body. The disadvantages of maintaining static postures are well understood. But significant difficulties emerge in the integration of stability and mobility. Where should the movement occur? How much movement should a system allow? At what point does controlled movement become out of control? These questions and many more of this nature confront individuals attempting to integrate these to diametrically opposed concepts. It is challenges of this nature that require innovative design solutions to bridge the gap between what is and what is possible.

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4. Freedom Designs, Inc, 2241 Madera Road, Simi Valley CA 93065; http://www.freedomdesigns.com/

5. Homecrest Healthcare; http://www.crestmarkinternational.com/Pages/health.html

6. Miller's Adaptive Technologies, 2023 Romig Road, Akron OH 44320;

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When Ethics isn't Enough – Making Tough Decisions in a Changing Clinical Environment

Simon A. Margolis, CO, ATS/P

I would imagine that as practitioners of a caring and healing profession we all consider ourselves to be ethical and moral people. We would probably say that we put the best interests of our clients first and foremost.

What happens when it is unclear if this is the best thing to do for us as individuals - or for our profession and industry in general?

In making effective, appropriate clinical decisions should we consider the needs of all the stakeholders in the provision of Re/habilitation Technology products and services? These might include the client; the referring professional; the company or facility that employs the referrer; the government regulatory agency; the funding source; the rehabilitation technology supplier or the manufacturer. Each of these people and entities may be viewed as having a legitimate concern and stake in the process.

Here are two examples of when our clinical decisions and advocacy for our individual clients may end up having an overall negative effect on access and funding for clinically appropriate seating and wheeled mobility:

1) An occupational therapist and physical therapist agree to do home visits within a 30 mile radius of their assistive technology facility. The common billing practice is that they may only bill for the amount of time they actually spend with the client. Because their evaluation is considered co-treatment, each can only bill for one half of the time they spend with the client. For a typical home visit each of the therapists spends a total of four hours but are only able to bill one. To compound the problem – it seems to be generally agreed that in assistive technology there is approximately one additional hour of paperwork for every hour of client contact.

Is this an ethical issue? After all, one might say that the client was seen and his/her home setting was appropriately evaluated. Is there, however, a short or long term impact of this practice on the other stakeholders - specifically the therapists and the facility they work for?

2) With the Internet emerging as a alternative source for information and products, many questions arise as to how professionals in Re/habilitation Technology might act and respond to this new medium. It would seem on one hand that there is a benefit to the consumer when they can "shop around" and get the best deal on the products they need. Especially when it is a second purchase by an experienced consumer. Is there are problem, though, when these Internet sites do not differentiate between the consumer, nor the products, that require an assessment and evaluation by a therapist and/or a rehabilitation technology supplier and those that don't.

Are there ethical questions that therapists, rehabilitation engineers and suppliers need to face around this issue?

There may be two ethical principles that come into play – that of beneficence and autonomy. Autonomy is a strong ethical driver – we should respect the client's preferences and desire. We should allow people the "dignity of risk". On the other hand, beneficence – the ethical imperative for us to get good results and avoid bad consequences from interventions with clients – may even be more compelling.

We might consider asking two questions to help understand our responsibilities in this situation.

- Is there a reasonable probability that clients who receive products over the Internet will experience negative consequences, including lack of service and follow-up?
- Will people who receive complex systems via the Internet - without the benefit of evaluation and assessment by a clinician and appropriate specification, fitting, delivery and follow-up by a qualified RTS - experience negative consequences?

Apart from theses ethical issues –are there significant implications brought about by this distribution network for the rehabilitation technology supplier and the company they work for? Are there implications for therapists working in seating and wheeled mobility?

Other Factors

Ethical considerations aside, there are three other factors that we might consider when faced with difficult clinical service delivery issues - including "want vs. need", cost of treatment and intervention, personal risk and others.

Technical issues – There are situations that arise that do not allow us to make the optimal clinical decision despite our desire to serve the best interests of the client or what they want or need.

Prudence – This includes situation when it might cause us physical, emotional or financial harm to do what is "right" for the client. One example might be doing an evaluation or delivery in a client's home where we feel unsafe or in physical danger.

Law – There are things that we are prohibited from doing by statute and regulation. To do these things, even in pursuit of the best interests of our clients, can have significant negative impact.

How then do we reconcile these issues?

How then do we do what's right for everyone in the process?

I only have answers for me – what about you?

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Cervical Flexion Problems and Possibilities

David (Scott) Pickett, CRTS, Michelle Gunn, ATP

Learning Objectives:

1. Recognize the need to thoroughly evaluate a client to determine tonal patterns, range of motion, and positioning needs.

2. Recognize when a head positioning problem is more caused by seating

3. Understand the concepts of three point positioning and opposing forces

4. Recognize points of force needed to achieve desired outcomes

5. HAVE FUN!

Introduction:

The presenters of this course have been working directly with clients in the field of seating and mobility, collectively, for thirteen years. Some of the most difficult questions we have been asked over the years have been about cervical flexion issues. This course will deal directly with this topic. Our goal in this session will center on giving the participants a detailed understanding of cervical flexion issues so that they can better identify the causes and find more effective solutions to these problems on their own. Cookie cutter approaches and absolute answers are not our intent. Although we work for Whitmyer Biomechanix, it is not our intent to be product specific. We will use generic clinical terms to describe what products we recommend. Class participation will be openly solicited and possibly rewarded.

Can Therapeutic Positioning Effect Functional Outcomes?

Faith Saftler Savage, PT, ATP, Nancy Waglow, MS, MEd

Functional outcomes have become an important factor in the past several years to identify the type of services for individuals to meet their potential(s). Developing functional outcomes can be challenging for individuals with moderate to severe physical and mental impairment. The Disablement Model from the World Health Organization assists health care providers by focussing on assessment strategies and identifying functional targets for personal outcome measures. The Disablement Model provides terms and definitions for uniform terminology. Areas covered include pathophysiology, impairments, functional limitations, disability and societal barriers/handicap. A person' strengths, preferences and potentials must first be discussed before determining what is disabling the person from reaching his/her potential and developing functional outcomes. This course will investigate the Disablement Model as a method to develop functional outcomes.

Following is a list of questions that will be addressed during this presentation:

- What are functional outcomes?
- Why are functional outcomes important?
- What kind of functional outcomes can you expect from a person who is severely physically and mentally challenged? Moderately challenged? Minimally challenged?
- How does therapeutic positioning support the attainment of functional outcomes?
- Does it matter where you live (long-term care facility, group home) when discussing functional outcomes?
- What disciplines assist in developing functional outcomes? How do you improve communication between disciplines?
- What knowledge base is important when determining functional outcomes?
- What is the cost analysis to providing services?
- How do we encourage adequate staffing in facilities and homes to adequately address the needs of individuals to achieve functional outcomes?
- How does the Disablement Model assist us with determining functional outcomes?

An environment needs to be created that supports all individuals with opportunities to improve their independence at home, work and leisure. These areas may include health issues (respiratory status, gastrointestinal status, neurological status, orthopedic status, skin integrity status, nutritional status); functional issues (toileting, bathing, dressing, eating, communication, transfers, mobility); environmental issues (environmental control, transportation, accessibility) and behavioral issues.

People with physical and mental disabilities are receiving services at long-term care facilities, group homes, and through supported living. It is important to determine if these services are appropriate and adequate to assist each individual in attaining their full potential. If a person is unable to communicate verbally, how do we know if they are satisfied with their life? How does this person know that there are other things in life that they have not experienced that may be extremely satisfying? How do we promote change for individuals whose lives have been static? How do we determine what the person wants to do and how do we support them?

Health care professionals need to be able to recognize a person' strengths and abilities and minimize the barriers and limitations that have prevented individuals from achieving independence in the past. They must stay on the cutting edge of therapy and technology to continue to assist individuals in independence. The following chart assists us in determining what makes a day valuable for all individuals.

Seating Interventions for Spinal Cord Injuries With Secondary Orthopedic Complications

Stephanie Tanguay, OTR, ATP/S,CRTS

It is estimated that more than 200,000 persons with spinal cord injuries live in the United States. Some of the greatest challenges for the seating team involve S.C.I. clients whose medical condition has been complicated with secondary diagnosis. Pressure sores, osteomyelitis, heterotopic ossification and surgical interventions such as shaved ischials, lower extremity amputations, hip disaticulation and hemipelvectomy all require customized seating strategies.

The SCI model systems reported 17-23.5% of SCI patients develop at least one pressure sore within two years of onset. It is unrealistic to expect referral of these clients to seating clinics for early intervention. While some hospital systems can capture these clients early on, it is more likely that referrals to clinicians or contact with rehabilitation technology suppliers occur following surgical procedures. According to Zacharkow (1), the most common site for pressure sores to occur is the skin overlying the ischial tuberosities. The two most significant postural risk factures in the onset of pressure sores are pelvic obliquity and decreased lumbar lordisis - Zachorkow (2). The resulting posterior pelvic rotation resulting in greater than 50% of sacral coccygeal sores developing as a result of sitting according to Barton & Barton (3).
Due to the close proximity of the ischial tuberosities, femoral heads and the sacral-coccygeal region to the skins surface, pressure sores in these areas frequently result in infections including osteomyelitis. The surgical interventions to remove infected bone result in significant alteration to the orthopedic structures responsible for maintaining seating posture. As an example – if a paraplegic client developed a unilateral pressure sore as a result of a pelvic obliquity, shaving the ischial tuberosity would not prevent the reoccurrence of the sore. Without seating intervention, the obliquity will be more significant, as will the resulting scoliosis and other orthopedic complications. Risk for reoccurrence of the pressure sore remains high. Heterotopic ossification (H.O.), the formation of extraosseous bone, occurs in up to 49% of S.C.I. patients. H. O. primarily occurs in hips, knees, shoulders and elbows where bone actually forms within muscle and connective tissue, limiting passive and active joint range of motion. Yashon (4) lists pressure sores development as a potential complication of this abnormal bone growth.

Hussard (5) reported a unilateral pressure sore associated with heterotopic bone formation in the hip joint. Limitation of hip flexion resulted in increased pressure of the ischial tuberosity during sitting. While H.O. can perpetuate orthopedic challenges for seating interventions, the rate at which these cells develop can be rapid. Through, accurate documentation of range of motion is helpful to justify the needs for equipment and seating modifications. The only resolution to the bony growth is surgery, which cannot be performed until the H.O. has stopped developing. Surgery is difficult and can require removal of orthopedic structures involved (such as femoral head resection to free a hip joint). Accommodation is required when H. O. is present. Post-operatively identifying the viable structures for support and pressure distribution and designing a seating system to achieve that is most important. Custom fabrication or molded seating and adjustable or customized wheelchair frames may be necessary to accommodate the postural needs of these clients. Consider the concept of maximizing weight distribution at the seating surface. The ischials and coccyx provide the structure of pelvic stability. The femurs provide a large area to distribute pressure with low risk of pressure sores. When one or both femurs is/are disconnected from the pelvis, the femur is free floating and unable to support body weight away from the pelvis. Hip dislocation and hip disarticulation both have this result.

Hemipelvectary – the resection of part of the pelvis in addition to the amputation of the lower extremity- leaves few options for seating intervention.

Orthopedic management is one option. Minkel and Bishoff (6) describe the casting process used to create a body orthotic support. These devices can be used to provide stability and pressure distribution. This intervention can be helpful with hemipelvectomy and bilateral hip dislocation or disarticulation. In the same way that a prosthetic socket is fabricated to distribute surface contact evenly, this prosthetic "socket" for the body will distribute pressure and provide support.

When attempting to achieve solutions for clients with such secondary conditions, the combined efforts of clinicians, rehabilitation technology suppliers, orthotists and surgical and rehab physicians is imperative to achieve successful outcomes.

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"Slip Sliding Away"
Dealing with the Client that Slides

Lois E. Tucker, OTR/L, ATP

Why Does Sliding Occur?

"The rounder the object the more likely it will roll."
"When two shapes don't compliment one another they are less likely to stay together"

1. Instability at the base of support
   - Slide to allow gravity to take over the function of stabilizing the body

2. "The end range" – Placing people at or beyond the physical capabilities of a joint leaves them no where to move but out of position
   - Range of motion limitation at the hips
   - Range of motion limitation at the hamstrings
   - Range limitations at the pelvis and lower back

3. Incorrect seat to floor height for functional mobility
   - Foot propulsion
   - Standing transfers

4. Poorly supported lower extremities
   - Lack of contact with the foot
   - Positioned to low
   - Elevating legrest

5. Seat Depth
   - To long for actual depth
   - To long for function

6. Reclined back with a horizontal seat
   - Setting the pelvis in a posterior posture sets the body in motion.

7. Visual field shift
   - Visual Midline Shift Syndrome, *Dr Padula*

8. Tonal pattern
   - Extensor tone

9. Primitive reflexes
   - STNR
   - Positive supporting
   - Extensor thrust
   - Tonic Lab

10. Kyphosis
    - Sliding to see
    - Sliding to eat
    - Sliding to breathe

11. Low back support
    - Sliding makes the back higher

12. Slippery surfaces
    - Friction creates resistance, that opposite force needed to stop or slow down the movement

13. No other means of movement
    - If you don't give people a way to move their body, they will find.

14. Behavioral
    - Sliding down in my chair means someone will pay attention to me long enough to pick me back up.

15. Transportation
    - Taken for a ride

16. Rider/Caretakers ability to properly position
    - Lift and drop vs. place and position

17. Better push on the wheels
    - The more wheel you contact the more efficient each push

18. Restraints
    - When you block a movement, where do you place the force?

Sliding

Leads to:

1. Poor posture

2. Shear and Friction

3. Pressure/Discomfort/Pressure Sores
4. Contractures

5. Swallowing Difficulty

6. Respiratory Compromise

7. Functional Limitations

- Reach
- Driver control access

8. Safety Risks and Restraints

9. Proximal Instability

10. Visual Field Limitations

What is the “key” to stopping the pattern of the slide?

Understanding the “The Law of Inertia”. – Inertia is the tendency for something at rest to stay at rest and for something in motion to stay in motion. A force is required to set an object in motion. It will continue to move in a straight line at a constant velocity unless another force acts on it. *Sir Issac Newton*

Don’t enable it; prevent it!

Seating and Wheelchair Configurations

Chairs

- Tilt, slants and slopes:

- Squeeze, dump and bucket:

Seating

- Shape
- Linear/planar
- Contoured, how much?
- Molded

- Material – Do you want to prevent the effects of shear when you slide or do you want to prevent sliding?

- Air
- Gel / Fluid
- Foam

- Cover
- Material:
- Loose or tightly fitted
- Smooth and slippery or gripping like Dycem?

- Pile
- Does it work for you or against you?

- Orientation

- Positioning holders

- Belts, angles and pulls.

- Sub-ASIS Bar; torture device or appropriate intervention?

- Distal Knee Block, Crazy Glue and other ideas for containment.

- Wheel and/or drive control access

- Seat to Floor Height

- Armrest Height

- Footrest Configuration

- Access to Function

Matt Evaluation

Adrienne Falk Bergen PT ATP/S CRTS

During the 30 years that I have been doing assessments for seating and wheeled mobility I have learned that a thorough assessment always results in a better result. Whenever a short cut is taken, and some critical information is missed, the result is usually less than satisfactory. This results in a need to "patch" the final product to make it work. Patching takes extra time, and since neither time, nor the materials needed to make the "patch" can be billed to a third party funder, everyone looses. The consumer must wait longer to get their equipment, and the equipment may be less than optimal. The clinician and supplier must spend added hours on fittings, delivery and followup. The supplier usually winds up supplying additional parts and/or equipment, or in the worst case taking the equipment back and paying a restocking fee to the manufacturer.

In an effort to standardize the assessment process and assist newer clinicians in gathering information, a series of forms were devised and posted on my web site, RehabCentral.com. Each of the forms guides the team along a path that will ensure a thorough assessment. The process begins with a good intake interview to gather pertinent information that may affect the intervention plan and/or the final outcome. This must include information about the entire environment where the equipment will be used. The environment includes the home, transport methods and comments about any other locales where the equipment will be utilized. Assessment of the client in his existing equipment and discussions about the equipment with the family and the consumer give the examiners valuable information about what has and has not worked in the past. It affords the team an opportunity to describe the user's posture and function in the equipment he already owns. A photograph is usually helpful in supporting the written word.

This initial intake should be followed by a complete mat evaluation in both supine (gravity eliminated) and sitting (gravity added, accommodation made for ROM limitations found in supine). This portion of the assessment will allow the examiners to see the underlying potential for good postural alignment without the influence of gravity. Once any interfering limitations are noted the client is brought to sitting with accommodation for the limitation. Support is given as needed to produce the best result possible, and the examiner notes how much support is required and whether or not the posture can be corrected. Simulation at this stage is very helpful, whether with the examiner's hands or a simulator. The simulator leaves the examiner's free to move around the supported client, make changes and observe over a long period of time.

This detailed assessment is recorded, along with complete measurements to provide a baseline from which intervention planning can begin. Once intervention planning and product trials are complete the complete recommendation can be written and justified using the forms included in the Justify section of the site. If questions come up during the funding process, or during the ordering phase, the complete assessment document can be used for further decision making, often without having to revisit with the client. Fittings and delivery should then go smoothly.

Innovative Solutions for Seating and Positioning

Mark Dilabio, RT, David Cooper, M.Sc, R, Gord Broughton, RT

Innovation: simply put, is a change in the way of doing things.

Due to time and cost constraints, we sometimes limit ourselves by not seeing past the prescribed use of items, or to see the use of it in basic form.

One example of this type of situation could be described as follows. Many companies manufacture swing away trunk laterals. Each company has approached the mechanics in different ways, but what remains is the fact that they hold a fixed position until they are swung away.

Being able to look/see this equipment at its base level will enable you to see a much broader usage such as:

- Swing down pelvic lateral for ease of side transfer
- Swing up shoulder retraction for shoulder stabilisation during power chair driving and removal to allow client to work at a desk.

Following this concept, let's look at another situation. You require a small head support for an 18-month-old child; your agency typically uses Otto Bock equipment. All the standard Otto Bock headrests are too big. What can you do? You could look at the Otto Bock lateral pads with the ball joint. They come in several sizes, the smallest one being 3" height x 5" wide complete with ball joint for angle adjustment.

Another approach to innovation would be association of the common areas of different industries. Examples I'd like to bring to your attention are the wheelchair and bicycle industries. The commonality is tube structure construction. Almost anything that can be mounted on a bicycle frame (lights, horns, bells, etc) can be mounted on a wheelchair frame.

A very practical example of this is the use of mountain bike bar ends as a second height set of handles on a wheelchair back cane. See FIGURE 1.

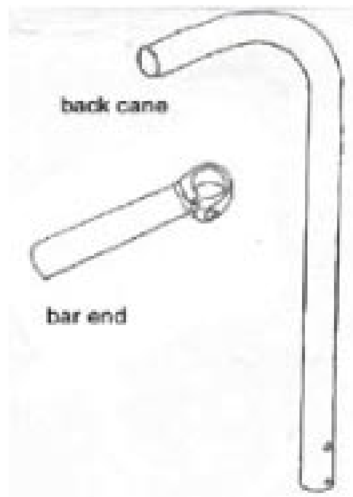

FIGURE. 1 Mountain bike bar end and back cane.

These are examples of low-tech solutions which use existing products in innovative ways. There are many other unique and exciting products that can be adapted for seating and positioning. One example is using drum kit hardware, which is inexpensive and sturdy, for mounting switches, computers, etc. Also, most marine motors and accessories are 12 volt DC and are easily adapted to power wheelchairs

Pressure Mapping- Uses and Abuses

Martin Ferguson-Pell, PhD, Emma Parry, SROT, ATP

Learning objectives

– Become aware of the potential inaccuracies of pressure mapping systems and the differences between pressure mapping products
– Learn how to use pressure mapping in clinical practice. Learn how to implement protocols for correct use, maintenance and calibration
– Learn how to correctly interpret results from pressure mapping systems
– Become aware of ongoing work to develop international standards for pressure mapping data which is likely to be used for the disclosure of product information in the future

Why are shear
measurements elusive?

• Shear sensors do exist for research
• Very sensitive to friction coefficients of skin, clothing and support surface
• Very sensitive to repositioning - difficult to reproduce the same sitting conditions each time
• Unsure how to interpret the results

Transfer of forces

• In the sitting position, lines of force for:
– head and trunk pass through pelvis
– arms may be supported by armrests
– legs supported by footrests and along thighs

• At each point of contact a distribution of forces is generated, influenced by:
– the amplitude and direction of the force
– characteristics of soft tissues & underlying anatomy
– characteristics of the support surface

Force, pressure, shear & friction

• Forces may be generated by gravity acting on the body, or dynamically when the body moves, such as during propulsion or transfers. Normal forces are perpendicular to the surface of the body and shear forces are tangential to it
• Pressure (normal stress) is determined by dividing an applied force by the area perpendicular to it
• Shear is a force acting on tangentially to a body that changes its shape
• Friction is a force that opposes a shear force. Its maximum value before slipping is influenced by the size of the normal force, the frictional properties of the surfaces in contact and the prevailing shear force

Background - Why measure pressure?

• In an ideal world we would measure the distribution of all forces at seating interface and how this affects tissues mechanically and physiologically
• A map of the pressure distribution beneath the client provides some information about the transfer of normal (vertical to skin) forces between the body and the support system
• Clinical experience and some (weak etiological evidence) supports at least two strategies for body support to reduce pressure sore risk:
– achieve uniform pressure distribution
– redistribute body forces from bony areas to areas with more tissue bulk
• Pressure mapping allows us to see if we are achieving this on an individual patient basis, in quantitative terms

Pressure and time relationship

• Controlled animal studies demonstrate clear relationship between pressure amplitude and duration of loading to produce ulceration
• However models may not be transferrable to humans
• Relationship is substantially altered by clinical status of patient
• Pressure in real life is not uniform
• Real life produces many cycles of loading: tolerance to repetitive loads is unknown

Accessories

• Autocalibrator
• Multiplexer
• Videoport
• Remote trigger
• Modem and video for remote operation

What do the numbers mean?
• Although there have been a number of publications providing guideline maximum pressures, the evidence supporting them is not strong
• We recommend that you use numerical information to make comparisons for different support surfaces being tested for an individual.
• Remember that pressure mapping is a tool to support a clinical problem solving process for an individual client.
• Be very cautious in making generalised comparisons between support products based on numerical data.

Data manipulation
• Averaging reduces large variations in the display of data for neighboring sensors that are attributable to various measurement errors
• Interpolation is used to make the display less grainy. The software "guesses" what the pressure readings are between sensors.
• Equilibration is part of the calibration process that ensures that differences in sensitivity between sensors are accounted for.

Calibration
• Should be performed regularly, frequency depends upon manufacturer's guidelines, frequency of use, and newness of sensor pad.
• When setting up to calibrate you may need to decide whether you want the software to correct for hysteresis and/or creep. This is usually desirable but does not completely eliminate these errors.
Sources of measurement
error in pressure mapping systems
• Hysteresis: output differs depending upon whether the pressure is increasing or decreasing
• Creep: output keeps increases with time even though the pressure is constant
• Limited spatial resolution: The number of sensors on the mat is too small to detect very localized areas of pressure difference

Pressure sensor thickness effect error
Creep
Hysteresis
Interpreting data
• ALWAYS try to validate physically what you see on the screen
• ALWAYS check what display mode you are using and consider whether this is the most suitable for the situation
• ~80% of the time, changes in distribution validate the expected outcome of the intervention
• Check, double check and recheck (and involve your client)
Quality issues
• Storage of mats
– never fold
– store flat or in original packing (usually loosely rolled)
• Care of mats
– never pull or carry by the cable (or handle for Tekscan)
– don't pivot on the mat
– don't pull on the corners when the mat is under a clientCare of mats (continued)
– protect from torque and shearing by using an isolation bag and/or cover provided with the mat
– use corners to position the mat on the seating surface gently (not whilst the client is on it!)
– follow the manufacturers cleaning instructions
• Keep your mat calibrated

Glossary of Terms

Calibration is the method by which the digital output is converted to an actual unit of pressure such as mmHg. Calibration enables comparison of the output of the same sensor in various environments and allows comparison of calibrated outputs of various sensors.

Saturation pressure is the point at which the sensor output no longer varies with applied pressure (the level of pressure at which this occurs (or the display) varies with different sensors and with the way the calibration was performed). A potential source of error.

A Threshold is created when the lower limit displayed is increased from '0'. All pressures below this level are disregarded, so as to suppress the display of noise.

Equilibration. The sensitivity of each sensor in the matrix differs somewhat from it's neighbours. The software used by the mapping systems accommodates for these differences during calibration, and this process is called 'equilibration', and is usually performed automatically during the calibration process.

Averaging. Most mapping systems have a feature that smoothes out large differences between neighbouring sensors. This Is achieved by taking the average between adjacent sensors. Manufacturers have different formulas for performing this averaging process. Care must be taken to ensure that real local feedback and pressure are not lost in this process.

Repeatability is the ability of a device to respond in the same way to the same pressure applied multiple times.

Hysteresis is the difference in the sensor output response depending upon whether the applied pressure is increasing or decreasing. A potential source of error.

Creep is the change in sensor (and system) output when a constant pressure is applied over a period of time. A potential source of error.

Noise. After a period of use, or in the presence of electromagnetic interference, a sensor may indicate 'noise' as low level pressure Which usually fluctuates with time. The effect of this can be reduced by setting a noise threshold using the software. A potential source of error.

Sensitivity is a measure of the amount of pressure needed to generate a given unit of change in the output. For example, a very sensitive system would give a full scale output (red display) at a much lower pressure than a less sensitive system.

Spatial resolution is a measure of the ability of a mapping system to discriminate between two or more pressure features separated by a given distance.

Curvature Effect. Some sensors produce an output when they are draped over curved surfaces. Some sensors give different readings when loaded with the same pressure, depending upon whether they are on a flat or curved surface.

Interpolation. All mapping systems use a technique in displaying their data that will make the image smooth, rather than the mosaic that would appear if you drew each sensor on the screen and represented it's output by a square of colour. This process is called 'interpolation' and is rather like making a picture by joining the dots.

Forces may be generated by gravity acting on the body, or dynamically when the body moves, such as during propulsion or transfers. Normal forces are perpendicular to the surface of the body and shear forces are tangential to it.

Pressure (normal stress) is determined by dividing an applied force by the area perpendicular to it.

Shear force is a force acting tangentially to a body that changes its shape.

Friction force is a force that opposes a shear force. It's maximum value occurs before slipping which is influenced by the size of the normal force, the frictional properties of the surfaces in contact and the prevailing shear force.

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www.clevemed.com

www.novel.de

www.talleymedical.co.uk

www.tekscan.com

www.vistamedical.org

www.xsensor.com

Manufacturers of Pressure Mapping Systems

Contact details:

Company	Telephone number	Web page	Email
Xsensor (USA)	403 205 4012	http://www.xsensor.com/	imain@canuck.com
Tekscan, Inc (USA)	617 464 4500	http://www.tekscan.com/	(mail from internet site)
Talley Medical(UK)	01794 503500	http://www.talleymedical.co.uk	Sales@TalleyMedical.co.uk
Cleveland Medical Devices, Inc (USA)	(toll free)1877-clevemed	http://www.clevemed.com	sales@clevemed.com
Vista Medical Ltd (USA)	800 563 7676	http://www.vistamedical.org	mail@vistamedical.org
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Factors for Intergrating Wheelchairs and Transportation

Marty Gallagher, MS, LOTR, ATP; Ann Havard, LOTR, CDRS, ATP; Mike Shipp, M.Ed., CDRS

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II Sedans

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C. Wheelchair Transportation Options

III Pickup Trucks

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V Mini Vans

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C. Driver Transferring From a Wheelchair
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Measuring and Recording Seated Posture - A Proposed Standard

Douglas Hobson, PhD, Kelly Waugh, MA, PT,
Barbara Crane, MA, PT

Rationale

Standardized terminology and definitions are required in order to be able to accurately measure, record and communicate information about the posture of a wheelchair-seated person. This session will present a proposed a new conceptual framework and related terms and definitions for an integrated system that permits the measurement of a person's wheelchair seated posture relative to a baseline or neutral posture.

Wheelchair seating and positioning has developed into a sub-specialty of rehabilitation services. As in most new clinical endeavors initial, advances are based on clinical observation and largely trial and error problem solving. In order to advance the field, areas of scientific rigor must now be identified developed where practical. Also, due to the increased complexity of products and services, it is important that we develop the tools and terminology necessary to communicate more effectively. We must also do this in order to further advance professional recognition in the rapidly emerging field of specialized seating.
Widely accepted industry terminology for measuring and recording wheelchair seated posture that is grounded on accepted clinical practice and scientific methodology could, over time, significantly advance the field in the areas indicated above. In order to have widespread industry acceptance, the plan is to use the ANSI/RESNA and ISO standards development forums to bring the key constituents together and produce a product that will ultimately form the essence of worldwide standard.

Purpose/Objectives

1) Provide the clinician with an objective way to assess and track the client's posture over time in comparison to a standard reference.

This will help in the determination (quantification) of the effectiveness of clinical interventions. This will also allow more effective and efficient prescription of seating surfaces with proper parameters to provide adequate support. The information obtained will also enable the proper set up of a seating simulator and ultimately a prescribed seating system. In addition to these clinical goals, these measures will allow comparison of clinical outcomes within a facility or between comparable facilities.

2) Provide an industry-wide standardized methodology for defining and measuring seated posture upon which commercial products can be based that will automate the quantification of wheelchair seated posture.

3) To lay a widely accepted foundation for the conduct and communication of future research that can further advance the science and clinical significance of seating measurement, recording and intra-disciplinary information exchange.

For example, the proposed standard methodology could provide an effective means of reporting three-dimensional research of the seated posture. Having a consistent method of reporting research outcomes will allow researchers to more effectively compare results and communicate with their clinical colleagues.

4. To establish the structured framework that will allow electronic transmission of postural measurement data for use by manufacturers, clinicians, and researchers.

History of Seating Terminology Development

In the early 1990's, Sig09 of RESNA formed a working group under the leadership of Drs. Medhat and Hobson. The purpose of this group was to develop a seating terminology manual and the result was Standardization of Terminology and Descriptive Methods for Specialized Seating (1992). Sig09 reorganized this group in 1997 to update this manual under the leadership of Kelly Waugh. In 1998, the group became the ANSI/RESNA WG-TD (working group on terms and definitions) in order to develop an ANSI/RESNA standard on terms and definitions. This group first met in June of 1998 and continues to meet annually at the RESNA conference. Three additional groups on wheelchair seating standards formed at the same time. All RESNA groups continue to meet annually to review the ISO work and further the US position.

At about the same time, four parallel groups were established in ISO (WG-11) to develop the same standards for the international community. The Working Group first met in March of 1999. This ISO, or International Organization for Standardization, is a worldwide federation of national standards bodies from 130 countries. This is a non-governmental organization established in 1947. The technical committee responsible for the development of wheelchair standards is the ISO TC 173. The subcommittee responsible for seating standards is SC-1/WG-1: Wheelchair Seating Sub Group I is responsible for development of ISO 16840-Part 1: Body and Seat Measures. Kelly Waugh and Marisa Samuelsson are the co-chairs of SG-I.

The American standards development organization is the American National Standards Institute (ANSI). The functional component of this organization is the technical committee, which is responsible for the development of US standards and US collaboration with ISO. RESNA has been designated by ANSI as its standards development body in technology and disability.

Ultimately, the RESNA group decided to merge their efforts with the ISO group (WG-11) in order to generate the four seating standards. After this task is completed, the ISO standard will be adapted for use by the ANSI/RESNA working group. The WG-TD committee approved this collaboration in June 1999. The ISO group meets several times per year and the WG-TD continues to meet only at the annual RESNA conference.

Current Developments

The current draft of the Wheelchair Seating Standard — Part 1:Body and Seat Measures contains four major sections. These include: the geometric reference system for the seated person, definitions for anthropometric and postural dimensions of the seated posture, definitions for the orientation, placement and dimensions of seating support surfaces, and a glossary of related seating terms.

The geometric reference system for the seated person establishes and defines a system that enables measurement of a seated individual. These include absolute positioning in relationship to the environment as well as relative body segment positions. The geometric reference system establishes a three dimensional axis system made up of two horizontal axes (X and Y) and a vertical axis (Z). A system for determining rotation in this system is established and a 0,0,0 location has been determined. In addition to this, the Seated Reference Position is indicated and a measurement method for referencing positions that vary from this position is established. This forms the basis on which all of the other sections are built.

The next two sections relate to defining and measuring postural dimensions of a seated person and orientation and dimensions of seating support surfaces. Defining the postural dimensions of a seated person involves establishing methods for determining linear dimensions and angular dimensions. The angular dimensions are further divided into absolute angles referenced to the Seated Reference Position and relative angles which reference adjacent body segments to each other. The seating support surfaces must be described in terms of orientation, placement, and dimensions. This is done through the use of a centroid, or geometric center of the surface. The centroid is used to establish the linear placement and angular orientation of the surface regardless of its size, and the linear dimensions are used to establish the overall size of the surface.

The final section of the proposed standard is the glossary of related seating terms. This glossary is used to define all terms used in the standard that are specific to measurement and definition of the seated posture.

Future Plans

Part I of 16840 is scheduled for completion by ISO by fall, 2003. When the document has been essentially adopted by the ISO, the WG-TD group will then review the document and make recommendations to the ANSI/RESNA Wheelchair Standards Committee. The resulting document will then be voted upon by the committee for acceptance as US standard. This will then be followed by the development and dissemination of guidelines for implementation of the standard.

More Information

There are several WWW sites that can provide more information:

ISO
http://www.iso.ch/welcome.html

Wheelchair Standards
http://www.wheelchairstandards.pitt.edu

RERC on Wheeled Mobility
http://www.rerc.pitt.edu

ANSI
http://www.ansi.org

RESNA
http://www.resna.org —
(RSWS is the RESNA subcommittee on wheelchair standards)

Standards participants

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Children in Power

Karen Kangas, OTR/L

Introduction:
To obtain a powered chair for a child in the past, it was believed that requirements included specific prerequisite cognitive and motor skills. However, with today's assistive technology of seating and programmable mobility systems all children can now become functionally independent in their mobility. Changing these attitudes, obtaining the new knowledge, using appropriate equipment, and learning how to teach mobility will all be discussed with real cases.

It is critical to consider all children seen in therapy as candidates for powered mobility. In the past therapists evaluated the need for powered mobility on the basis of an arbitrary hierarchy. This assessment regarded the child as "ready & capable" or "not ready & not capable." This hierarchy focused solely on the "presumed"attributes (or lack of flexibility of the attributes) and function of the powered wheelchairs rather than any "presumed" need for mobility of the individual child. In short, a hierarchy of children's prerequisite "readiness" skills was developed in direct response to the lack of flexible powered chair systems. The individual child was then "judged" rather than the equipment's limitations .

This hierarchy appeared to exist in contradiction to accepted standards of practice of rehabilitation. The strong emphasis of treatment of independent ambulation did include functional mobility and early on included the use of manual wheelchairs. It was a foundation of standard practice to recognize that ambulation and functional mobility were critical. In fact, occupational and physical therapists were the first professional groups to be looking towards adaptive equipment and treatment techniques which would assist children in mastering mobility.

However, when it came to powered mobility, this same standard of practice did not apply, it was not considered to be a viable treatment technique or even standard adaptive equipment. It was a "last resort" and only for those children who could prove in advance "readiness" skills.

With the microchip technology available today within powered chairs, the focus of "readiness" must change. The need for more bold and courageous treatment must include each child's ability to gain independent mobility through the use of power. This assumption then precludes that all previously held biases towards age, cognitive characteristics, or physical disabilities when considering a child as a candidate for power change. The only prerequisite to power now is the child's desire to be mobile.

In this session, I will demonstrate how powered mobility is both a treatment technique and adaptive equipment necessary for independent mobility (ambulation). It must be utilized as a standard of practice so that children can develop independent mobility.

Teaching Powered Mobility, not Driving:
Not only did we establish hierarchies of readiness, we also developed without thinking, I might add, methods of teaching, based on "driving."

We thought that giving someone a powered chair was most like giving them a car, and we proceeded to teach them as we were taught to drive. And when and how were we taught to drive? First of all, we were already experienced ambulators, and experienced hand users, and experienced task accomplishes. We came to driving with a rich past, and a capable, competent body. We had already mastered a bicycle, many riding toys, skating, dancing, and running. We also came with great desire, for the independence of control. Our teachers, however, came to this situation with great trepidation. They knew how much a "crash" could entail, not only in expense, but in dangerous bodily harm. Their primary job, was to try and ensure SAFE control.

In order to do that, they took the student and a vehicle to an open unfamiliar parking lot. The student was then taught some of what skills might be needed before approaching the environment to be managed, the ROAD. In this environment braking, turning, stopping short, starting quickly, looking both ways, all of this was considered. Windy roads, control of staying on the right, keeping the eyes forward, but also in the rear view mirror, all was emphasized.

The real skills needed were these: when the student entered the car, they were to maneuver it from a stopped position onto a path which would lead to a specific place. Once on the path, the car must stay on the right, (while the driver is on the left) and an imaginary line is picked with the eyes, between two lines, a middle line, and a side line, on the road. While the foot is pushing on an accelerator, and the hands, in view, are on a steering wheel, stay straight, but watch all around you. Read landmarks, and street signs, and watch carefully. Watch all other drivers, but never let your eyes leave the road. Keep your hands on the wheel, and pay attention. Watch where you are going. Don't go too fast. Don't go too slowly. Always be safe.

Now, let's consider an infant and toddler learning to walk. Do we set up cones and teach them right and left? Do we tell them to watch where you are going? Do we make them walk only on the right side? Do we instruct them the entire time they are walking, and do we stand over them, hovering, and instructing every moment? Do we insist that they walk over to us, first, and then on a predetermined pathway, we think is good? I am afraid if we did do this, no child would have walked.

When teaching a child to ride a bicycle, are the same strategies used? Do we take them between cones? Do we tell them to look out, look behind, watch out? No, we stand with them, we work with them when both of us are ready to work, we work for short periods of time, and we hold onto the bicycle, making sure that the bicycle is managed, and the child is assured by our very presence, that they will not fall, and that the bicycle is under control. The child then slowly begins to take control as we allow it. We give up control as we see the child managing the bicycle.

First and foremost we need to understand how to teach mobility. To a child who has never had control of their body before, this powered chair is going to be her legs. We need to encourage her and teach her as if she were learning to walk, using some strategies of teaching equipment like we would in teaching a bicycle.

We need totally change our approach in teaching driving to children. It must much more resemble the support required for ambulation. The powered chair to a young child, is a first form of independent mobility, walking some of the time. We must give up many of our ideas, past strategies and understandings of how we used powered chairs with adults. Our children are not going out by themselves onto a road, or off to work. Our children are learning to move.

These principles must be taken into consideration.

1. Familiar environment, small space, parents first
2. Immediate success and independent control
3. Control of Speed
4. Going and stopping, vs. forward (Turning, circling)
5. Switch site/access
6. Forward Direction
7. No reverse at first

Assessment of Seating and Positioning for Access

1. Task Performance Position
2. Consistency/Reliability of Switch Access
3. Head vs. Hand switch access
4. Equipment Needed
   a. Programmable electronics, multiple drives
   b. Tilt?
   c. Two chairs
   d. Joystick last
   e. Visual display, not visible

Training/Treatment Required

1. Time needed
2. Environments to be trained in
3. Strategies to include
   a. Never crashing
   b. Managing doorways later, how to teach
   c. Experience, experience, experience
4. Methods
   a. Practice drills
   b. Activity for forward
   c. Wandering/Strolling
   d. Risk taking/unpredictability

Summary
The use of single switches initially with children in powered chairs has really allowed an observable, easy progression, controlled by them, from the very beginning, to be ultimately, extremely successful. Many children progress easily and readily to a joystick. Others do not, but rather continue to progress to multiple switch access.

Who is a successfully trained child? Who is independently mobile? Independence must mean that the child is doing the act by all by herself. However, the level of independence varies greatly. If a child were able to drive a chair on a walk around the neighborhood, and her mother did not have to push her, and even if that child only controlled one switch which was forward, with the mother still responsible for the stops and turns, is this child independent? Yes, this child is independent at this task. Her mother can walk beside her, she is not pushing her, and the child is controlling the chair, independently. If a child could only do this, would this make her a candidate for powered mobility? Yes, yes, yes.

In closing, a lot more time could be spent on how the assessment process works, training strategies which have proven to be successful, and equipment which is preferred. In a few pages, this is impossible. Instead, as therapists, please think and try various types of mobility with children.

Remember, it is the point of delivery at which treatment really begins. Training is treatment. Use will define change, and functionality. Training must occur within the individual's environment. It should never be a "weekly" training, but rather sessions, more infrequent, but over a longer period of time. The system ordered needs to be flexible to allow for change in use, and change in demand, both in seating, access, and chair performance.

Treatment and training need to come from reaction rather than control, expecting our children to tell us what they need and want, and by providing them with rich, and satisfying, successful experiences. Providing them with patience, and supporting them with faith in their own abilities to explore, and be curious is a greater gift. Wait for them to request what they need, wait before telling them how to use the equipment. Recognize that supporting an individual's own relationship with independence and subsequent mobility, is the task, not teaching an individual how to drive.

Continue to observe that mobility and the control of mobility is an interaction which provides opportunities for competence. Continue to promote the use of assistive technology, and to remember that powered mobility is crucial. Without independent mobility, it is difficult to interact. Without independent mobility it is almost impossible to be included. Remember that mobility is an inherent human desire, and trust it to show itself.

The Effects of Seating on Respiratory Function

Jill Sparacio, OTR/L, ATP, ABDA

Breathing is a dynamic, 3 dimensional activity that is vital for function. Its efficiency is based on the mobility-stability relationship that develops in the trunk through the normal developmental sequence. As a result of neurological/neuromuscular impairment, this ability can be greatly limited. Poor respiratory skills can lead to many secondary disease processes ranging from lethargy to life threatening conditions. The use of seating components, often necessary for support, can further limit respiratory abilities. During the seating and mobility evaluation, respiratory skills are often overlooked.

In the able bodied individual, efficient respiration is reliant on a number of factors. These include an intact airway system, a properly functioning alveolar system, a properly functioning cardiovascular system and intact respiratory musculature. The musculature needs to be addressed in terms of strength, alignment of muscular forces as well as the alignment of skeletal structures.

To fully understand how seating components can influence respiratory skills, one must understand the sequence of development that leads to efficient respiration. The developmental process that allows for the maturation of motor skills is directly related to respiratory development. In newborns, the chest is a triangular shape with the shoulders rounded and ribs aligned in a horizontal manner. The intercostal spacing is very narrow with little mobility among the ribs. The newborn relies on his diaphragm for breathing as the abdominal and upper trunk musculature has not yet developed. Respiratory movement is restricted by contact with support surfaces. As the infant grows, extensor tone and movement begin to balance the initial flexor patterns. The anterior chest opens and the overall chest shape becomes more rectangular. The active extension patterns and changes in muscle balance result in increased volume during inspiration with a resulting decrease in the rate of respiration. Since each breath brings in a greater amount of air, the infant can breath less often. At 6 months of age, the infant remains a diaphragmatic breather but he can now use upper anterior chest accessory muscles to assist.

From six to twelve months, the child develops the ability to independently assume positions against gravity. Respiration is no longer impacted by support surfaces. This upright posture allows gravity and the developing abdominal muscles to pull and rotate the ribs downward, resulting in elongation of the chest wall. This rib cage change allows for development of the diaphragm, the abdominal and the intercostal muscles. The intercostal spacing is increased which allows for greater mobility. Primitive reflexes are integrated and a tonal balance between flexion and extension is achieved. This results in the stability-mobility relationship within the trunk that allows for efficient respiration.

Abnormal chest development, whether congenital or acquired, results in respiratory limitations. In children with injury prior to or at birth, this normal sequence of development does not evolve. In adults who have incurred an injury resulting in neuro-muscular impairment, the stability mobility relationship is lost, making the various muscle groups inefficient. Skeletal changes also impact respiration as muscle tension varies due to malalignment.

There are two phases of respiration that need to be observed, inspiration and expiration. Inspiration is an activity of extension while expiration is an activity of flexion. If one's trunk is in a flexed position, efficient inspiration is difficult. Similarly, if one's trunk is in an extended position, efficient expiration is limited. If an individual is seated in a posterior pelvic tilt, general trunk flexion occurs, limiting inspiration. Anterior pelvic tilts result in a lordotic pattern that increases spinal extension, limiting expiration. Since the diaphragm receives stability from the lumbar spine, individuals with spinal changes can experience instability in their diaphragm. For these individuals, the diaphragm becomes a trunk stabilizer instead of a primary respiratory muscle. Individuals with limited trunk support often rely on their accessory muscles to assist in the phase that is most limited. This can be observed through individuals who show little expansion of their rib cage and/or minimal abdominal movement. Instead, observation shows that inhalation is accomplished through external rotation and elevation of the shoulders. Upper trunk musculature can often appear overdeveloped as a result of its over-use.

If a trunk displays limitations in strength and less efficient accessory muscles are used for respiration, the use of seating components can further limit their ability. The imposing of external supports to provide stability can restrict the individual's movements to breath. For example, if an individual relies on trunk expansion to initiate inspiration and lateral trunk supports are placed firmly against the rib cage, the necessary trunk expansion is then limited. Consideration needs to be taken when adding external supports as to how they will impact respiratory movement patterns. Options should be pursued to provide the lateral stabilization that is necessary for the maintenance of an upright position.

Upper extremity positioning can also impact respiratory skills. For example, shoulder blocks are frequently used to maintain upper extremities out of positions of external rotation and abduction. Many individuals have compensated for poor respiratory control through using this upper extremity pattern to assist in opening their chests, gaining a mechanical advantage for inspiration. Once the arms are positioned in a more midlined manner, respiratory effort increases as well as the individual's stress to gain a full and efficient breath.

The use of seating components can greatly impact an individual's respiratory capabilities. Although these components are used to promote stability for function, they can instead create greater limitations. Care needs to be taken during the seating and mobility evaluation to insure that seating components facilitate alignment and the potential for function.

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Seventeenth International Seating Symposium

Friday, February 23, 2001

High Tech Solutions for a Special Needs Client

Kathryn Fisher, BSc (OT), OT (C), Gloria Liebel, OT (C)

Samantha is a 7 year old with athetoid cerebral palsy . Over the past three years the team has been involved in prescribing assistive technology to provide her with opportunity to access her environment. Because of the complex needs of this client and the number of people involved in her daily life, it became apparent that a process was needed to identify, trial, evaluate and integrate the various devices.

In this presentation we will discuss the rationale for using various equipment that has been tried and why it was successful or unsuccessful. We will include a video of the client to show her functional level with and without the use of technology. In the 3 years the team has included Samantha ,her family including grandparents, various and sundry professional interdisciplinary team members and a vendor .Co-ordination of this very large dedicated team proved to be part of the process and the struggle .

The question still remains have we achieved the goal of improving Samantha's quality of life.

Process;

MAT assessment to determine key points of stability for Samantha

Problems; controlling pelvis, controlling head in space, discouraging thrusting and excess movement. Safety issues. Increasing overall stability of her body. Needed to determine the seat to back angle and the orientation in space.

Other assessments were going on at the same time but it became apparent to all that if we didn't find her optimum position and stabilize her she could not function. Eye pointing was not accurate. No consistent switch access points could be found.

Establish goals- talk to mother,and father, teachers , therapists (treating, communication, seating)

Priorize the goals identified-

Goals; positioning for function, mobility, communication, access for school work. independent mobility

Goals ; family- positioning, communication- mother was not concerned with independence initially

Goals; Therapist- communication- (treating therapist and AC therapist)
Seating therapist- positioning and mobility and explore opportunity for independent mobiliy

Goals; Teachers- communication and positioning for functional school activities.

Goals- Samantha- comfort and some control over her head so that she could communicate and have some control over her environment.. Everything must be purple.

Priorize the goals;

1. Positioning
2. Head control
3. Mobility manual w/c
4. Communication
5. Independent mobility- power w/c and walker (Long term goal)

Equipment trials; Manual tilt Zippie TS

1. KSS system, back with laterals, ultimate base with adductors, pelvic-Y padded, ottobock headrest, tray with elbow blocks..

2. Jay fit—base worked but back didn't

3. KSS system, back with laterals, ultimate base with customization- adductors enlarged pommel and lateral thigh supports, wings (by grandfather) headrest ottobock, pelvic-y with gel pad (she was having shearing problems.) tray with the elbow blocks.

4. Large wheels on frame changed to small wheels at the request of Samantha because they look more like a power w/c.(our goal was to keep her hands out of the wheels- Sam had her own agenda)

5. Head rest- Whitmyer soft pro-series (clinical trial made available by Whitmyer through Kathy Fisher) Allowed Sam to see her environment, .not as hot and provided intimate points of control (sub occipital) Also allowed for switch mounting (switches always stay in the same place.) Ottobock blocked her vision was very hot.and difficult to mount switches..

6. Switches- swing aways were added. Initially left

7. RPS- rigid pelvic stabilizers presently known as the embrace system (research project from ORTC)Provided the best stabilization of pelvis , improved distal function discouraged excess movement of both upper and lower extremities and head. Sam found them comfortable and loves to wear them; No shearing on ASIS (mother is happy)

8. Right lateral facial pad to help Sam stabilize her head and give her a point to rest on when using the switch.

9. Power w/c training at school using single switch access and a scanner every week for 45 minutes with OTA and PTA

Team Meeting with all members

To review goals and review current system to see if it provided the stability that Samantha needed to function and if we needed any adjustments including growth, safety, extra support.

Reassessment- Mat – confirmed that the key points of stabilization were the pelvis-(successfully accomplished with the RPS.) Seat to back angle was established at approx. 87 degrees promoting thoracic extension and positioning for function (Tom Hetzel). Dynamic tilt provided orientation in space for rest and gravity assistance where needed.(Byron Guisbert) Head rest- whitmyer with the switches(swingaway) .Sam had grown and needed adjustments and more support in the sacral area. Extra padding of hangers and calf strap.
Power assessment – Switch sites were limited to her head (side to side) and access was slow and she had difficulty with mechanical switches hold and release, therefore we thought of proximity switches (head array)

New Goals;

1. Prepare for integrated school setting every one's goal

2. Independent mobility- Samantha's goal

3. Provide better back support- therapist goal

4. walker- Mother's goal

Equipment trials:

1.ASL head array , action power tiger w/c- trial is now in new school and the person training Sam is not the person who prescribed the equipment . Issues re ; complexity of the equipment . Servicing and maintaining the w/c. How much time is allotted for driving in this setting. (note Sam is a competent driver and had 2 years to learn there was never a question about cognition only how to set up the system for her.)

2. Back support- symetrix integrated with the whitmeyer and the base with the RPS. Provides great support and control of the sacral area and allows for growth and adjustment as needed. Is cool and helps Sam control her temperature because it is not such an intimate fit.

3. Smartwalk integrated with the whitmyer headrest. First opportunity for Sam to move in a standing position and make eye contact with her peers and her sister (huge impact on Sam and her family – increase in upper extremity control and in head control and sound production.)

What have we learned?

The paradigm works and we followed it without realizing. It helped us to organize our thoughts and goals and gave us some direction because we could work on several things at the same time without losing focus. We could integrate our goals.

There is a method to the madness- for every piece added there was a reason and this helped us justify the prescription for our funding agency and for new therapists and people who are working with Sam.

We don't have to reinvent the wheel every time Sam changes we have a system that can change and grow with her.

Problems;

Equipment is sophisticated and not caregiver friendly for new staff. Needs to be adjusted for Sam very specifically . Trial equipment is limited and not specific to her needs because of the customization required. Funding is an issue because she has soo many needs. Education of the integrated setting and family(who is responsible for training and education of set up) Accessibility of home environment and transportation issues.

Parents Versus Therapists Views Of Their Child's Adaptive Seating System

Rachael McDonald, B.App.Sc.(O.T.). Post Grad Dip (Biomechanics) SROT, PAM's Research Training Fellow

Background

This paper will discuss the development and pilot of a measure to explore the difference between parents' and therapists' views of adaptive seating systems provided for their children with cerebral palsy.

Clinicians and parents/users often have differing perceptions of their child's equipment. Research on compliance and agreement has mainly been studied in terms of compliance with augmentative communication devices (Ko et al 1998, Clarke et al 2000, Murphy et al, 1994). Some of the findings of this research can be transferred to look at compliance and understanding of families and clinicians needs for adaptive seating systems in wheelchairs. White (1997) showed that there is a need for greater collaboration between therapists, carers and users of special seating systems. This is likely to have an effect both on compliance in using the system as well as overall satisfaction with the service the family receives from their primary seating therapist.

Two similar questionnaires have been developed in order to address this. The first questionnaire is designed for parents and the second for therapists dealing with adaptive seating. The questionnaire has both quantitative and qualitative sections and is divided into the areas of Ease of Use, Appearance, Seated Function and Comfort. A separate qualitative section to ascertain background information (such as how long the child spends in the seating system, how long they have had the seat) is also included in the questionnaire. There is a further section asking what the parent/therapist like and do not like about the seating system.

There was not an opportunity of ask the children themselves about their view of the wheelchair/ seating system at this stage. This was a decision based on the difficulties that the children had in particular with development and communication. There was not the time to perform a study with users comprehensively, and a decision that to do so would be tokenism. However, this is an exceptionally important topic and must be addressed in future.

Research Questions

1. What is the purpose of providing adaptive seating systems for children with cerebral palsy?

2. What do parents and therapists think are the key issues when discussing their child's seating system?

Method

An initial questionnaire was given to 6 parents and 6 therapists to complete, and an interview followed. The questionnaires were then modified in terms of style and language. All parents and therapists agreed with the subject content, except one parent who objected to the attractiveness questionnaire. With the exception of one parent who felt they would like safety to be included, the parents and therapists did not feel any other topics should be included.

Following the modifications, the questionnaires were sent out again to 5 therapists and 5 parents, and interviews performed. The questionnaires were sent out several times to each individual to check agreement. The purpose of the interviews was to check the reliability of the questionnaire information and to gather information as to the topics/areas that were important to the interviewees. The interviews were manually recorded using a pen and paper and also recorded on a dictaphone to assess reliability of recorded information.

The reliability of the questionnaires was found to be satisfactory.

Results and Future Plans

Because the parents and therapists were each looking at individual children, the results of the quantitative analysis was varied and no discernable pattern emerged. Interestingly though, whilst the parents' responses were wide and varied, the therapist's responses were quite similar, even thought they were talking about different children and conditions. However, all the therapists had chosen to answer the questionnaire using children whose seating they found challenging.

There was general agreement between therapists and parents that the seating systems were provided primarily for postural management. This was important to the parents, who reported that they used the chairs consistently for this reason even thought they actively disliked the chairs in nearly all cases. Therapists however, reported that though the chairs had been provided for a valid reason they were generally inadequate and did not perform their role satisfactorily. Therapists expressed dissatisfaction with the range of chairs available to them.

There was agreement between clinicians and parents that most seating systems were quite unattractive, but this mattered more for the parents. Comments such as 'I wouldn't choose to have this equipment in my house if it wasn't doing X some good' were frequently heard from the parental interviews. Parents were also concerned with environmental issues – such as storage, ease of getting the chair in and out of their home or car.

Both parents and therapists said that they found the questionnaires useful and would like to have the opportunity to answer such questions prior to attending a wheelchair/seating clinic. Comments were made that this could aid communication at the time of the appointment. .

The next stage in the project will assess the opinions of parents and therapists thoughts on the seating systems and wheelchairs of the same children.

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A Retrospective Study of the Effect of Postural Management Programmes in the Management of Hip Dislocation and Spinal Curvature in Bilateral Cerebral Palsy

Terry Pountney MA, MCSP, Elizabeth Green MD BA Hons DCH, Eur Ing Roy Nelham CEng., FIPEM, SRCS, Anne Mandy PhD

Hip subluxation and dislocation in children with cerebral palsy has a well documented history and morbidity. The incidence of hip dislocation in the UK is approximately 60% of children with bilateral cerebral who do not walk independently. This paper will present a study of children with bilateral cerebral palsy who had various postural management and surgical interventions to control hip deformity.

The most widely accepted theoretical model of hip subluxation /dislocation is that an imbalance of muscle length and strength around the hip leads to acetabular dysplasia and consequent hip subluxation. Muscle spasticity is implicated. Current knowledge of musculoskeletal plasticity, however, suggests that apparent spasticity has a greater component of muscle and connective tissue shortening than neurological hyperexcitability. This suggests that imbalance of muscle length and strength and the consequent impact on bony development should be preventable. Maintenance of muscle length and strength, loadbearing and joint compression are logical preventative measures. Research on normal infants' postures has provided biomechanical data to form the theoretical basis of 24 hour postural management equipment.

Prior to this, surgery has been the main treatment approach to controlling hip dislocation but many children undergo two or three surgical interventions for their hips followed by later spinal surgery. These episodes of surgery are traumatic for the child and family and costly to the National Health Service.

The Chailey approach to postural management is based on more than 15 years of research and clinical practice at Chailey Heritage Clinical Services to improve the physical and functional abilities and reduce deformity for children with bilateral cerebral palsy. The Chailey approach involves provision of positioning equipment for lying, sitting, standing and cycling and hands on treatment and active exercise over the 24 hour period. The equipment is designed to position the children at higher levels of physical ability by altering the biomechanics of the posture and is provided in the lying, sitting and standing positions (the Chailey Levels of Physical Ability in lying, sitting and standing have been validated). It aims to normalise the forces to allow the musculoskeletal system to remain intact.

This study reviewed a retrospective cohort of 60 children and young adults with bilateral cerebral palsy using locally recommended levels of postural management and surgical intervention. Length of the review period ranged from1.2 years - 24.4 years (mean 7.3 years). Medical therapy and rehabilitation engineering notes were reviewed and measurements of X rays were made. The cohort were from East and West Sussex, Oxfordshire. Hip status was determined by the migration percentage and was categorised as both hips safe, 1 hip safe or neither hip safe.

Postural management interventions were divided into 3 groups for analysis. Category 1: use of all Chailey Adjustable Support Systems(CAPS) in lying sitting and standing; Category 2: 2 items of CAPS (either lying & sitting or sitting & standing); Category 3: use of the CAPS seat only and/or any other postural supports.

A total of 446 hip Xrays were measured, mean of 7.4 (range 1 - 16) per child. Children using “All CAPS” prior to hip subluxation maintained significantly more hip integrity than other groups (Fishers Exact $p < 0.001$). 36 children (60%) in the study group had hip surgery, 21 of whom had a second surgical intervention . Across the range of surgical interventions, children undergoing hip surgery had significantly worse hip outcomes than the group who did not have surgery ((2 $p < 0.001$). 3 individual case studies show commonly occurring sequences of events.

This study indicates that the Chailey approach to twenty four hour postural management can provide a successful conservative means of preventing hip dislocation if implemented prior to the development of hip problems. A current prospective study aims to confirm these findings.

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Effects of the Use of Intrathecal Baclofen on Seating and Function

Susan Johnson Taylor, OTR/L, Deborah Gaebler-Spira, MD, Sue Mukherjee, MD

It has become more common in the past few years to use the Baclofen Pump as a means to control spasticity. Because of the sometimes dramatic changes in tone, there is usually a concommittent change in the support necessary to obtain and maintain the seated position. This paper will review the decision-making processes for recommendation for Baclofen pump insertion, as well as therapy goals for post-pump insertion. Additionally, initial results of a post pump questionnaire with clients who received Baclofen pumps will be reviewed.

Spasticity is a motor disorder characterized by velocity- dependent resistance to a passive stretch, resulting in exaggerated tendon jerks and hyperexcitability of the stretch reflex. This is caused by an imbalance between excitatory and inhibitory impulses to the alpha motor neurons. The clinical/ functional consequences of spasticity can include interference with mobility and joint range of motion (passive and active). This leads to interference with some or all functional and activities of daily living (ADL) skills, depending on the severity of the spasticity. Indications for consideration for a Baclofen Pump are multi-faceted, but generally include clients who are unresponsive, or minimally responsive, to oral medication or for whom oral medication for spasticity produces undesirable side effects, such as fatigue. Additionally, a drop of 1-2 points must be noted on the Ashworth Scale. Interference with ADL care is also taken into consideration.

Baclofen is a gamma-butyric acid (GABA) agnonist. It is thought to act as a GABA agonist in the spinal cord by reducing positive input to the alpha motor neuron. It is delivered into the intrathecal space viai a catheter from the implanted pump. The goals of ITB (intrathecal Baclofen) include reduction of spasticity, reduction of pain associated with spasticity, improvement of function and facilitation of care by a caregiver.

While there are many positive effects of ITB, one of the possible side effects related to seating is hypotonia. Clinically, it was observed that some clients had developed the need for increased support from their seating system as well as a tendency toward pressure sores once the muscle bulk from the spacticity was reduced. A questionnaire was developed jointly between the RIC Physical Medicine and Rehab Dept and the RIC Seating Clinic. This questionnaire will be completed with approximately 30 children and 15 adults with cerebral-based spasticity who have had ITB pump insertion for at least 3 months. They (and/or their caregiver) are being questioned as they come back into the medical clinic for pump refill. Questionnaire includes the following areas:

- Age
- Age at implant
- GMFCS
- Dignoses, with specific questions about the presence of scoliosis, dislocated hip
- History of surgery prior to pump insertion
- Medications
- Current dose of Baclofen
- Previous seating system and problems related to skin, orthopedic, others.
- Changes in ADL, mobility (transfers, dressing, wheelchair mobility, etc.)
- Weight gain
- Effect on pain
- Hours of caregiver time required
- Outside participation level: education/ vocation/ home/ insitution

The desired outcome will be to gather and analyze this information and determine the types of physical/ functional changes that may be expected with this diagnostic group, and how they may relate to seating and other assistive equipment changes.

At the time this paper was written, results had just begun to be gathered. There will be a compilation of results available by the end of February.

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Clinical Use of Simulation

Kelly G. Waugh, MA, PT, Mark Schmeler, MS, OTR/L, ATP

by: Elaine Trefler, MEd, OTR/L, FAOTA, ATP
with permission: Team Rehah 10:2, 1999 pages 32 to 36

A simulator, according to Webster's dictionary, is "a device that theoperator uses to reproduce or epresent under test conditions phenomena likely to occur in actual performance."

Today's positioning simulators are a far cry from the simple measuring chair first used by therapists back in 1975 to help position severely disabled children. Those homemade prototypes evolved into the multipurpose simulator we know today. Many assistive technology practitioners and suppliers have been simulating clients' posture as part of a comprehensive evaluation process for years. More recently, we have been able to simulate their differing abilities to drive powered chairs1 using a variety of powered wheelchair controls.

Now, therapists can simulate features of an ugmentative/alternative communication system by using feature simulation/matching for evaluation purposes such as ACES (Augmentative Communication Evaluation System) or customization of high-end AAC devices for symbol options or board designs.

Why simulators?
Facilities benefit in many ways, not all of them clinical, from using simulators. They satisfy a variety of purposes.

*Evaluation of the seated posture. Often therapists see clients who come to them in poorly designed seating systems. The systems can be too small, the components incorrect, or the combination of the components inappropriate for the client's present needs. In order to determine the most appropriate system, it is critical that clients be placed in the seated posture in the most appropriate components and configuration. They must also be given the opportunity to try the system for at least a short period of time. In other words, we simulate the optimum posture before deciding on the final configuration and components. The more accurate our evaluation is, the more likely that the subsequent prescription will be appropriate for the client.
*Evaluation of function. From the simulated optimal seated position, clients can then use their available motor skills for functional activities. Operating powered mobility devices, the well-seated person can more easily work AAC devices or ECU devices. The proximal stability provided by the seating components enhances the distal function often used for other control functions. In addition, simulation enables people with severe and multiple challenges to try several different systems without the purchase of expensive equipment that they might not be able to operate efficiently.

*Education. Simulation can allow consumers to physically experience what a therapist means by "best posture." It also clearly demonstrates the concept to their caregivers and third party payers.

*Communication with technical personnel. Measurements can be taken from the simulator rather than from the client. For example, gravity will often change a person's measurements for seat back height from the lying or even supported sitting posture to the posture in a seating system. Measurements taken from the components themselves are more accurate. There is no miscommunication as to whether the measurement is that of the person (thigh length, say) or the device (length of the seat component).

*Documentation. With the client in the optimal posture, photographs can be taken that are useful when seeking third party payment for seating technology.

*Saving of time and money. Setting up a simulated posture using a simulator is much quicker than simulating posture by placing components in a wheelchair frame. A simulator can quickly be readjusted for a variety of clients of different sizes, ages and disabilities throughout the day. Evaluation time is efficiently spent. And because the simulator is part of the evaluation, its use can be billed as part of the evaluation process.

*Documenting outcomes. Using a simulator enables practitioners to document objective outcomes over time. Specific dimensions will document growth, improvement in range of motion, or a client's ability to sit upright and function within the effects of gravity.

History

In 1975, at the University of Tennessee at Memphis, therapists working in the Rehabilitation Engineering program requested a measuring chair to help position more severely disabled children for evaluation and measuring purposes.

At the time, measurements for seating systems were taken with the clients on a mat. When they came back for their system, the seating components, especially the backs, often did not fit. It became obvious that for clients with neuromotor problems in particular, measurements for a seating system needed to be taken while the clients were seated.

A simple measuring chair was built from plastic seating components on a metal frame. It sat on a small table that enabled the therapist to reach the child from all angles. This measuring chair enabled the therapist to change the size of seat and back components, the length of the seat, and the height of the back. It also accommodated various neck and head supports, a lap belt, and various anterior trunk supports. The original measuring chair allowed changes in recline, but there was no ability to change tile.

Over time, the simple chair evolved into components that were mounted on a powered wheelchair base so that simulation of posture and powered wheelchair operation could occur using the same device.

New Uses

The measuring chair was renamed the simulator at the University of Tennessee when it was obvious that it was being used for much more than measuring children. The therapists had learned what is now common practice: Simulators are useful for persons with neuromotor impairment such as cerebral palsy and for those with traumatic head injuries. Tonal changes often occur with these patients as their position in space — and therefore the effects of gravity — are changed.

Simulators are also useful with elderly people or those with cognitive impairments because therapists can observe postural changes even if the client cannot articulate such things as discomfort.
As the concept of simulation was accepted in the field, several commercial companies fabricated simulators to fill the market demand or to ensure correct use of their own product.

The Flamingo by Tallahassee Therapeutic Equipment (now defunct) was a simulator that could be used with both planar and custom components. The Kiss was developed for use with Pin Dot Products ContourU customseating components (now owned by Invacare Corp.). The PSS-97 was developed as a molding frame for Prairie Seating Corporation's Reflection custom contoured cushions. More recently, Physipro, of Sherbrooke, Quebec, and Prairie Seating have developed a simulator for planar components.

Wider Availability Needed

For many potential users, however, simulators are relatively expensive and product specific. Some are no longer commercially available.

Therapists agree that the market needs a low cost simulator that can be used in simulation of posture for persons who need either planar seating or custom seating or a combination of both. And they would like it to be easily transportable for use at remote sites or in the clinic.

The biggest barrier to widespread use, however, is cost. Ideally, all therapists doing seating evaluations should have access to a simulator either in their own department or from the assistive technology supplier (ATS) that they work with. But according to one manufacturer, price is the one component that will not change any time soon. "Low volume makes them expensive," says Adolf Trenkenschuh, director of product development for Prairie Seating Corp. "If I could build 100 at a time, I could build them cheaper. Right now I'm handmaking them myself."

List prices can range up to $7,500, but Trenkenschuh says he keeps his institutional and dealer cost below $5,000. "More facilities are buying them now," he says. "Dealers don't have time to really play with these things and become familiar with them." He does note that those dealers who have bought simulators use them to help secure funding by sending photographs along with other dfocumentation to payers.

Doing Without

Therapists can use seating components to simulate the seated posture before recommending the final product combination by temporarily fitting a seating system.

Products such as those designed by Metalcraft Industries, Mulholland Positioning Systems and Freedom Designs are particularly suited to being temporarily fit for simulation purposes.

"Our approach lends itself to simulation in two ways," says Bob Jones, marketing director for Metalcraft. "We have a lot more adjustability and we have standard parts, so you can adjust without taking the person out of the system, and you can put a second person in later on with the system set a different way." Modular systems like Metalcraft's generally sell for less than $1,000.

With a simulator, however, the seating team can perform the simulation much more quickly and consider solutions that encompass more than one product line. Decisions based on actual trials with products and positions can save both time and money.

Looking Ahead

Simulation should ideally be done in both the evaluation clinic and in the environment in which the client will be using the seating system for function. Therapy departments or assistive technology service delivery programs that see many clients a week for services might purchase the simulator. Or the supplier might own the device and take it along to evaluations with therapists at different locations.

In this age of service delivery programs' striving for consumer-centered and cost-efficient services, it is a challenge for professionals to provide consumers with every opportunity to make good decisions. What better way is there for patients to participate in the decisions relative to their posture than to try various options and express their preferences based on first hand experience?

As technology evolves, perhaps the scenario of clients adjusting their own seat and back angles, changing contours and operating other technologies in their virtual environment with a thought-controlled simulator is not too far in the future.

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SIDEBAR
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Niles, IL; 800/588-0071
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Akron, OH; 800/227-2152

Physipro
Sherbrooke, PQ; 800/668-2252

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Oregon, WI; 608/835-3232

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Santa Paula, CA; 800/543-4796
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Simi Valley, CA; 800/331-8551
www.freedomdesigns.com

Custom Contoured Seating – The Next Step

Gord Broughton, RT, David Cooper, M.Sc, RT, Mark Dilabio, RT

This paper is addressing the production of custom contoured seating and recumbent systems that are fabricated for people requiring an intimate fitting posture and pressure control system. These may be provided for reasons of comfort or pressure control combined with posture control and they are usually provided for people with severe asymmetries and contractures. Regardless of the method used to produce a contoured system there are several enhancements that enable a more appropriate match to the needs of the clients and their caregivers. These enhancements are in many ways dependent on the process. If the system is produced in house there are opportunities for innovation and trial that may not otherwise be available.

There are several fabrication methods for custom contoured seating systems. These methods involve one of three techniques for capturing the desired finished shape:

- the Foam in Place technique where the client is the mold;
- making a mold, (either real or virtual), that represents the desired shape of the person; Vacuum bag dilatancy casting and drape casting would fall into this category and would include fabrication techniques such as Foam in Box, vacuum forming and most of the CAD CAM techniques;
- and, the good old method of manually measuring the body contours and reproducing them by cutting and gluing foam.

The second method is utilized by central fabrication facilities where a mould is produced in the clinical facility, sent away for fabrication, then the finished product is shipped back. Though this method provides access to custom contoured systems for clinical facilities without technical resources, it limits the interactive trial and fitting process that is fundamental to optimizing the system for the user. This interactive process, that is often a headache for seating technicians, is fundamental for the advancement of custom contoured seating.

Modular sections

One of the fundamentals for making these systems more appropriate is to make them modular. This has two primary effects, it increases adjustability and enables dynamic components.

Increased adjustability has advantages during fitting of the system enabling it to be fine tuned to the client and for future changes in the client's needs be it growth or progressive posture or physiological changes. This concept provides a combination of the advantages of a custom contoured system with a modular system. There are limitations in where splits can be made in the contours. Where the shape is divided presents a disruption in the contour and care must be taken not to introduce a pressure ridge in a potentially dangerous location.

The most common modularization is to split the seat portion from the back portion. This has many advantages:

- Back height and sitting depth can be adjusted as long as the contours remain appropriate. If growth is expected it may be possible to adjust the contours to accommodate future growth. For example, on the seat portion remove any lip behind the buttocks and have the seat extend under the back portion.
- Lateral adjustments of the seat and/or back portions is possible with appropriate hardware. These adjustments allow the back to be moved laterally relative to the seat permitting lateral displacement of the trunk over the pelvis. This introduces changes in pelvic obliquity and the

resultant spinal curvature above it. Lateral adjustments can also be used to change the position in the wheelchair to accommodate for windswept hips.

- Lateral tilt adjustments of the back are possible to alter orientation and when combined with lifting one side of the seat can provide minor lateral tilt.

- Rotation of the back portion forward on one side enables the Therapist to play with rotation of the trunk above the pelvis.

- Dynamic back supports for management of hip extensor spasm is possible when the back is not attached to the seat portion. This process involves incorporating a spring loaded recline mechanism into the wheelchair frame.

An extension of the concept of modularization is to separate the pelvic/thigh laterals from the seat portion of the seat. This permits:

- width adjustments in the pelvic and thigh regions;

- placement of straps closer to the body for a more direct angle of pull. This is also an advantage of separating the seat and back portions;

- removal of the laterals for easier inspection of the contours under the buttocks;

Separating the trunk laterals from the back enables them to be adjustable and/or removable or swing away, figure 1.

- Adjustability is a definite bonus for easing the fitting process and for maintaining long term appropriateness of the system.

- Removable or swing away portions can be important for ingress and egress. There are many ways this can be addressed. A key feature is stability and ease of use. It is possible to have large sections swing away with conventional trunk lateral swing away hardware but in many instances it is important to double up on the hardware.

Other sections may be made swing away or removable to provide access for care. For example on one sidelyer a small section was made to open like a small door for access for G tube feeding.

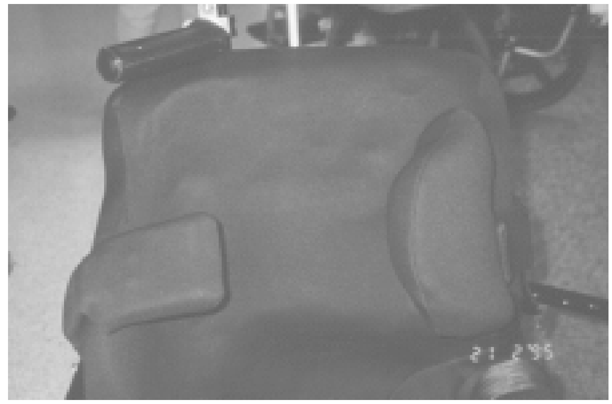


Figure 1: Contoured trunk laterals attached to swing away hardware

Reinforcing
One of the advantages to doing Foam-in-Box contoured seating is the ability to have large trunk laterals that intimately fit the trunk. Their shape, position and orientation are often critical to posture and pressure related goals of the system. Flexibility in the laterals can compromise these goals. How they are reinforced or stiffened is critical.

There are two components to the reinforcement, figure 2. The first is to insert a plate inside the lateral or to its outer surface that adds stiffness to the lateral and helps maintain its shape. The second is a bracket that connects the lateral to the back. The bracket should allow lateral and angular adjustments of the trunk lateral. The same method is used whether the lateral is separated as a modular piece or an integrated part of the back support. Considerable adjustability is possible in both situations.

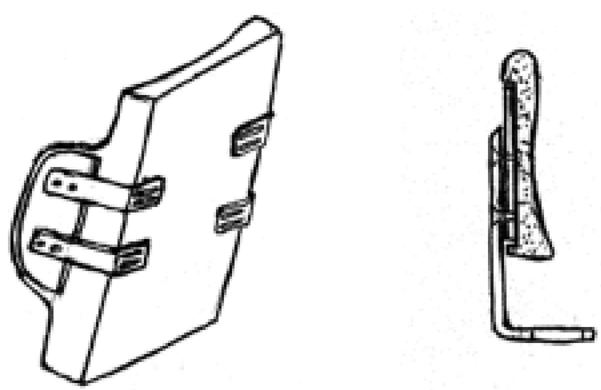
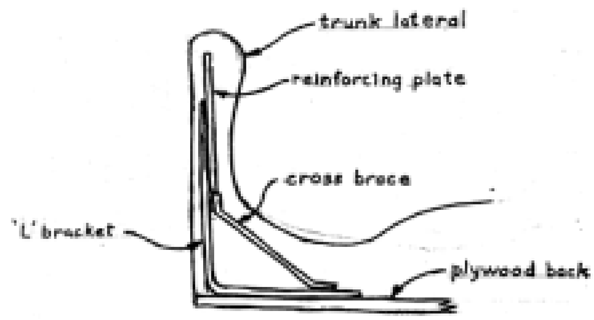


Figure 2: Diagram of reinforced trunk lateral using a solid plate inset into the outside of the lateral and two ‘L’ brackets attached to the rear surface of the back. Slots in the ‘L’ brackets allow width and angle adjustments. The view on the right is a cross section of the trunk lateral. The lateral may be part of the back or separated from it.

In extreme circumstances when the forces tending to distort or bend the lateral support are large, it may be necessary to use cross braces to provide enough strength. These cross braces are imbedded in the foam of the back portion of the system.



F igure 3: Diagram of cross bracing for extra strength in the trunk lateral. The cross brace and 'L' bracket are embedded in the foam of the back support.

There are circumstances when adjustability is important and pliable materials are used to enable changing the shape of the support surface. For example, this may occur with small children where forces are minimal and changes to the shape are expected. In these instances thin soft metal reinforcing plates are used that can be shaped manually without taking apart the seating system.

Reinforcing by this method also lends itself to providing dynamic support. By careful selection of the connecting bracket controlled flexibility can be introduced into the system. This enables portions of the seating system to be pushed out of the way during critical moments. For example it may be advantageous for a trunk lateral to shift out of the way during extensor spasm to alleviate harmful pressures then to return to their normal position when the client relaxes.

Hybrid systems
As well as hybrid systems that incorporate different types of seats and backs it is also possible to incorporate orthotic components into custom contoured systems. In many instances we find that we are taking the mould while the client is wearing their TLSO. This seems redundant in that there is already a functional shape in the TLSO but the support of the TLSO is important to maintain orientation of the trunk relative to the pelvis and hips.

We have had occasion to take portions of the TLSO and incorporate then into the back support. In these instances the TLSO has been made specifically for this purpose being reinforced in the areas that we use. Typically it would be the lateral support areas that are used. They are cut out of the TLSO and attached to swing away hardware, Figure 4.

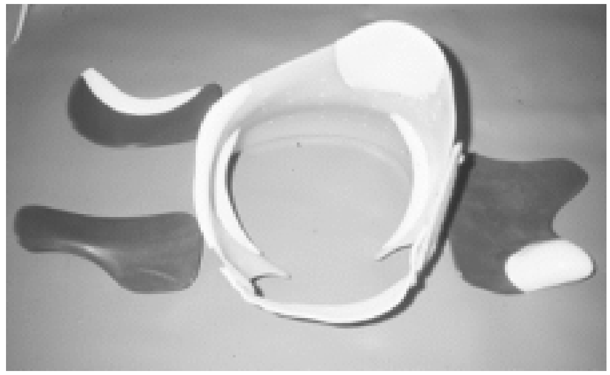


Figure 4: Portions taken from a TLSO for incorporation into a custom contoured seating system.

Summary
It should be possible for modularization of custom contoured seating systems in most applications whether made through commercial central fabrication or at in-house facilities. This process greatly increases the adjustability of the systems allowing greater control of the final product.

To implement these concepts requires additional technical resources in time and materials, but the improvement to the clients' comfort and functionality makes it well worth it.

Personal Mobility, Vehicle Mobility…Strengthening the Link

Kathryn Fisher, B.Sc.O.T.(C), ATS, Brenlee Mogul-Rotman, B.SC.O.T.(C), OTR,ATP, Terry O'Neill

Seating and positioning while behind the wheel, whether it be driving from the factory seat or from one's wheelchair, is ideally accomplished through comfort, balance and stability. Drivers that do not have a physical disability and do not require the assistance of a mobility device are subject to the forces that are exerted on a driver while making turns, lane changes and multi-tasking. Most drivers without a disability compensate while turning with the assistance of trunk stability through leg support and the use of lower body muscle groups. These drivers can also use back muscles and arm positioning to maintain balance, which in turn, maintains vehicle control. Disabled drivers that require simple hand controls to allow them to be independent must understand the forces that are required to maintain vehicle control while driving. Use of adaptive devices to assist with driving a vehicle forces the individual to have one hand on the steering wheel and the other hand used for acceleration/deceleration and possible other controls. Balance, stability and function must be maintained while using the adapted controls, and many of the muscle groups used by the able-bodied individual are not available to use for the disabled driver. The personal mobility device (wheelchair) and the modified vehicle must provide the individual with the necessary stability, function, and safety features in order to allow them to safely drive. Set up of the wheelchair and seating system, vehicle modifications, and compatibility of both systems is paramount in the success of the individual's ability to maximize personal and community mobility.

As clinicians, our goal is to optimize functional potential of our clients, regardless of their disability. By utilizing available equipment and technology, we are better able to offer our clients enhanced independence in personal and community mobility. Transportation within the community is an area of mobility that contributes to an individual's completion of functional tasks and independence.

Many individuals with mild to severe functional limitations are now able to drive independently. A thorough evaluation is paramount to ensure that vehicle modification and personal mobility devices are appropriate and compatible. Clinical evaluation will determine level of necessary modifications and success with the activity of driving. The clinical evaluation must include:

- Diagnosis-presenting condition
- Range of motion
- Strength
- Muscle tone
- Sensation
- Balance
- Transfers
- Skin integrity
- Vision/hearing
- Cognitive status
- Perceptual status
- Overall endurance and functional ability
- Equipment use and type of equipment

Lifestyle of the client, life roles, preferences, social needs and psychosocial needs must all be considered within the clinical evaluation and recommendation of equipment, abilities and need for adaptations and modifications to drive safely and independently. The seating and mobility team and the vehicle modification team must work together to ensure that all client needs are met, and that equipment is compatible to achieve overall mobility success for the client in a time and cost effective manner.

The following outlines many of the features of wheelchairs, considerations that must be taken for driving and possible vehicle modifications and recommendations. Many features and considerations overlap for both manual and power wheelchairs.

Wheelchair feature	Considerations for driving	Vehicle modifications/recommendations
W/C width and camber	Maneuverability within vehicle, positioning behind steering wheel, access to vehicle	Low floor mini or full size van, lift platform size
W/C length (overall)	Turning space, interface behind steering wheel(reach wheel, controls), access to vehicle, distance from air bag, may determine choice of vehicle	Vehicle construction style-mini vs. full size van, steering effort and reduction, spinner knob, seat belt positioning, lift platform length
W/C height with client seated	Access (doorway height), client's position (upright/tilted), L/E positioning and clearance of dashboard, clearance for tie down	Raised roof and door, lowered floor, six way power seat, tie down system
Footrests	Fixed vs. swingaway footrests, angle of footrests and front end (dashboard clearance), type may affect tie down mounting	Power tie down with anti tip device
Armrests	Removable/flip back, client independence in moving armrests	Proper positioning of gas/brake controls, operation and positioning of seat belt
Brakes	Engaged when driving	Tie down type and method
Back Height	Effects client stability/balance, assists during stops/acceleration, lateral support offers additional stability and support	Clients with low back height should be encouraged to transfer to vehicle seat with higher support back, upper torso belts(Grandmar or chest strap), spinner knobs, low effort steering
Seating surface (cushion)	Effects client stability, balance and ability to maintain upright posture, provides pressure redistribution	Encourage use of stable support medium in w/c, in addition to vehicle seat
W/C weight (power chairs)	Must be compatible with lift, ramps. Must consider weight of client as well.	Regular vs. heavy duty lifts
Power tilt &/or recline	Must be stationary in one optimal position for driving, drive lock out setting, access to vehicle, change in w/c size	Type of vehicle (may need larger vehicle), raised roof/lowered floor, door, type of access method, set up of controls etc.

Driving a vehicle is not only an expression of autonomy and independence, but this activity contributes to maintenance of family and social ties, the running of households and the pursuit of vocational and avocational activities. For our clients with disabilities, beginning or resuming the activity of driving is a major goal towards community reintegration and independence. Traditionally, transportation issues of our clients have been addressed as a separate entity from seating and mobility issues. With little consultation between clinicians and vehicle modification specialists, numerous problems have arisen, including access into and within the vehicle, use of driving equipment, appropriate visual sightlines and headroom, ability to transfer and ability to lock the wheelchair in place. These issues usually result in extra costs to the client, as changes are necessary to the personal mobility device and/or the vehicle. Ideally, a team approach to seating, mobility and vehicle modifications will reduce unnecessary cost, time delay and inconvenience to the end user.

Providing solutions to the end user is the ultimate goal of the team.

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Seating for People with Multiple Sclerosis (MS) in a Long Term Care Facility

Faith Saftler Savage, PT, ATP

The Boston Home is a unique facility in the Northeast that caters to individuals with Multiple Sclerosis (MS). Programs have been developed in the past 7 years that have a positive impact on the lives of the individuals at this facility. The seating and positioning program will be highlighted in this course.

Wheelchair positioning and mobility is a high priority for all individuals at this facility. Individuals with MS experience many changes over a period of years. Systems need to be adjustable to accommodate the changes. Areas of concern include increased muscle weakness with increased postural changes especially in the head/neck and trunk, increased tone that effects upper and lower extremities, increased memory loss that effects mobility, increased/decreased sensory awareness that effects ability to delineate pain and discomfort and psychological impact of the disease.

This course will review the pathology of MS and specific issues that effect the person with MS. Seating interventions will be discussed from basic manual mobility to power wheelchairs with tilt and head control systems. The methods for modifying systems as person changes will be investigated. The management of loaning facility manual wheelchairs to a person going into the community will also be discussed. Long term care with multiple caregivers concerns including wheelchair positioning, charging of power wheelchairs, repairs of all wheelchairs and notification of new problems will be covered in this presentation.

Muscle Weakness and Exhaustion

Muscle weakness and exhaustion have a major effect on a person with MS. As the individual loses strength and functional abilities, dependence on mobility equipment increases. As a person loses upper extremity function, the need for power mobility increases. Power mobility may assist the individual in conserving energy and decreasing exhaustion. If the person is also demonstrating a loss in trunk and head control, a tilt in space system may be necessary. Most individuals start driving a power wheelchair with their hand. If they lose this ability, they may need to be evaluated for a head control system or a sip'n puff system. Electronic equipment on the power wheelchairs should be adjustable to meet the person' changing needs.

Tone Management

Many individuals demonstrate varying degrees of difficulty with managing involuntary muscle contractions. Spasticity can effect both upper and lower extremities and trunk. Range of motion may be difficult to assess and actual shortening may not be present. However, even without range limitations, an individual' movement pattern will effect posture and function in their wheelchair and accommodations need to be made to the seating system.

Medications are frequently used to reduce spasticity. Knowledge regarding the various types of medication intervention is important for a better understanding of short and long -term effects. Possible changes with medications include reduction of pain, increase in range of motion and decrease of muscle spasms. Although medications may make a big difference in spasticity management, wheelchair seating should be able to accommodate limitations associated with the spasticity. For instance, prior to medication, an individual demonstrates limitations in movement for knee extension and requires a seat to calfrest angle of 75°. After medication, the same individual now requires a seat to calfrest angle of 90°. Although I would set the seat to calfrest angle at 90°, I may also ensure that the footplates could be moved rearward to accommodate increased tightness/tone over time depending on the overall problems that the individual presents and the type of medication being used.

Cognitive Issues

Many individuals with MS demonstrate short-term and/or long-term memory loss. Some individuals benefit from cognitive retraining and specific cues for remembering. Many others can not be assisted in this area. Cognition impacts wheeled mobility. For instance, an individual may be capable of propelling a manual wheelchair but “forget” that she can reach down and complete the task. This person should be verbally encouraged to move the chair and may always require cues. Power mobility may be appropriate for an individual with increased upper extremity weakness but a careful assessment must be completed to ensure the individual is a safe driver. The person may “forget” how to stop the wheelchair or how to avoid other people in wheelchairs. Safety needs to be a priority so no one is harmed.

Psychological Impact

MS effects a person’ quality of life. Although technology can improve a person’ quality of life, psychologically, the person may not be ready to accept the technology. As the needs of a person with MS change: walking independently —› walking with cane or walker —› manual mobility —› power mobility so to does the acceptance of the various types of equipment. The diversity of equipment and the ability to trial equipment in the nursing home setting assists individuals with acceptance but the process continues to take many months or even years.

Pain Issues

Individuals with MS exhibit various types of pain and this pain may be due to demyelination. It is important to determine the source of the pain. If a person complains of foot pain, the footplate position and shoes must be assessed to determine if this is the cause of the pain and modified accordingly. However, many times the seating position is appropriate and is not directly related to the pain. In those cases, the individual is referred to the doctor for further evaluation and medication.

Weight Changes

Individuals in the nursing home setting may gain weight. The weight gain may be associated with decreased activity level (due to decreased strength/ function), medication and/or fluid retention. The increase in weight effects the person’ width and fit in a wheelchair. Wheelchairs may have been ordered with a fixed width since growth was not expected and a new system would need to be purchased to accommodate the changes. Consideration of possible weight changes needs to be included in the prescription of equipment.

Pressure Sores, Urinary Tract Infections, Incontinence

Management of these areas is a combination of good positioning and good nursing. Areas of concern to prevent the development of pressure sores and urinary tract infections include position in bed or in wheelchair, nutrition, infection control procedures and types of padding for incontinence problems. The type of seat cushion and amount of incontinence padding under a person’ buttocks also will effect the development of pressure sores and comfort.

Vision Loss

Another area that effects people with MS is vision. Loss of vision can increase the difficulty of driving a power wheelchair but does not eliminate them from driving. It is important to determine if the person has functional driving vision. This entails knowing if the person is able to see the shape of another person or wheelchair, differentiating the walls and door openings for indoor driving. The person with visual loss needs to be observed to ensure they are safe drivers. Some individuals are safe in an indoor setting but have difficulty when out in the community. Outdoor driving skills include the ability to differentiate curb cuts from the curb and to be aware of the potholes in the road as well as car traffic. Limitations on locations to drive may need to be enforced to ensure safety.

General Nursing Home Concerns

The Boston Home is home for 84 people. Fifty residents use power wheelchairs as their primary means of mobility with 34 residents using manual wheelchairs. The four major issues regarding wheelchairs effecting the home are safety, maintenance of equipment, charging power wheelchairs and wheelchair positioning.

A complete assessment is performed to ensure individuals will be safe in specified equipment. If someone is using a power wheelchair, and skills decline, reassessment of mobility is completed with adjustments to driving parameters performed as necessary.

Equipment maintenance is a very important issue. Problem areas include module failure, joystick failure, motor failure, tilt failure and battery failure. Residents experiencing problems with their wheelchair must be assessed to determine if loaner equipment can temporarily fix the problem. Due to funding issues and schedules of equipment companies, repairs can take from 1 week to 3 months so temporary solutions are important. If parts are unavailable to repair a person' personal wheelchair, a spare chair is set-up to attempt to meet their needs. If possible, a power wheelchair is used to continue to promote independence.

Charging wheelchairs is the responsibility of the evening aides. Problems occur when aides don't plug chargers into chairs, don't turn chargers on or don't notice charger failure lights. Some of these issues should be resolved when charging cabinets are installed. These cabinets will house the chargers and have a master on/off switch. Elasticized cables will be used so that it will be obvious if a charger is not plugged into a wheelchair.

Positioning an individual properly in their wheelchair is a constant challenge. Aides are instructed in positioning but problems continue to persist. Improper positioning increases fatigue, pain and functional abilities and good positioning is an ongoing challenge.

The residents of The Boston Home are encouraged to be as independent as possible and to participate in facility and community activities. Appropriate seating and mobility equipment is an important component in encouraging this independence.

Mat Evaluation

Jean L. Minkel, MA, PT

I. POSITIONING EVALUATION

1. Observe the individual in an unsupported sitting position. Ask individual to raise their arms, if possible. Are they a:
    A. Hands free sitter
    B. Hands dependent sitter
    C. Prop sitter

POSITION IN SUPINE ON A FIRM MAT

2. What are the available pelvic mobility and lower extremity joint ranges?

A. Check available pelvic mobility:

1. Anterior/Posterior pelvic mobility:

a. Posterior rotation:
Position yourself on one side of the person. Using your hand closest to their head, locate and hold the ASIS closest to you. Use your arm closest to their feet to hold under their knees. Flex their hips and knees at the same time until the thighs rest on their stomach and the buttocks has rocked up off the mat surface. Person is rolled up into a ball, lumbar spine rounded, pelvis is posteriorly tilted.

b. Anterior rotation:
Start with thighs on chest position (see above). Keep one hand on the ASIS. With the other arm behind the knees, slowly extend the hips and knees until the legs are straight. Take your arm out from under the knees and reach across the person's body and slide your palm under the pelvis on the opposite side of the body. (To gain leverage, if you are kneeling next to the client, you will need to assume a half-kneeling position and turn your body to face the top half of the persons body.) Rock your own body back pulling on the backside of the pelvis to create an exaggerated lumbar lordosis and pull the pelvis into an anteriorly tilted position.

2. Pelvic Obliquity:

Place each of your thumbs on the persons ASIS. Rest the web space of your hand and your index finger on the pelvic crest. Note the "resting" orientation of the pelvis. Kneeling next to the person, place one arm under the knees, support the legs in a flexed position. Pull both legs toward you, flexing the trunk on the side closest to you and extending the opposite side. Maintaining this trunk flexed position, let the feet rest on the mat and re-palpate the ASIS. The side closest to you should be higher than the opposite side. Move yourself to the other side and repeat the procedure. Can you return the pelvis to a midline position? If not, which side is higher than the other?

3. Pelvic Rotation:

Start with the pelvis in a centered position. Position yourself in a 1/2 kneeling position next to the person. Place your palm on the ASIS closest to you. With your other hand reach behind the person and place your hand over the posterior pelvic crest. At the same time, push down on the ASIS and pull up on the posterior pelvic crest to rotate the pelvis. Reverse you hand position. Slide your palm from the ASIS closest to you around the back to the posterior pelvic crest. Move your hand from the posterior crest forward and place your palm on the ASIS. Repeat the rotation, this time in the opposition direction.

Before proceeding,

Position the pelvis in the best "corrected" position possible. Record findings about pelvic mobility on assessment form.

B. Check hip flexion in supine while palpating the pelvis in the best corrected position.

1. Hip Flexion with stable pelvis.

Kneel next to the person. With your hand, which is closest to their head, hold the pelvis. Thumb on ASIS, web space and index finger on crest. With the your other hand hold the back of the leg closest to you, under the knee and flex at the hip. As you move the hip toward 90 degrees of flexion, slow down. Concentrate on your thumb and index finger, when you feel movement of the pelvis under your thumb, stop and observe the amount of hip flexion. Repeat the movement starting back with 45 degrees of flexion and slowly flexion until you feel the pelvis start to “rock”. Record results on form. Move to the other side of the body. Find and hold the ASIS and pelvic crest. Position your arm under the knee closest to you and repeat the procedure. Record results onform.

C. Knee extension with the hip flexed

1. Hamstring range - 2 joint muscle.

Maintain your position kneeling next to the person. Hold the ASIS and the pelvic crest with the hand closest to the person’s head. Slide the other arm under the knee and wrap your hand onto the knee cap, your elbow and forearm should be supporting the lower leg. Flex the hip to range available, without pelvic rocking. Now extend the knee by pushing the knee cap and extending your elbow toward the ceiling. As the knee extends, concentrate on any movement you may feel under your thumb, indicating the pelvis is being pulled into a posterior tilted position. Record your findings on form. Move to the other side and repeat the procedure. Record.

D. Hip abduction /adduction and rotations

1. Start with one leg extended on the mat. Flex the other leg at the hip and the knee. With a flexed hip, slowly abduct the hip and then adduct. Return to a midline position and rotate the lower leg, internally then externally. Caution: Subluxed or dislocated hips often have limitations in joint range, especially in abduction and possibly external rotation. Record findings on form.
Move to the other side of the body and repeat both procedures with the other leg.

If the person naturally assumes a windswept deformity, it is critical to determine the available passive abduction and adduction range, and not position the hip into a neutral position, if range is not available.

E. Ankle and Foot position:

Can the foot be positioned so that the sole of the foot is a weight bearing area. If foot deformities prevent the sole from being a weight bearing area, determine which part of the foot will need to be supported while in the sitting position. Holding a “corrected” foot position is most often best accomplished with an orthotic and not from extensive modifications to the footrests.

3. Skin Inspection

   A. Check all weight bearing areas
      1. Note areas of persistent redness
      2. Note size, shape and location of any open areas
      3. Determine mechanism of trauma:
         a. pressure
         b. shear
         c. moisture

Sitting - up: Integrate findings from supine evaluation into supported sitting

4. Sit the individual up against gravity.

A. Assist the person to assume a sitting position over the edge of the mat. Ask to remove a shirt (or at very least lift the back of a shirt to see spine and pelvis. Position yourself behind the person, placing your legs on either side of theirs and provide pelvic support with the inside of your thighs.

Position the hips in the available amount of flexion found during the supine eval. Let knees flex under the mat, if 90 degrees of flexion is not available with hips flexed.

Palpate spinous processes from cervical through sacral regions.

1. Mobility of lumbar spine
2. Scoliosis - flexibility
3. Kyphosis - flexibility
4. Hyperlordosis - flexibility

5. Determine location and amount of support to achieve and hold balanced position.

1. Maintain your leg position to provide pelvic. Position your hands on the trunk to provide support and trunk control, then observe:

    A. Head position
    B. Upper/lower extremity position
    C. Effect of tilt or recline

2. Determine whether you are able to “correct” into a desired position or are you accommodating a fixed position. How much force are you hands and legs applying to the person to hold this position? (Minimal, Moderate, Maximal force).

3. Can you find a “mutually agreed” position? A position which allows the person to be relaxed, functional and feel well supported. Can the person or their caregivers get them into this position?

6. Record observations - See Evaluations Findings.

7. Put it altogether

A. Is the pelvis flexible or is it fixed in a position?

1. Will your intervention need to reduce a flexible deformity or accommodate a fixed deformity?

B. Think about the recorded hip range in terms of the angle between the seat surface and the backrest.

C. Do the hamstring muscles have enough flexibility to allow the feet to rest on standard foot plates?

To keep the hamstrings on slack, will the footplate need to be closer to the front edge of the seat?

D. Are the spinal curves flexible or fixed?

1. Will your intervention need to reduce a flexible deformity or accommodate a fixed deformity?

2. How much support is needed to maintain the agreed upon position?
3. Where will the supports need to be located?

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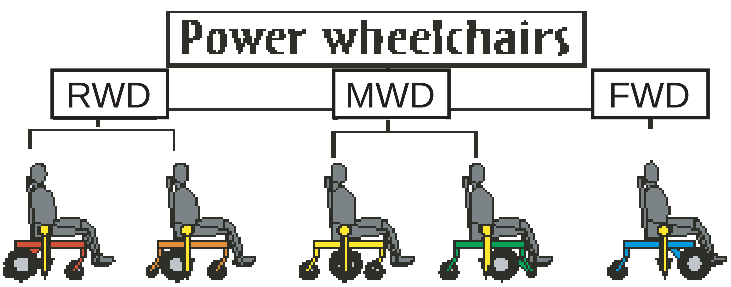
Redefining Power Wheelchairs

Ian Denison, PT; Doug Gayton, ATP

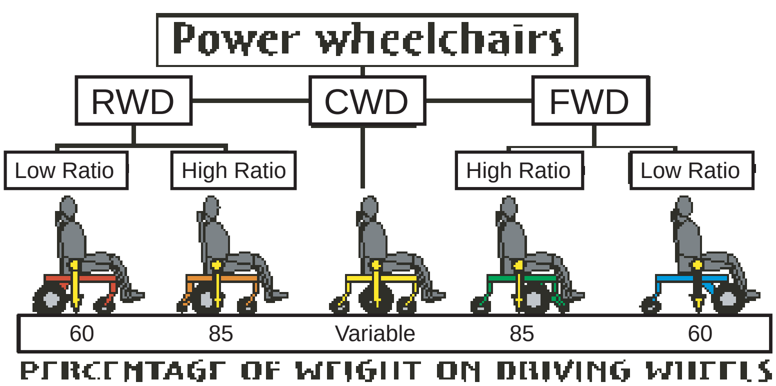
New power wheelchairs are being introduced at an incredible rate. New models have little in common with their fore runners. In their efforts to avoid patent infringements and to bring us unique products, manufacturers have made it difficult for us to pigeon hole chairs according to basic configuration. It used to be that a chair was either rear or front wheel drive. Not any more….

In an effort to identify the basic performance characteristics clinicians and clients at GF Strong Rehab Centre tested a number of power wheelchairs. The initial need was to create a new definition for the various configurations, a family tree if you like. This paper describes our attempt to make sense of the power wheelchair jungle.

New Definition



Traditionally power chairs have been classified as Rear WHEEL drive (RWD), Mid wheel drive (MWD), or Front wheel drive (FWD).



Our experience led us to classify chairs according to the drive wheel location relative to the system centre of gravity (chair and user). This classification makes it easier to understand and to predict how a chair performs

The ratio of weight on the driving wheels for centre wheel drive chairs varies depending on the caster location and whether the chair has suspension. I have tested chairs with ratios between 50% and 90% on flat surfaces. In some instances it is relevant to consider CWD's as a whole, in other instances they will be split into High Ratio Centre Wheel Drive (HR CWD) and Low Ratio Centre Wheel Drive (LR CWD). LR CWD have about 60% of their weight on the drive wheels and HR CWD about 85%.

By this new definition the chairs included in our report are categorized as follows:

Low Ratio RWD	High Ratio RWD	CWD	High Ratio FWD	Low Ratio FWD
The drive wheels are behind the centre of gravity (c of g). The front wheels are casters. The chair may have basic anti tippers at the rear as a safety feature.	The drive wheels are behind the c of g. The front wheels are casters. The anti tippers at the rear are large and designed to be in contact with the ground in some normal driving situations.	The drive wheels are directly below the c of g. The front and rear wheels are casters and designed to be in contact with the ground at all times.	The drive wheels are in front of the c of g. The rear wheels are casters. The anti tippers, at the front are large and designed to be in contact with the ground in some normal driving situations.	The drive wheels are in front of the c of g. The rear wheels are casters. The chair does not have anti tippers.
Bounder	Arrow RWD	Vector Velocity	Arrow MWD	Arrow FWD
Viva	Ranger X RWD		Pride Jazzy	Permobil MPS
Quickie S 525	Quickie P200	E & J Solaire		Permobil Corpus
Spitfire S8				ΩmegaTrac®
Spitfire 10	Quickie G424			

Chairs spanning two categories exhibit some characteristics of each type.

Factors Influencing Power Wheelchair Performance

Horizontal location of C of G
The horizontal centre of gravity location determines how the weight is distributed between the driving wheels and the auxiliary wheels. Regardless of the tire type or the surface being negotiated, reducing weight on the auxiliary wheels produces less drag. Increasing weight on the driving wheels produces more traction.

Weight distribution is critical in determining how the chair will perform for a given user in a given environment. When a wheel has more weight passing through it, the performance characteristics of that wheel are more significant in determining the chair's overall performance. Whenever the chair is being driven it is desirable to have as much weight on the driving wheels as possible.

Skidding
The effect of weight distribution is evident when changing direction on slippery surfaces. Chairs with lots of weight on their casters will spin their drive wheels and continue skidding in the same direction for a few feet. Those with most of the weight on their driving wheels produce minimal wheel spin and a much quicker turning response. Wheelchair basketball players deal with skidding by popping wheelies prior to making a quick turn. This puts all the weight through the driving wheels eliminating the skid.

Tracking
If the centre of gravity is in front of the drive wheels (as in all RWD chairs) the chair wants to keep going straight. If the centre of gravity is behind the drive wheels (as in all FWD chairs) the rear wheels want to overtake the drive wheels requiring frequent corrections with the joystick.

These are just some of the characteristics discussed in this paper. The instructional session should leave you with a clear understanding of where new chairs fit in and an ability to predict their strengths and weaknesses.

How To Avoid The Pitfalls In Assistive Technology Research

Shirley G. Fitzgerald, PhD

Objective: Upon completion of this workshop, the participant will be able to

1. Understand the theoretical 'threats to validity' and how they impact 'real life' research.

2. Design research projects that lessen the threats.

3. Understand how to devise solutions for commonly occurring problems within the research environment.

Background:
In the increasing development of technology for individuals with disabilities, it is important to assess the technology to make ensure that it truly makes a clinically significant difference. Why prescribe a device that may be affordable, but is easily abandoned because it does not fit the specific needs of an individual. Clinics may perform in house trials to assess customer satisfaction with services or evaluate a new cushion that a vendor recommended is crucial to increasing service and delivery. In order to attain accurate results, it is crucial to understand the problems that may arise.

The problem with research on human subjects is just that, research on human subjects. Humans seldom have, and seldom will be, consistent. Inconsistency in the subjects combined with the inconsistencies of the research staff as well as environmental influences can result in research that is not perfect. So how does one control for all the extraneous factors that may happen in research, preserve the sanity of your staff and keep your subjects coming back for more?

To answer that question, one must remember what the goals of experimental research are as well as to remember what encompasses threats to internal and external validity. In experimental research, the ideal goals are:

1) Is there a true relationship between the variables of Interest?

2) If that relationship exists, can one variable be directly related to the cause of the other, or are t here other factors that were not thought about?

3) Given that a cause-and-effect relationship most likely exists, are the results accurate and generalizable to other situations, other disabilities and other technology?

Threats to validity of a research study can be thought of as any factor that will prevent the study to achieve those previously mentioned goals. There are two categories of validity when assessing a research study: internal and external. External validity refers to the extent to which the results of your research can be generalized to other populations and situations. Internal validity refers to the extent to which the experimental treatment really caused the observed change in the subject population. True theorists of research methodology have given names to the threats to validity, and these have been summarized in Table 1. As rule of thumb, many of the threats can be controlled by way of study design. For example, a randomized controlled clinical trial will impose more constraints on a study than a cross-sectional mail survey, and thus will have fewer threats to the validity of the study. The workshop will provide detailed information about which study designs eliminate the different types of validity.

Table 1: Types and Descriptions of Validity

Type of Validity	Specific Problems
Internal Validity	
	History
	Maturation
	Testing
	Instrumentations
	Regression Toward the Mean
	Selection
	Mortality/Attrition
	Compnsatory Rivalry
	Imitation of treatments
External Validity	
	Interaction with treatment and selection
	Interaction of treatment and setting
	Interaction of treatment and history
	Pretest Sensitization
	Posttest Sensitization
Statistical Conclusion	
	Power of the Study
	Violation of statistical methods
	Reliability
	Variance
Construct Validity	
	Operational Definitions of variables
	Experimental Bias
	Hawthorne Effect
	Multiple-treatment interactions

But from a practical standpoint, the threats can be more simply classified as those created by the participants (subjects, investigators) and the environment (place, time). Participants are defined as all those who take part in the research process. This includes the investigators, the clinical coordinators, interviewers and subjects or patients. The environment can be defined by the setting of the research study – either the laboratory atmosphere or the natural constraints imposed upon research subjects. Should these threats be present in a research study, the validity of the study is jeopardized. Ideally, by being able to recognize the threats and treating the problem, the research may be carried out with valid results.

Recognition of the problems (or possible problems) will be discussed including an overview of problems that commonly arise with the participants and environment. Detailed information on solutions to lesson the problems and thereby lesson the threats to validity will be provided. Examples from actual research projects will be provided and the audience will be encouraged to participate to discuss research problems that have been encountered.

NOTES:

The Use of Technological Advances To Evaluate Seating and Positioning in Individuals with Severe Orthopedic and Developmental Disabilities

Karen Hardwick, Ph.D., OTR, FAOTA; Susan Hanson, PT; Roxane Nichols, OTR; Christy Yeager, PT

There are a number of technological advances that are available for use in evaluation and fabrication of seating and positioning systems for individuals who have severe physical and developmental disabilities. Examples of these devices include Doppler ultrasound and the ABI (ankle Brachial Index) for information about circulation, computerized pressure mapping to identify areas at risk for skin lesions, pulse oximetry to measure oxygen saturation, and videofluoroscopy to evaluate functional alignment of eating, swallowing, and digestive systems. A new area for evaluation involves testing elderly individuals for vertigo or balance disorder that could result in abnormal postures or resistance to recline or tilt. Often, individuals with profound disabilities cannot communicate verbally or in other traditional ways. Because of the deficits in communication, information about fit, comfort, function, and preference cannot be shared between providers and consumers. The use of objective measurement tools can give the clinician critical information about the skin, circulatory system, respiratory status, digestive processes and other vital functions to ensure the postural devices being provided meet the basic physiologic needs of the consumer. Additionally, the results of assessments utilizing such tools can provide concrete data for research in an area that often lacks opportunity for controlled study.

Doppler Ultrasound

High frequency ultrasound is a technique used to detect peripheral arterial pulses. When distal pulses are not easily palpable or cannot be detected with a regular stethoscope, the Doppler can be used to find and measure blood flow. The equipment consists of crystals that emit and receive ultrasound waves reflected by moving red blood cells (Medasonics, 1998). Use of this technology during seating evaluation can help to indicate the presence or absence of peripheral blood flow in different positions as in supine, sitting, and in various degrees of recline and elevation of the lower extremities.

ABI (ANKLE BRACHIAL INDEX)

The ABI is a standard noninvasive test used to assess the severity of peripheral arterial occlusive disease. Positioning is effected when arterial flow is insufficient and cannot move against gravity when the legs are elevated (Gardner and Montgomery, 1998). The ABI is calculated by dividing the ankle systolic pressure by the brachial systolic pressure.

- ABI readings indicate:

>1.0	=	Normal
0.8 – 1.0	=	Mild peripheral arterial occlusive disease (compression therapy should be used with caution)
0.5 - 0.8	=	Moderate peripheral arterial occlusive disease (compression therapy is contraindicated)
<0.5	=	Severe occlusive disease, with referral to a vascular specialist (compression therapy is contraindicated)

- If the systolic pressure is exceedingly high, an ABI is not considered accurate. This is common among diabetic patients where the vessels of the lower leg have become calcified and cannot be compressed by the blood pressure cuff (Collier, Boyd, and Merwarth, 1999).

Rubor of dependency

Rubor of dependency is used to test the adequacy of arterial circulation. This test is performed by placing the individual in the supine position and noting the color of the soles of the feet. In individuals with normal arterial circulation, the feet will be pinkish in appearance. To perform this test:

- Elevate the legs to about 45 degrees. If a quick loss of color occurs, resulting in a dead grayish white appearance, arterial involvement may be suspected.

- Return legs to a dependent position, normal individuals will display a quick pink flush in the feet. If the arterial circulation is impaired, the color change may take longer than 30 seconds to occur and will be a very bright red (McCulloch, 1988).

When arterial insufficiency is suspected, consider the following:

- Use of gravity to facilitate circulation is

  necessary for tissue health of dependent structures (arms and legs).

- Define and confine tilt feature to the window where the strongest Doppler signal is achieved.

- Assure adequate thigh support.

- Open knee angle slightly if possible.

- Provide foot support which reduces pressure areas and provides optimal support.

- Avoid constrictive clothing as elastic banded sweats, socks, some house lippers, etc).

- Do not elevate feet or arms above the heart.

- Elevate head of bed at least 5 degrees or lower foot of bed at least 5 degrees.

- Careful skin monitoring.

- Encourage movement).
  If venous insufficiency is suspected then consider the following:

- Use the tilt to elevate feet above the heart.

- Schedule elevation times throughout the day.

- Open the knee angle slightly.

- Compressive hosiery.

- Encourage movement.

- Careful monitoring of skin.

It is possible for both arterial and venous insufficiency to occur simultaneously. In this event arterial problems rule decisions of elevation and compression. For example compression may still be able to be used but at a milder degree, i.e. 20mm Hg vs 40mm Hg. Positioning can be used by specifically defining the angle of tilt during elevation.

Pulse oximetry

Pulse oximetry is a non-invasive technique to measure pulse rate and saturation of oxygen in the blood. The SaO2 is computed by measuring differences in the visible and infrared absorbance of oxygenated and deoxygenated arterial blood (Mendelson, 1992). SaO2 should be at least 90% or above. However, any condition that restricts blood flow may result in inaccurate Sa02 readings. Because positioning can impact a person’s ability to breathe adequately, thus compromising O2 intake, it is important to test individuals in the positions being considered. For example, upright sitting in individuals with low muscle tone, or kyphosis can cause collapse of the T-spine resulting in inadequate ventilation and a drop in SaO2. Tilting the position back slightly can open the trunk, ease ventilation and improve O2 levels. Similarly people with severe scoliosis may not tolerate certain positions at all or become compromised over time. Monitoring Sa02 for a proscibed period of time is recommended.

When SaO2 drops frequently consider the following:

- Avoid positions that cause such fluctuations. Positioning should enhance breathing ability.

- Design or modify the wheelchair/seating system in positions that stabilize the readings such as an open seat to back angle, various degrees of tilt in space, rotation or derotation of the spine by contouring or mounting of the seating components.

- Be cautious using prone positioning because in certain individuals diaphragmatic breathing can be compromised and gastroesophageal reflux can be facilitated.

PRESSURE MAPPING

Pressure mapping refers to clinical use of a tool that enables the user to identify areas of concern and to assist in positioning person's at risk for pressure sores. The system utilizes an array of individual pressure sensing elements to determine the pressure between the individual being tested and the sitting surface; then it presents the information in measurable units and as a color-coded display. Pressure is usually recorded in mmHg. Individuals who register low pressures, <80 mmHg, coupled with no active skin problems, generally require no additional intervention. Individuals who record pressures higher than 80 mmHg may need additional intervention that could include changing the cushion, altering angle of tilt, replacing the wheelchair frame, or other actions (Shapcott & Levy, 1999).

VIDEOFLUOROSCOPY

Videofluoroscopic evaluation of swallowing refers to a moving X-ray examination of swallowing using various densities of food and liquid impregnated with Barium, a radiopaque substance. Such studies should include oral, pharyngeal, esophageal, and gastric components to present a comprehensive evaluation of dysphagia (Jones and Donner, 1991). Appropriate assessment should involve a routine that incorporates both erect and recumbent positions including supine and prone oblique positions to assess esophageal motility, gastroesophageal reflux, and gastric emptying.

Following evaluation, it is often necessary to utilize individualized positioning regiemes and equipment to address the range of medical, orthopedic, respiratory, digestive, and neurological considerations that are frequently displayed by individuals with developmental disabilities. The use of seating and positioning systems for individuals with severe handicapping conditions can enhance daily living skills and basic digestive and respiratory functions by assisting in alignment of body structures and by the use of gravity. Appropriate positioning may be upright, reclining, side-lying, sitting, standing, prone or a combination of positioning routines depending on the problem that is revealed during the assessment (Hardwick & Feichtinger, 1991; Morris and Klein 1987). Simple positioning procedures may also be used to control symptoms of dysphagia in individuals who are ambulatory. These include conservative antireflux techniques, such as raising the head of the bed to use gravity to control reflux, and maintaining upright positioning at least thirty minutes to an hour after meals.

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The Importance of the Therapist in the Wheelchair Decision-making Process for Older Adults

Deborah A. Jones, PT

Currently it is common for wheelchair equipment to be prescribed and procured either by a caregiver, user, physician or supplier without a therapist involvement. Occasionally with less complicated clients, this will be satisfactory. But, often problems occur when a team approach is not utilized. Too many seating interventions are not meeting the needs of the individual user. Including an occupational or physical therapist proficient in assessing the physical needs and the environmental and specialized equipment needs of older adults in the decision making process is key to success. With fewer dollars available for durable medical equipment (DME), it is important to provide equipment that will accommodate both the short-term and long-term goals for the user.

When individuals with complex needs purchase a chair without proper assessment, the result is often poorly fitted systems or systems that can't be modified as the client changes. However, few professionals in the medical field know what to do about it. What is needed is individualized seating. Individualized seating means identifying the person's body contours, range of motion, and orientation in space and implementing a seating system that best positions and supports the person for comfort and function.(Jones, Miller and Rader, 1998). The occupational or physical therapist will need to conduct a thorough seating and mobility assessment and prescribe individual wheelchairs and seating systems that address the users needs, wants and desires. Success is largely the result of the combined efforts of knowledgeable and competent clinicians who, in collaboration with informed consumers and caregivers, make decisions based on both specific knowledge and experience (Cook and Hussey, 1995).

If a physical assessment is not conducted, underlying problems such as hip flexion contractures or other fixed deformities, skin issues and pressure management, trunk alignment for upright control, respiratory complication and swallowing dysfunction will not be identified. In addition, progressive degenerative diseases may not be taken into consideration resulting in the wheelchair needing to be replaced because it cannot be modified to meet the changing needs of the client. The living environment or vehicle will also need to be thoroughly assessed to determine the appropriate priorities of the wheelchair and seating interventions. If the assessment does not cover all these areas, inappropriate equipment may be purchased and can have long term negative consequences for the user in the areas of posture, skin and pressure management, safety, comfort and overall ability to function.

Here are some interdisciplinary perspectives on the need for therapist involvement in wheelchair decision-making:
DME Supplier: Richard Kruse, President, Wheelchair Works, Inc.
"There are several reasons a therapist needs to be involved in the evaluation to ensure proper fit of a wheelchair. Due to the inexperience of the supplier, it is necessary to have a therapist to help assess the proper positioning and alignment of the patient in the wheelchair. In addition, the therapist can make equipment recommendations based on the progression of the client's diagnosis and help the supplier understand the physical disability. Many times the therapist knows the client on a more personal level and therefore knows the client's needs better than the supplier. With the therapist involved, the client also tends to feel at ease and participates more actively in the evaluation process. A therapist also can help with reimbursement issues. Medicare

and other insurance companies require therapist involvement in the evaluation process in order for the supplier to be reimbursed for the equipment."

Case Manager: Diane L. Hansen, RN, MBA
Director, Utilization/QI Management, Mullikin Medical Centers

"I think most people, like me, who do not deal with these issues on a daily, weekly or even monthly basis would agree:

- things that we aren't comfortable doing get put aside to be done "tomorrow";
- it's hard to keep up-to-date on the more specialized equipment;
- it's not always easy to know what equipment will really improve a patient's daily living or quality of life;
- insurance restrictions/plan benefits can make it difficult to find the "right equipment" for a given patient's needs.

Throughout my career, I have wished for someone who understood patient equipment needs and my own needs as the case manager, potential payer source, or consultant reviewing plaintiff medical bills or life care plans.
Therefore, I look for a therapist who is knowledgeable about durable medical equipment and seating assessment and can listen and suggest ways to resolve my issue in a timely and cost-effective manner. A therapist who talks to me in "lay" terms but acknowledges my medical knowledge. A therapist with acute and sub-acute rehabilitation experience so that long-term issues are considered with the initial purchase of equipment, especially for patients with progressive degenerating conditions. The therapist needs to be independent of the DME company to provide a second opinion – about actual equipment, the quote itself, alternative ideas to accomplish the same goals, etc. and a patient's advocate."

Marie Valleroy, MD Rehabilitation Medicine
"Why consult with a therapist for wheelchair fitting? A wheelchair purchase is a major durable medical equipment expenditure. The wheelchair user must often live with the consequences for years, sometimes quite painfully, if the choice is not carefully thought out. Physical or occupational therapy involvement in wheelchair selection and fitting is the key to optimizing function and avoiding problems as back pain and pressure sores. A therapy consultation for wheelchair fitting is not only a good investment, it is the right thing to do."

Case Study:
Seventy-four year old Mr. T began living in a nursing home due to skin ulcers and swallowing complications from multiple sclerosis. He presents with a severe forward head and right rotation of the neck. There is redness and moisture in the neck region due to the prolonged poor positioning of the head and neck. He said his head had been in this position for about two years. He says he would like it if his head would remain upright so he could see. Although, he chooses to sit in and sleep in his stationary lounge-style mechanical lift chair because it reclines slightly, lifts his legs to decrease pain and it is more comfortable than a bed or wheelchair. He can raise and lower his legs and recline slightly in the chair by himself, if the controls are placed in his right hand. . According to Mr. T and his wife, this method of sitting, reclining and sleeping has been going on for several years.
He had acquired a Quickie P110 power wheelchair with an 18" wide, 16" deep Comfortmate cushion and a J2 Tall back, just 6 months ago. But, the only time he uses his power wheelchair is to visit his doctor. He does not use the power wheelchair in other time because it is not comfortable and he cannot see where he was going.

According to the client and his wife, their physician recognized that Mr. T needed a power wheelchair and recommended that he contact a DME supplier. The supplier met with the patient and his wife at their home. Mr. T's main concern was getting the power wheelchair into their Dodge Mini-van that had a lift system. A power wheelchair, cushion and back system were selected for comfort and van access. A therapist was not involved at this point, so no physical assessment was performed.

Due to Mr. T refusal to sit in his wheelchair, his poor positioning and skin issues, a therapist was consulted. The physical assessment performed by the therapist revealed that Mr. T had poor trunk control, right torticolis, a coccyx and heel wound, 70 degree right hip flexion and 15 degree hip external rotation contracture, minimal external rotation control at the right shoulder. Left hand is worse than the right. He is right handed. Also, he complains of leg pain when he cannot move them with the mechanical lift. With this information, it was evident that he needed a power wheelchair with power tilt-in-space to assist with his declining trunk control, pressure and pain management. He needed a cushion that could accommodate his fixed hip contracture, distribute pressure for skin integrity and have more depth for increase femoral support. He requires a head support to assist in upright head control. His controls needed to be placed closer to midline for optimal function. In addition, if the client was transported in his van, he could enter in a tilted position.

The client's case manager was contacted to reveal the new information. The P110 power wheelchair base could not be used for a power tilt system. Therefore, a new power tilt wheelchair and cushion were recommended with footplates set at 90 degrees and midline joystick mount and bilateral arm troughs for positioning. A flip-down Whitmeyer head rest with forehead strap and pulley system was recommended along with a ROHO Quatro or J2 Deep Contour cushion 18x18 and using the current J2 back system.

The case manager negotiated with the supplier to exchange the P110 for the recommended wheelchair and seating system and pay the extra for the upgrades.

Mr. T now sits in his power wheelchair everyday for several hours. His skin wounds have healed with the accommodation of his hip, he now does not put extreme pressure on his coccyx. His neck redness has disappeared and his neck flexion and rotation have improved with the combination of a Botox injection, stretching program, daily positioning power tilt wheelchair and a power lounge chair that has dual motors to fully recline like a bed and still move the lower extremities, if needed. With his improved head position, his chewing and swallowing has improved along with his ability to cough. Since he can drive his chair with better control and visual acuity, he attends activities, drives throughout the home and outside when weather permits. With his upright head position, it has improved his social interaction with other residents, friends and staff. He now can look at the person he is talking to and can watch the television with ease. This power wheelchair and seating system has met his individual needs and has made a huge difference in his quality of life.

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Seating and Access II: Those Children Who Grow Up!!

Karen M. Kangas OTR/L

Introduction:

With children who are non-speaking, and have physical disabilities and require alternative access for powered mobility, and for other assistive technology, finally getting these systems to work is empowering. Then, they grow and change. Should the system of seating, access, and technology, be replicated? Or, change with them. This session will explore how to allow this transition to support the continued growth of these children, now young adults, and face the ensuring complicated issues involved.

It is an involved process to assist young children in becoming more independent in their use of assistive technology, especially with alternative access. Adequate seating remains the foundation of their ability to use their bodies and to continue to gain control and competence of the assistive technology they are using. In this course, we will explore how to plan, or react to the changes that occur when these young children become young adults. Which pieces of their current systems (seating, access, assistive technology, equipment) should be replicated, and which should change? How can the change be supported?

I will be sharing actual cases I have worked with for over 10 years , as the children have grown up into young adults. The fact that all these children now spend so much more time in their chairs is critical to factor into the changes needed in their seating. Also, the goals of seating may also change. When they were young and primarily control of tone was needed, now orthopedic changes may need to be accommodated.

The need for programmable electronics; multiple drives in powered chairs; flexible, yet stable seating systems, including powered seating options; and the needed support of treatment/training/ and implementation strategies will be shared and discussed.

CASE STUDIES

I. What changes occur
   - A. Bodies, themselves
      1. Growth
      2. Orthopedic changes
      3. Major Surgeries esp. spinal rod insertion, baclofen pump
      4. Medication changes
   - B. Environmental Demands
      1. Long days in chair
      2. Multiple classroom environments at school
      3. Addition of attendant/aide
      4. Transfers
      5. ADL needs

II. Equipment Needed
   - A. Seating Changes
      1. What used to work, doesn't
      2. Where do we put the lower extremities?
      3. More flexibility can only come with powered seat functions
      4. Front wheeled and mid-wheeled drive vs. rear wheeled drive
      5. Angle adjustability, adjustability in all lateral supports
      6.
   - B. Chairs, themselves
      1. Multiple, separate, programmable Drives (in electronics)
      2. Powered chair with ECU controls
      3. Use of powered seating functions
         - a. Tilt
         - b. Recline
         - c. Seat elevation
         - d. Legrest elevation
         - e. Combinations
      4. Use of computer
      5. Communication device and mount

C. Traveling within the community
   1. Manual chair needed
   2. Van tie-down systems
   3. Transfers
   4. Accessibility
      a. Restaurant
      b. Bathrooms
   5. Leisure Activities

III. Therapy Needed
  A. Private vs. School Therapy
    1. Frequency and Duration
    2. Working together
      a. School therapist to clinic
      b. Clinic therapist to school

  B. Feeding/Swallowing Studies (Radiology and its seating)

  C. Tracking, not predicting what is needed

  D. Transfers

  E. Standing

IV. Costs involved
  A. Not replacement chairs
  B. Integration of multiple funding sources
  C. Vocational Rehabilitation involvement

V. Looking to the future
  A. Transition Planning
  B. Work of private therapy vs. school therapy
  C. Developing critical pathways of equipment necessary for total care/yet increased independence
  D. Research and compilation of equipment needs, for real, given the changes in institutionalization, ADA, and leaving the education system
  E. If not college, what?

Summary:

We are now seeing children grow up within families and communities who never used to live in these environments. These children were either shipped off to institutions or never survived birth. As we have developed as a society, encouraging the inclusion and appreciation of diversity, we must forge pathways which allow continued equality, not simply a different form or prejudice and isolation.

I know in this "cost conscious" world, we have all been led to believe, things cost too much, or we try and prove they don't. I am interested in what works for an individual, preventing injury and disease, supporting health and well being. Our whole society is struggling with that, knowing how to use the medical system, how much is our own responsibility, well, we, as professionals, should stop predicting stuff we don't know. We are in a new age, a new time, coping with individuals who have begun to benefit from our more open society. We must develop not research to prove what works, I think that type of clinical research will always be outdated as it cannot follow long enough individuals before equipment changes itself, or we deprive folks of equipment for the sake of the study.

Studies used for drug efficacy are not the only type of scientific data. When we learned about human development we did not develop a laboratory. Instead, a young father, a biologist, observed his own growing children. Jean Piaget, simply a scientist and a father, in his observations, recorded human development, with excellent observations. In his scientific study he assisted in recording what occurred, and from that we are beginning to understand how human beings learn.

We need to do this same kind of "research." We need to study what works, identify what doesn't. We need to provide equipment, and assess why or why it doesn't work. We need to observe, record, observe, record, and over time begin to understand what is needed to work. We do not have this information. Yet, we have allowed others to anticipate the needs of our patients. We must begin to identify working strategies and share them with each other. I hope the struggles of my best teachers, these kids I have watched grow up, will help us all, as we still attempt to help them and us, all live together in a more caring, and peaceful world.

Use of Modular High-Strength Lightweight Manual Wheelchairs as a Fleet

Mark R. Schmeler, M.S., OTR/L, ATP, Nigel G. Shapcott, M.Sc., ATP, Elyn S. Tovey, PT, Michael J. Stonfer, ATS, CRTS

INTRODUCTION

Prescription and delivery of high-strength lightweight (K0004) wheelchairs to individuals upon discharge from the hospital requires careful assessment of needs and selection of a system that can be modified and adjusted as the new user's needs evolve (1, 2, 3, 4). Lack of flexibility can result in decreased function and costly service calls to the person's home following discharge. Clinicians are under productivity demands and have limited time to spend trying to modify and adapt wheelchairs to meet a person's needs. People are also being discharged home from the hospital sooner and sometimes unexpectedly making it difficult to predict mobility needs and level of recovery that will continue after discharge. Errors in prescription and assembly of wheelchairs are also common especially given the limited training clinicians obtain in the application of this technology.

For these reasons a collective project was developed and launched within the UPMC Health System between the Center for Assistive Technology (CAT), the Rehabilitation Hospital (RH), and Home Medical Equipment (HME) to identify strategies to better serve the needs of people being discharged with a rental manual wheelchair. As a somewhat self-contained system with responsibility for both clinical and financial outcome, UPMC was also interested in looking at cost-effectiveness and cost-benefit of traditional wheelchair prescription and service delivery practices and identifying cost saving alternatives.

The ETAC Twin manual wheelchair was identified as a potential "fleet type" highstrength lightweight wheelchair for rental and purchase to patients who are discharged from UPMC RH. The ETAC Twin is designed and manufactured in Sweden where they typically recycle wheelchairs and therefore design them in a manner that is more durable and adjustable to meet the needs of multiple users as well as address a user's changing needs. Specific features are as follows:

1) The back angle can be quickly adjusted with the user in the wheelchair to accommodate a user's limited hip range of motion, trunk deformity, and sitting balance.

2) The orientation of the seat angle can be adjusted to provide posterior tilt for wedging or anterior tilt for foot propulsion.

3) The seat to floor height can be adjusted to accommodate individual leg length for foot propulsion, height for transfers, or access to working surfaces.

4) The rear axle can be moved forward to promote efficient push-rim access and propulsion biomechanics using the upper extremities.

5) The rear axle can be moved rearward for a longer wheelbase and increased stability.

6) The adjustable tension back upholstery can accommodate various back shapes and spinal deformities without always having to equip the wheelchair with an expensive third party backrest.

7) The cross frames can be switched to accommodate various seat widths.

8) The standard angle adjustable footplates can accommodate a user’s specific ankle position.

9) The standard height adjustable armrests can accommodate a user’s specific arm support and trunk stability needs.

10) The standard adjustable length footrests can accommodate a user’s specific leg length.

11) The double cross frame and side frame potentially make the wheelchair stronger and less likely to fail.

PROBLEM ANALYSIS

Clinicians from the Center for Assistive Technology and the Rehabilitation Hospital together with staff from Home Medical Equipment identified the following problems in the procurement of highstrength lightweight wheelchairs at the time of discharge from the hospital:

1. HME has found on several occasions they were given very short notice of a person’s discharge and need for a specialized wheelchair. The short notice made it challenging to locate and set-up a system in time for discharge.

2. When the wheelchair was delivered to the hospital, it often either did not fit properly or needed to be modified. This often resulted in having to return the wheelchair and redeliver another one, which was costly in terms of time, labor, resources, and potential delay of discharge.

3. It was often difficult for therapists to determine the specific configuration of a wheelchair to meet a user’s needs without trying them first. This resulted in HME being requested to set-up and deliver multiple wheelchairs to the hospital for trial at the time of discharge.

4. Therapists had concerns that users do not have adequate time to learn to operate or get experience using their wheelchair prior to discharge. This is necessary in order to identify any modifications or adjustments that might be needed. This might also result in a service person or RTS having to go to the home after discharge to make the modifications.

A pilot program was proposed to assess the overall cost-benefit of the ETAC Twin both to the end user and the Health System. The potential cost saving factors included:

1) The Twin appears to be more durable in design as compared to other highstrength lightweight wheelchairs therefore service calls to the user’s home may be reduced. The potential increased longevity of the Twin may produce added revenue across the life cycle of the wheelchair as a rental unit.

2) The Twin can be easily adjusted by trained clinicians eliminating the need to deliver multiple wheelchairs with different configurations for clinical trial.

3) The Twin can be adjusted to address a user’s progressive or improving needs without having to change components or an entire wheelchair. The adjustments could also be done by clinicians eliminating the need to send a service person out to the home or facility.

4) Upon delivery, the Twin can also be adjusted to suit the specific needs of the user eliminating the need to bring the wheelchair back to the shop.

5) When a user no longer needs the Twin, it could be cleaned and readjusted for use by another person.

6) An inventory of Twins and components could be housed at the Rehabilitation Hospital to be set up for discharge eliminating the need to deliver a specific wheelchair that sometimes does not fit or meet the needs of the user.

METHODOLOGY & IMPLEMENTATION PLAN

Problem Assessment

For a period of two months UPMC Home Medical Equipment monitored the number of wheelchairs that were ordered by the Rehabilitation Hospital for patient discharges. Specific information was gathered related to number of mistakes or refusal of a wheelchair that would warrant the need to send a service person out to correct the situation or replace the wheelchair. Results are shown in table 1.

Table 1:
Highstrength Lightweight Wheelchair Orders for August/September 1999
No. of K0004 Wheelchairs: 47
No. of Errors/Rejections: 12
Percent: 25.5%

Reason for Problem:
- Need for different equipment after initial trial (5)
- Change in discharge time or date (3)
- Clinician provided inaccurate measurements (2)
- Defection in product (1)
- Equipment not delivered to specifications (1)

Clinician Training

A comprehensive inservice training program was developed and implemented at the Rehabilitation Hospital to all Physical Therapy personnel and others involved in the provision of wheelchair technology. The inservices were carried out over five one hour sessions during lunch hours or early in the morning prior to patient treatment. Content of the sessions focused on assessment procedures, types of wheelchairs, clinical criteria and indications for each type, and hands-on adjustability of the ETAC Twin. The inservice content was also based on existing courses in the Department of Rehabilitation Science & Technology curriculum at the University of Pittsburgh.

Inventory & Other Resources

UPMC Home Medical Equipment provided a consignment inventory of ETAC Twins and components to be housed at the Rehabilitation Hospital. A Rehabilitation Engineer from the Center for Assistive Technology (NGS), assigned two half days a week to the hospital, was available to the therapists and provided expertise in the initial identification and fitting of appropriate candidates for this type of wheelchair. A Physical Therapist (EST) was also available on a daily basis to support other clinicians interested in the wheelchair for an individual. A Rehabilitation Technology Supplier (MJS) was also available at the hospital one morning per week to assist with the project initially and to monitor the inventory.

Assessment

Individuals were identified by the team as being potential candidates for the ETAC wheelchair based on the following; long-term need for a wheelchair following discharge, need for specific seat to floor height, limitations in lower extremity range of motion, flexible deformities of the spine or limitations in trunk control, or difficulty propelling other less adjustable high-strength lightweight wheelchairs. Candidates were set-up in a loaner ETAC to try as part of their in-patient rehabilitation program. The wheelchair was adjusted as needed for optimal positioning, comfort, and function. Once it was determined the ETAC will suit their needs, a system was pulled from the consignment inventory and configured to meet their needs. Individuals were provided with an opportunity to use the device prior to discharge to determine any additional adjustment needs. All necessary paperwork was completed and signed by the attending physician prior to discharge. HME replenished the consignment inventory as needed.

Life-Cycle Durability Testing

Three ETAC Twin wheelchairs were also obtained to conduct ANSI/RESNA Durability testing in the Human Engineering Research Laboratory at the University of Pittsburgh (5). Results of this testing are to be compared to data that exists on other manufacturer's high-strength lightweight wheelchairs (6, 7). Specifically, a cost per cycle analysis is of interest to determine cost-benefit of using ETAC Twins as compared to lower per unit cost alternatives.

RESULTS

Over a six-month period 13 ETAC Twins were procured to people upon discharge from the Rehabilitation Hospital. Demographics are described in table 2. Typical specifications for an order included a 16" to 18" seat width; full-length arm pad to accommodate an arm trough; one brake extension; swing away footrests; and all available configurations of casters and rear wheels.

Table 2: Overview of Candidates who Received ETAC Twin Wheelchairs

No. of ETACs Provided: 13 No. Rejections/Errors: 0	Sex: 10 Males & 3 Females Mean Age: 60.5 (SD 14.4)
Diagnoses: Hemiplegia (7) Quadriplegia (2) Paraplegia (2) Multiple Sclerosis (1) C1-C2 Instability (1)	Discharge Setting: Alone (1) With Family Member (12) First floor set-up in 2 story home (7) Two story home – Bed bath upstairs (2) One story accessible home (2) Apartment (1) Skilled Nursing Favcility (1)

Clinician Feedback

Feedback from the therapists was generally very favorable. They reported they liked having all the adjustability including; seat to floor height, seat angle, seat to back angle, and adjustable tension back upholstery. They also felt the wheelchairs were lighter, more compact, and easier for the individual to self-propel with either their arms or feet or both. They further felt the swing away footrests, removable armrest assemblies, and wheel locks were easier to learn to operate by the user. Therapists reported they disliked the difficulty in attaching common arm troughs necessary for people with upper extremity paralysis associated with hemiparesis. One therapist commented that it takes longer to adjust as compared less adjustable systems. Others reported they would like more size options especially widths greater than 20” and greater weight capacities. Furthermore, they would like more height for the back uprights with two bolt fixings and a treaded tire option as part of the standard option package.

Rejections & Errors

There were no reported problems with rejection of a device or having to send someone to the home after discharge. There were also no reported delays in discharge associated with provision of the ETAC Twin as people were already fitted and trained in the use of the device upon discharge. Home Medical Equipment also reported decreased need to have single wheelchairs delivered to the hospital by a delivery person due to the in-house consignment inventory.

Following discharge there were only two incidents of repair calls; one to replace a broken wheel lock extension and one incident of caster loosening by a

DISCUSSION

Costs

The manufacturer’s Suggested Retail Price (MSRP) of an ETAC Twin equipped with height adjustable armrests, swing away footrests, and adjustable rear anti-tippers is currently about $1330 according to the order form and price list dated January 2000. Other high-strength lightweight wheelchairs with fewer adjustable components commonly sold in the United States retail for about $1180 (according to order forms and price lists dated September 6, 1999 for Sunrise Medical’s Breezy 510 and Invacare’s 9000XT dated March 1, 2000). The ETAC essentially costs $150 more if one considers only MSRP. Wholesale cost to Rehabilitation Technology Suppliers is variable depending on primary and secondary discounts however wholesale cost differences could be less than $100. (See Table 3) This may be a very insignificant difference especially considering it costs approximately $50 each time a service person goes out to home or facility to adjust a wheelchair.

Table 3: Cost Comparison of Common K0004 Wheelchairs

Manufacture	MSRP	Wholesale (40% & 20% discounts)	Wholesale Difference to ETAC
ETAC Twin	$1330	$638	na
Breezy 510	$1180	$566	Less $72
9000XT	$1180	$566	Less $72

Life Cycle Cost Analysis

Unfortunately life cycle data analysis was not available at the time of press but will be provided at the presentation. One can hypothesize though that the ETAC Twin has a longer life cycle than other K0004 wheelchairs due to its composite side frame design and double cross bracket construction.

Other Associated Costs

In this project there were no reported delays in discharge nor the need to return or the product for another one at the time of discharge. Delays in discharge can be extremely costly especially in a managed care environment. A consignment stock of fleet wheelchairs was also maintained at the hospital eliminating the need to deliver a single wheelchair at a time. Stock was usually replaced in a larger number and at a time when other equipment was scheduled to be delivered to the hospital.

Overall clinician satisfaction with the wheelchair was favorable as compared to their experience using other types of wheelchairs. Unfortunately, there was no formal survey of the end users perspective of the wheelchair however this would also be difficult given this was usually their first wheelchair and there is no basis for comparison. The wheelchair is more adjustable as compared to other manufacturer's K0004 wheelchairs therefore it can assumed will more readily meet specific individual needs.

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Transport Wheelchairs

Douglas A. Hobson

In April, 2000, ANSI/RESNA WC-19 was approved as US national voluntary industry standard for wheelchairs designed for use in motor vehicles. The whelchair industry is responding to the need for wheelchairs that comply with the new industry standard for transport wheelchairs. Models of wheelchairs that meet the standard will be featured and discussion about the special transport features will follow. All those prescribing wheelchairs that are used as seats in motor vehicles are encouraged to participate.

The Posture-Pressure Connection: The Importance of Multidisciplinary Seating Assessment in Prevention of Ischemic Ulcers

Cynthia A. Fleck, RN, BSN, ET, CWS; Tina L. Roesler, MS, PT, ABDA

Often, when discussing the impact of seating and positioning on a client's life, we fail to consider the direct implications of proper positioning on skin health and integrity. It is important to remember that the seated client is inherently at greater risk for skin breakdown due to a myriad of factors including: prolonged pressure over a small surface area, lack of mobility, impaired sensation, and inactivity. While the list is more extensive, it is important to know that 85% of clients who are seated dependent will develop ischemic ulcers at some given time. There are steps that clinicians can take to minimize and prevent the impact of ischemic ulcers, a problem that costs Medicare $2.2-$3.6 billion annually.

First, consider the extrinsic risk factors that we can control. They are pressure, shear, friction and moisture. Specifically, focus on pressure and the direct correlation between wheelchair configuration, posture and pressure. Basic adjustments can have a significant impact on pressure distribution and risk for ischemic ulcers. For example, properly adjusted armrests can decrease seated pressures by 25-35%. Other components to pay close attention to are leg rest height, backrest height and angle, the type of seat and back upholstery, and appropriate seat width and depth. Each of these adjustments has an effect on normal seated posture and has the potential to put the client at increased risk for skin breakdown and skeletal deformities.

Second, be sure to take a real team approach to seating and wound care. While some may prescribe to the old adage "Too many cooks spoil the pot", when we talk about strategies to minimize effects of ischemic ulcers, this could not be more wrong. Consider the input of seating specialists, therapists, ET nurses, physicians, rehabilitation technology suppliers, manufacturers' representatives and the client. Each has a unique perspective and set of skills that can aid in making the best choice for the client. Therapists and seating specialists understand the physical and functional implications of seating systems and prescribed treatments, ET nurses can contribute knowledge about the topical wound care options and the never-ending list of dressing choices, physicians can contribute with a complete medical history and inform us of future medical interventions, and suppliers have an in depth knowledge of specific product and how it can be applied to individual situations. Your manufacturers' representatives may also be able to provide clinicians and clients' with valuable educational opportunities regarding specific product and clinical applications of seating components. Of course, do not discount the client who will provide valuable feedback regarding the effectiveness of current interventions and share their goals and needs.

Last, but not least, education must be an ongoing process involving all of the team members. Remember that education and repetition is the key to retention and prevention. Make it sink in, repeat concepts regarding skin care, pressure relief, and nutrition often. Not only does this keep the team members on top of things, but the more the client hears suggestions, the more likely that he or she will follow through with that information. Do not be shy about showing the client what could happen as a result of poor skin care. In this case, it is true that "a picture speaks a thousand words". Give the client ownership of their skin health and give them the responsibility of managing it. Also, remember that each team member should constantly update his or her own wound care knowledge. Wound care and seating options are changing constantly and very quickly; therefore, we can never idly sit by and assume that we understand all of the latest advances in treatment and equipment choices.

With all of this in mind, we can make the best decision and equipment choices for our seated dependent clients. Take a holistic approach to seating and wound care and be open to new ideas and technologies. Choose the appropriate equipment and seating support surfaces from the onset and we may be able to prevent the debilitating physiological, physical, psychological, and social effects of ischemic ulcers.

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The Challenge of Optimal Seating for People with Joint Contractures

Marygrace DiStasio Mangine, OTR/L; Cheryl T. West, MSPT

An appropriate seating system and wheelchair will enable clients with joint contractures to increase their quality of life, by allowing them to interact with the world from a wheelchair level while also preventing further medical complications. It may also increase comfort by accommodating deformities of the extremities and trunk, which in turn decrease the risk of skin breakdown. Proper seating and positioning equipment, along with an appropriate mobility base, can promote overall health with regards to improving respiratory functioning, gastrointestinal functioning, and swallowing. The potential to increase functional mobility and participation in self-care and previous life roles increases dramatically with an appropriate seating system. In this session, several low and high tech seating adaptations will be discussed via presentation of evaluative procedures and case studies. The Magee Rehabilitation Hospital equipment procurement process will be used as a system example.

Significant joint contractures often influence and limit the choice of equipment due to special adaptations or custom modifications required. Some of these modifications are as simple as opening seat to back angles or as challenging as fabricating custom molded seating systems. A variety of seat backs and cushions along with manual and power wheelchairs will be discussed with emphasis on options for people with joint contractures in the upper extremities, trunk, and lower extremities.

Our clinical decision process will briefly be discussed in determining appropriate seating equipment systems for clients with joint contractures as follows:

- Client interview, completion of screening forms
- Assessment of clients' functional status
- Financial and funding considerations
- Vendor identification
- Postural evaluation
- Client education and trial/evaluation of equipment/wheelchairs
- Documentation procedures
- Submission to payment source
- Interaction of potential seating and mobility system in home/work environment

The Occupational and Physical Therapists at Magee Rehabilitation perform initial evaluations to determine overall function. While each discipline looks at different aspects of the client, the evaluations are performed jointly. Occupational Therapist's assess community re-entry, self care, kitchen, and homemaking as well as perform a thorough upper extremity assessment that measures available active and passive movement, strength, sensation, coordination, and tone. Visual, perceptual, and cognitive screens are performed as needed to determine safety and ability for new learning.

The Physical Therapists perform a comprehensive trunk and lower extremity evaluation to determine active and passive movement, strength, sensation, coordination and tone. Physical Therapists also assess the client's mobility status including all types of transfers, ambulation, bed mobility and basic/ advanced wheelchair mobility skills.

Upon completion of the inpatient or outpatient initial evaluation, a discussion between physical and occupational therapists occurs regarding the client's present level of function and primary equipment needs. Investigation of funding options is the next step in determining if a client has coverage for various types of durable medical equipment. If an inpatient, communication between therapy and case management needs to take place prior to equipment evaluation and ongoing throughout a client's admission. If an outpatient, it must be determined if coverage for the outpatient evaluation exists, as well as for the potential durable medical equipment.

A durable medical equipment vendor is chosen either before or after the evaluation and ordering process either through the payors choice or through vendor rotation. The vendor then assists with the ordering of the wheelchair and discusses the necessary specifications, availability of loaner mobility equipment, equipment maintenance, warranties, and training.

During the initial contact with Occupational and Physical therapy a postural evaluation is completed, assessing flexibility and postural stability of the client's entire body. More often than not, pressure mapping is used as a tool to determine pressure distribution of seating systems evaluated. The result of this evaluation enables the therapists to determine appropriate seating intervention and mobility needs for the client. Evaluation of a variety of equipment is then conducted along with education on each piece of equipment. The client, family/caregiver, and therapists (with the DME vendor input if applicable) together choose which seating system and mobility base is the most comfortable, safe, and functional. A variety of environmental situations are discussed and assessed.

Both therapists document the client's functional status and results of the initial evaluation. The therapist(s) then writes a letter of medical necessity justifying the need for the seating system and mobility base. The medical documentation is processed through case management, the attending physician and through our Equipment Office. The Equipment Office is responsible for submitting paperwork to the respective payor and vendor and tracking delivery or problems. Once the system is approved and delivered, our clients return as outpatients to be fitted and educated/trained with the prescribed equipment prior to home delivery. Follow through in the home setting is the responsibility of the assigned vendor. Future issues can be addressed by the therapists in the lifetime Follow Up system of care.

Back in Style- Suggestions to the Field

Thomas R. Hetzel, PT, ATP

INTRODUCTION:
This course will outline the biomechanical principles and clinical indicators to be considered when selecting a wheelchair back support. Tips on evaluating current technologies in respect of the ways they address the person-to-support-surface and support-surface-to-mobility-base interfaces will be presented.

Upon completion of this program, participants will:

1. Understand the roles a wheelchair back system plays in supporting the pelvis and trunk in the effort to optimize postural control and distal extremity function.
2. Expand their current assessment skills to include techniques for determining back support characteristics as they relate to the key interfaces of person-to-support surface and support-surface-to- wheelchair.
3. Understand seating simulation strategies, and ways to translate simulation results into final goals and product selection.
4. Recognize the intended application of several commercially available back support systems.

Biomechanical relationship of the pelvis and trunk in a balanced seated posture.

In a balanced seated posture, spinal curves are most greatly influenced by pelvic orientation:

Posterior pelvic tilt.

- Reduction or reversal of lumbar lordosis
- Increased thoracic kyphosis
- Shoulders protract
- If head rights:
    - Increased cervical lordosis
    - Capital extension
    - Mouth tends to open
    - Unsafe swallow
- If head does not right or collapses:
- Cervical kyphosis
- Capital flexion
- Head tends to fall forward, “chin on chest”

Anterior pelvic tilt.

- Increased lumbar lordosis
- Reduction or reversal of thoracic kyphosis
- Shoulders retract
- If head rights:
    - Decreased cervical lordosis
    - Capital flexion
    - Mouth tends to close
    - Safe swallow

- If head does not right or collapses:
    - Cervical extension
    - Capital extension
    - Head tends to fall back

Pelvic Obliquity.

- Initially, a compensatory lateral “C” curve with the apex to the same side as the obliquity (low side) is observed, and is most likely seen in the lumbar and thoracic spine.
- The shoulder on the side of the obliquity tends to be elevated.
- If the head rights, then a compensatory curve will be observed in the cervical spine with apex opposite obliquity.
- If head does not right, then the head will tend to fall laterally, opposite the obliquity.
- If the obliquity persists, then a compensatory curve may progress in the thoracic spine with apex opposite the obliquity creating and “S” curve. This compensatory curve tends to level the shoulders.

Note that any lateral bending of the spine is linked to a corresponding degree of rotation. It is this rotational component that often leads to the progression of a “rib hump” or anterior-posterior spinal and thoracic cage deformity.
In the case of pelvic rotation, a compensatory spinal rotation opposite that at the pelvis can be expected.

A brief summary statement of the above would be that wherever the pelvis tends to posture, the shoulders and head will tend to go opposite. This simple statement is the cornerstone for back support configuration and selection. It is also important to remember that it is not enough to simply recognize the postural tendency. One must further evaluate to determine the cause of the undesirable posture targeted for correction.

Evaluating the individual for a back support
Time and space limit the degree to which this program can focus on specific evaluation principles. It is recommended that participants without background in evaluation for seating and mobility pursue programs which cover it in depth. The general order in which the physical evaluation proceeds is as follows:

Identification of postural tendency in current equipment
- Posterior
- Anterior
- Lateral

Postural control and functional skills in current equipment.
- Mobility
- ADL
- Transfers

Flexibility (Supine). The primary goal of the supine assessment is to establish true joint flexibility as it influences seated posture.
- Pelvis
- Lumbar spine
- Hips
- Hamstring
- Thoracic spine
- Cervical spine, head and neck
- Shoulder complex and upper extremities

Flexibility (Sitting).
The primary objective of the seated evaluation is to determine where an individual can be supported comfortably and functionally within his/her available range of motion. A flexible component of posture is not always a correctible component. Once the individual is in the seated position, both intrinsic and extrinsic factors work together to create a complex constellation of influences on postural control. Seating and mobility features must be considered with respect to these influences.

AMOS and the Back Support
Back support features can be arranged around the acronym “AMOS”. The acronym is arranged below in the order in which the features may best be considered:

- “A” represents Angles, or angular relationship of supports with respect to anatomic angles.
- “S” represents Shape, that is the shape of the supports with respect to the shape of the sitter in his/her corrected posture.
- “O” represents Orientation of the back support with respect to gravity, method of mobility, and environment.
- “M” represents Materials selected with respect to the sitter’s requirements for support, comfort, and care of skin integrity.

Simulation of the parameters above is essential in determining the proper back support.

The primary methods of simulation are:
- Linear/planar simulation
- Molded or dilatency simulation
- Computer assisted design (CAD)
- Equipment mock-up
- Combination

The results of the simulation will help refine the final goals of the seating intervention, and establish product options. By first defining the support parameters in terms of “AMOS”, one can then assess the various options objectively.

Defining and evaluating back supports:
ANGLES & SHAPES
One basic principle that is extremely important in the selection of a back support is that the support ultimately has two responsibilities:
1. Pelvic support
2. Trunk support

With this in mind, and the relationship of the pelvis and the trunk discussed earlier, i.e. their tendency to work opposite of each other, one can begin to understand how to evaluate potential options for a consumer. For example, assuming flexible and correctible postures, if the objective is to rotate the pelvis from a posterior tilt towards neutral, one might attempt to close the seat-to-back angle. As the angle is closed and the pelvis is rocked forward, the trunk will need to extend, but will be blocked by the back support. Conversely, if the objective is to accommodate a kyphotic spine, one might attempt to open the seat-to-back angle. As this is done, the pelvis will tilt posterior and the kyphosis may actually increase.

Therefore, one parameter to consider is the ability to independently adjust pelvic and thoracic support. This is accomplished in some commercially available systems through adjustment of shape, angles, or both. It may also be accomplished through the means in which a shape is “captured” for fabrication of a more custom shaped back support. This is an essential feature for correcting a flexible pelvis and spine. One must be able to “capture” the optimal shape, adjust a more generic shape, or adjust the angular relationship of the pelvic and trunk supports to optimize flexible spinal postures.

Shape or contour is another consideration.

Traditionally, it has been taught that back supports are categorized somewhere within the range between planar and custom contour. Advantages and disadvantages of both ends of the spectrum have been widely discussed. What needs to be considered, however, is where and how specific contour should be applied in any system. One theme that is regularly accepted is that proximal stability promotes greater freedom and “normalization” of distal mobility. To that end, it follows that by providing contours specific to the stability of the pelvis, it may be possible to “open” the shape distally to allow, or even promote, greater freedom of movement. In summary, the specificity, location, and depth of contour needed in a back support is driven by the amount of control required proximally to balance someone’s posture in an effort to realize a desired functional outcome distally.

ORIENTATION of the back support with respect to gravity, mobility, and environment.

With respect to gravity, one needs to be able to adjust the back support to fully take advantage of gravity for postural stabilization. This may be accomplished through the mounting hardware for the back support, or possibly through the configuration of the wheelchair itself.

The method of mobility is critical in determining how to select and mount a back support. One must recognize that if a back support utilizes the full width of the wheelchair, it may decrease seat depth. This results in a shift of the center of gravity of the sitter in relationship to the drive wheels of the chair, and can dramatically reduce wheelchair performance. If the back support fits between the back canes of the wheelchair, width of the support may be limited. Recent innovations in back support design have reduced the impact on seat depth and width.

The back support must also fit the environment and lifestyle of the user. Weight, portability, manageability, design, safety, and numerous other factors contribute to back support selection.

MATERIALS

If a material touches the body it needs to address the parameters of comfort, support, and skin care. One must determine the priority in which these three parameters need to be addressed. If the priority leans more toward support, then a firm material may be indicated. The firmer the material used, the more accurate the shape must be to address the areas of skin care and comfort. Issues of heat and perspiration also need to be considered when support and cover materials are determined. Maintenance and durability of the materials requires consideration as well.

Other Considerations:

Sitting is dynamic. Consider how a particular back support can promote favorable, symmetrical resting postures with good spinal alignment, yet allow for, maybe even promote active transitions to more functional postures.

Define the critical tasks and desired outcomes. One back support cannot be everything to one person. It is imperative to know and guide intervention in support of the most critical tasks needed to be accomplished when sitting. Trying to address too many tasks may dilute the overall effectiveness of the support and ultimately do nothing very well. Look for user adjustable seating parameters when appropriate, and challenge manufacturers to recognize the need for and develop truly dynamic seating systems.

People change.

Consider the prognosis of the individual. It is a rare case where a person is beyond the point of possible change. All parameters considered need to also take into account the capacity for change be it growth, progression of a condition both positive or negative, living situation, transportation, etc…

SUMMARY:
The wheelchair back support plays a critical role in the support of safe, comfortable and functional postures. Knowledge of the roles the back support plays, i.e. pelvic and trunk support, and the biomechanical relationship of those postural segments in a balanced system are critical in determining the most appropriate back support option. The evaluation for and simulation of product features as they relate to angles, shapes, orientation, and materials will help direct a consumer towards that optimal product option. Awareness of currently available technologies and how to personalize them to best support the consumer's needs will help to ensure favorable outcomes.

Tom Hetzel is part owner of Aspen Seating, LLC, a direct service manufacturer of specific seating systems for the most unique and complex of needs. Headquartered in Denver, Colorado, Aspen Seating provides outreach services nationally in areas of manufacturing, consultation, education and evaluation for individuals with the most severe, profound and unique seating requirements. Tom can be reached at (303) 579-7078, or hetzel@infi.net.

Linking Clinical Presentation with Power Wheelchair Programming

Lois E. Tucker, OTR/L, ATP

Programming is the most important link to a power wheelchair users success. Programming powered mobility is also the one area many clinicians and rehab technology suppliers find intimidating. The key to programming a power chair is understanding how the client's physical and cognitive limitations, environment and choice of driver control impacts on the programming parameters.

Physical conditions that impact programming can include, range of motion limitations, weakness, fatigue, spasticity and ataxia to name a few. Cognitive and perceptual differences like attention, memory and the speed at which information is processed will also require different settings. The environment(s) the client will negotiate and the driver controller they will use will modify the programming setup as well.

In this instructional session, each one of these issues will be discussed. Guidelines will be provided to assist the dealer and clinician in the programming process based on the client's profile. Written handouts will allow the participant to leave the session with guidelines they can use in their own clinical environments. New computer software will be highlighted at the end of the session that can be used to simplify the programming process in the field.

Reimbursement - Rehab 101 — All You Need to Know & More to Get Your Client What They Really Need

Peggy Walker, RN

In all instances for any type of DME the medical records must contain information which supports the medical necessity of the item ordered.

Canes/crutches are covered when prescribed by a physician for a patients with a condition causing impaired ambulation and when there is a potential for ambulation.

“a white cane for a blind person is non-covered since it is a “self help: item.”

Walkers -
1. Standard walker is covered if prescribed by physician for a patient with a medical condition impairing ambulation & there is a potential for ambulation, AND there is a need for greater stability and security than provided by cane or crutches.

2. Heavy duty walker (K0458,K0459) is covered for patients who meet coverage criteria for a standard walker AND who weigh greater than 300 pounds. Use ZX modifier.

3. E0147 - Heavy duty, multiple braking system, variable wheel resistance walker is covered for patients who meet criteria for a standard walker AND who are unable to use a standard walker due to a severe neurologic disorder or other condition causing the restricted use of one hand. (Obesity by itself is not sufficient reason for an E0147 walker) Manf. name, make, model & note or other documentation from physician detailing functional limitations which preclude the pt. using another type wheeled walker & diagnosis causing this limitation.

Enhancement accessories of walkers will be denied as non-covered.

Leg extensions are covered for patients 6 feet tall or more.

Bathroom equipment is non-covered. (anything that goes inside the bathroom door.)

Heavy duty commodes (K0457) width =to or > than 23 inches – weight capacity 300 pounds or more.

Detachable arms (E0165) are covered when used to facilitate transferring the patient or if the patient has a body configuration that requires extra width.

Patient lifts (Hoyer or other types) - covered if transfer between bed and a chair, wheelchair, or commode requires the assistance of more than one person and, without the use of a lift, the patient would be bed confined.

Lift Chairs - Patient must be able to ambulate once standing (can not be used in conjunction with a w/c or pov (must be non-amb. with these)

1. have severe arthritis of hip or knee or have severe neuromuscular disease.

2. must be a part of the physician’s course of treatment & be prescribed to effect improvement, or arrest or retard deterioration in the patient’s condition.

3. patient must be completely incapable of standing up from any chair in his/her home. (The fact that a patient has difficulty or is even incapable of getting up fro a chair, particularly a low chair, is not sufficient justification for a seat lift mechanism. Almost all patients who are capable of ambulating can get out of an ordinary chair if the seat height is

appropriate and the chair has arms.)

4. Once standing, the patient must have the ability to ambulate.

POVS:
1. The patient's cond. is such that a w/c is required for pt. to move in their home.

2. Unable to operate a manual w/c.

3. Capable of safely operating the controls of a POV.

4. and can transfer safely in & out of the POV & has adequate trunk stability to be able to safely ride in the POV.

BEDS:
1.Semi-electric — Pt. requires positioning of the body in ways not feasible with an ordinary bed in order to alleviate pair;

2. requires the head of the bed to be elevated more than 30 degrees most of the time due to CHF, COPD, or problems with aspiration. Pillows or wedges must have been tried and failed to achieve the desired clinical outcome; or

3. requires traction equip. which can only be attached to a hospital bed.

Specialty Mattresses:
Coverage
1. Completely immobile - i.e. Pt. cannot make changes inbody position without assistance

2. Limited mobility - ie pt. cannot independently make changes in body position significant enough to alleviate pressure.

3. any stage pressure ulcer on the trunk or pelvis

4. impaired nutritional status

5. fecal or urinary incontinence

6. altered sensory perception

7. compromised circulatory status

Group 1 (mostly overlays) Criteria 1, or criteria 2 or 3 and at least one of 4-7.

Group 2 (powered pressure reducing mattresses) (Covered if meets: Criterion 1& 2 & 3 OR criterion 4 OR criterion 5 & 6 below.)

1. Multiple stage II pressure ulcers located on trunk or pelvis

2. Pt. has been on a comprehensive ulcer treatment program for at least the past month which has included the use of a n appropriate group 1 support surface.

3. The ulcers have worsened or remained the same over the past month.

4. Large or multiple stage III or IV pressure ulcer(s) on the trunk or pelvis

5. Recent myocutaneous flap or skin graft for a pressure ulcer on the trunk or pelvis (surgery within the past 60 days)

6. the patient has been on a group 2 or 3 support surface immediately prior to a recent discharge from a hospital or nursing facility (discharge within the past 30 days).

Group 3 (air-fluidized bed) ALL of following

1. stage III (full thickness tissue loss) or stage IV (deep tissue destruction) pressure sore.

2. bedridden or chair bound as a result of severely limited mobility.

3. in absence of an air-fluidized bed, the patient would require institutionalization.

4. the air-fluidized bed is ordered in writing by the patient's attending physician based upon a comprehensive assessment and evaluation of the patient after conservative treatment has been tried without success. Treatment should generally include:

a. education of patient and caregiver on the prevention and/or management of pressure ulcers.

b. Assessment by physician, nurse, or other licensed healthcare practitioner at least weekly;

c. appropriate turning & positioning.

d. Use of a group 2 support surface, if appropriate;

e. appropriate wound care.

f. appropriate management of moisture/ incontinence;

g. Nutritional assessment and intervention consistent with the overall plan of care.

The patient must generally have been on the conservative treatment program for at least one month prior to use of the air fluidized bed with worsening or no improvement of the ulcer. The evaluation generally must be performed within a week prior to initiation of therapy with the air fluidized bed.

5. A trained adult caregiver is available to assist the patient with activities of daily living, fluid balance, dry skin care, repositioning, recognition and management of altered mental status, dietary needs, prescribed treatments, and management and support of the air-fluidized bed system and its problems such a leakage.

6. A physician directs the home treatment regimen, and reevaluates and recertifies the need for the air fluidized bed on a monthly basis.

7. All other alternative equipment has been considered and ruled out.

As in all cases there must be documentation in patient files for Medical Necessity related to support surface ordered.

Application of Research Findings into Clinical Practice

Rosemarie Cooper, MPT; Shirley Fitzgerald, PhD

Clinical research has a direct impact on clinical practice. This lecture will introduce five of the several research studies conducted at the Human Engineering Research Laboratories (HERL) and will share with the audience on how the research results have and can influence the clinical wheelchair prescription and provision process.

Study 1:
Evaluation of the a Pushrim Activated Power Assisted Wheelchair

The purpose of this study was to evaluate the Yamaha JWII electric-powered, add-on unit for a manual wheelchair. The Yamaha JWII is designed to reduce user-applied force needed to propel the chair by supplying additional torque proportional to the user-applied force. The potential long-term significance will be to reduce the incidence of upper extremity injury and resulting pain, loss of function and dependency in manual wheelchair users. It was found that the JWII decreased metabolic cost when compared to a standard manual wheelchair at the same workload. Both ergonomic and comfort measures were significantly higher for the JWII. Subjects were very satisfied with the ease and stability.

Study 2:
The Efficacy of a Variable Compliance Joystick for Accessing the Graphical User Interface of a Personal Computer

The goal of this research is to determine whether a joystick equipped with compliance and damping features will help individuals with cerebral palsy achieve better computer cursor control than other proportional interfaces.

A research joystick has been constructed which can be configured to seventeen combinations of compliance and damping. One of these setting known as the Commercial Baseline will be equivalent to most commercially made proportional joysticks (no damping and modest return spring) Individuals with cerebral palsy who have upper extremity athetosis or tremor experience significant difficulties controlling rehabilitation technology such as wheelchairs, voice output communication devices and personal computers. In some cases, an individual cannot use a proportional control at all and must instead use a single switch-scanning interface, which is very tedious and slow. An improved proportional joystick, which can mechanically filter out unintentional movement, would be beneficial.

Study 3:
Effects of Cushion and Back Support During Wheelchair Ride Comfort

In this study we investigate the change in vibration and comfort with changes in wheelchair cushion and back support. Although cushion design has been thoroughly investigated, the focus of these investigations has been pressure sore prevention. How changes in cushion effect vibration transmission has not previously been explored. Improvements in back support have been shown to improve comfort however, a systematic evaluation of these back supports has not occurred.
The information gathered in this study will assist cushion back support manufacturers and designers. It also will explore the possibility of reducing secondary pain through a simple and low-cost intervention. Reduced secondary pain and impairment and will lead to improved quality of life for veterans with disabilities.

Study 4:
PVA Power Wheelchair comparison study
This study is intended to provide valuable information about the durability, stability, cost effectiveness, and other characteristics of five different brands of power wheelchairs. Although the safety and performance records of electric powered wheelchairs are required for Food and Drug Administration (FDA) approval of an electric powered wheelchair, the results of these tests are often not made available to the public.

Clinicians and wheelchair users can benefit from this information by making more informed choices about which type of power wheelchair is best suited for a particular individual.

Some initial results indicate that there are significant differences between the five different types of power wheelchairs with respect to sections 01, 02, 03, 04, 06, and 10. The results obtained from testing the wheelchairs to failure should also produce significant differences with respect to durability and cost effectiveness. This study may be expanded in the future to include new types of power wheelchairs and possibly power scooters.

Study 5:
Wheelchair Ergonomics and Chronic Pain Prevention

In our lab we have developed a device, the SMART^{Wheel}, which is capable of measuring the forces at the rim of MWUs in their own chairs. The device works by instrumenting the support beams of a wheelchair rim in such a way as to allow measurement of torque and force on the rim in 3 dimensions. We have successfully integrated this data with information on joint movement in a clinical workstation, the AIRWASP, to determine joint moments and forces. With this detailed 3-D analysis of wheelchair propulsion, we will attempt to correlate joint forces and moments with injury. The specific aims of this research are to reduce the frequency, severity and duration of pain episodes in IWSCI through optimal wheelchair fitting or provision of a cushioned high-friction push rim and to reduce the normal progression of peripheral pathology which occurs in IWSCI through optimal wheelchair fitting or provision of a cushioned high-friction push rim.

Information gathered in this study may help prevent upper extremity injuries in MWUs, may significantly change the way wheelchairs are designed, and provide the means for implementing protocols to instruct how individuals are taught to propel wheelchairs.

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Chris Bar Research Forum

The motion to be debated is as follows: *This House believes pressure measurement is irrelevant to the clinical practice of preventing and managing pressure ulcers.*

Sponsored by ROHO, Inc.

Chair: Geoff Bardsley, PhD

Participants::
- David Brienza, PhD
- Martin Ferguson-Pell, PhD
- Robert Graebe
- Barbara Levy, PT, ATP
- Steven Sprigle, PhD, PT
- Geoff Taylor

Two years ago, at this Symposium, our friend and colleague Chris Bar delivered a paper titled: Ethics of Ignorance. He challenged us to ensure that practice is based on evidence. And he challenged us to admit that much of what we practice today is not. He proposed that industry partners join with traditional sources of research dollars to fund the type of clinical research needed to validate our practices in the field of seating and wheeled mobility. " A more honest admission of ignorance might mean an increase in funding for research to both develop improved methods of determining the efficacy of products through a combination of standards and clinical trials and to perform the studies thereafter".

Chris died suddenly just weeks after the ISS. In honor of his creativity in design and thought, ROHO, Inc has generously funded an annual research forum for the next five years. In the first forum we are trying to capture a bit of the roguish nature of the man and join it with a serious research question. We will follow the style of the British Parliamentary-style debate with colleagues debating two sides of a research question. It should be enlightening and humorous. Chris would have enjoyed this session.

Participation in the debate is encouraged

TEACHING CLINICAL RATIONALE FOR SEATING AND WHEELED MOBILITY PRESCRIPTION: A RANDOMIZED CONTROLLED TRIAL OF FOUR INSTRUCTIONAL METHODS

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ABSTRACT:
The appropriateness of a consumer's seating and wheeled mobility system varies considerably depending on the competence, proficiency and experience of the professionals assisting the user [1-3]. The purpose of this study was to compare the effectiveness of four educational interventions (self study, workshop, internship or combination) to determine which one is most effective in elevating the knowledge of entry-level physical and occupational therapy clinicians. Results showed no significant change in pre/posttest score in relationship to the type of intervention (p= 0.488). However, total hours of training compared to the change in pre/posttest score were found to be significant (p= .047).

BACKGROUND:
The competence, proficiency and experience of therapy professionals evaluating and prescribing wheelchairs and seating systems vary considerably [1-3]. A well-fitted seating and wheeled mobility system promotes a more functional posture, enhancing independent mobility, improving comfort and decreasing the risk of pressure sores and postural deformity [1-5]. However, the availability of physical therapists (PT's) and occupational therapists (OT's) experienced and or specially trained to provide seating and wheeled mobility prescription is limited [3, 6]. Many feel that targeted professional training will maximize the consumer/ technology match [6]. A review of the literature has not revealed any research about the most effective means to increase the level of competence and proficiency for professionals in the area of seating and wheeled mobility prescription.

In the United States, the prevalence of persons with mobility impairments is increasing due to decreasing mortality rates. [7, 8] These trends result from advances in medical science and technology, increased survival rates at birth, increased life expectancy, and aging of the U.S. population [8]. The demand for assistive technology devices and services is anticipated to continue to increase; the availability of skilled service providers will not meet this demand unless training opportunities are developed to increase the supply of skilled AT practitioners [6].

Individuals with mobility impairments have the most potential for success when there is a suitable match between their needs and the equipment features [9] of the seating and mobility technology that they use. Failure to understand the factors involved in prescribing an appropriate wheelchair and seating system may result in "technology abandonment, wasting of funding to replace poorly prescribed equipment, and the consumer being without needed equipment for longer duration." [10, 11] Providing effective educational programs to elevate the level of competency and proficiency by which professionals prescribe wheelchairs and seating systems will diminish such negative outcomes.

Health care professions can take measures to promote and protect the health, safety and welfare of the public by identifying specific competencies to delineate technology-related knowledge and skills for AT practitioners across the areas and levels of practice. [12-15] For example, in 1996, RESNA, The Rehabilitation Engineering and Assistive Technology Society of North America, instituted a credentialing program for Assistive Technology Practitioners (ATP's) and Assistive Technology Suppliers (ATP's) to identify practitioners and suppliers who have demonstrated a minimal level of competence[16]. Entry-level PT and OT clinicians should be able to identify basic assistive technologies in their practice and be knowledgeable about the many factors that are involved in obtaining appropriate assistive technology including seating and mobility systems as well as recognize the importance of referral to experts. This training should be provided through their entry-level education. Clinicians who desire to specialize in AT service provision beyond entry-level need to pursue additional advanced level technology competencies [12] through continued professional development and credentialing.

Presently, the most widely accepted means to participate in upgrading professional competence is participation in continuing education activities. However, the literature suggests that this does not guarantee competence throughout a person's career and there is sparse data to support the effectiveness of continuing education units (CEU's) in changing therapist behavior and influencing patient outcomes. [17, 18] Surprisingly, few studies have examined whether education for practicing professionals changes clinical behavior or patient outcome in any area of medical practice. [19] Systematic reviews of literature provide the best evidence on the effectiveness of various educational interventions. The choice of an intervention should be guided by the evidence on its effectiveness [20], however "without effective methods to translate important findings into changes in clinical practice, potential benefits for patients will not be realized and research resources on clinical interventions will not be optimized." [21] The purpose of this study was to determine which educational intervention (self study materials, workshop, internship or combination) would best elevate the level of expertise of the entry-level clinician, in the prescription of seating and wheeled mobility systems. The results can help guide the future training of assistive technology (AT) professionals.

METHODS:

Second year masters and senior level bachelors PT and OT students from three universities were invited to participate in this study to receive supplemental specialized training for prescribing wheelchairs and seating systems. 37 students volunteered and 20 students were randomly selected (10 each PT and OT). The students were randomized into one of four training groups utilizing a stratified randomization process to equally distribute PT and OT students with equal representation from the three universities. The training groups were as follows: 1) self study (written materials and videos, approximately 15 hours to complete); 2) self study and attendance in an eight-hour workshop; 3) self study, attendance in an eight-hour workshop and two days of small group observation in a wheelchair service delivery program; and 4) self study and two days of small group observation in a wheelchair service delivery program. All subjects gave written informed consent prior to participating.

All subjects received an extensive self-study program consisting of a videotape [22, 23], two books [4, 24] and a training manual. The training manual consisted of a compilation of book sections [5, 25], decision matrix [26], and a sample evaluation form. The subjects were provided with learning objectives, directions, assignments and exercises to work through the self-study program. It was estimated to take 15 hours to complete the self-study program.

The 8-hour workshop included presentations in mat evaluation, common seating problems, equipment features (seats, backs, manual and power wheelchairs), and funding. The workshop included participatory lab sessions for the mat assessment and measurement section and case studies and problem solving.

The subjects assigned to the clinical internship group participated in a small group (4-6 students) orientation and observation in the Center for Assistive Technology seating clinic. The subjects were oriented to the clinic procedures, provided with clinic evaluation and intake forms, and sample guidelines for preparing an AT evaluation report. The small group was split up into subgroups and assigned to a clinical instructor. Clinic evaluations and fittings were observed over a two-day period. The subjects were given an assignment to complete a client evaluation and intake form and prepare an AT evaluation report. The students were provided feedback on their report on the second internship day.

A pretest was administered prior to subject group assignment. The pretest consisted of viewing a videotaped seating and wheeled mobility evaluation and completing an assessment form. The subjects were asked to identify the problems, goals, and recommendations for the client presented [1, 25, 27]. Upon completion of the study intervention, the subjects completed a posttest utilizing the same procedure.

The following pretest/posttest grading system was developed. A list of common seating and mobility problems, goals and equipment features was created by polling a group of "expert" clinicians. This list was used as a checklist to transfer the data from the subjects test sheets. The checklist sheet was then compared to a "gold standard" answer key of potential "correct" answers for each client example, created by two expert clinicians. A score for each subject was tallied to include a total for all correct, incorrect and missing responses.

The scoring system was tested for interrater and intrarater reliability and was highly correlated ($r2 > 0.70$) with $p<0.05$. Two independent scorers blinded to group assignment graded all pretests and posttests. Significance level was set at 0.05. Pre and posttest scores were first compared using a paired t-test. Then, change scores were created by subtracting posttest scores from pretest scores.

Analysis of variance (ANOVA) was used to determine if any significant differences existed between the four groups and the change scores. To determine if there was a relationship between hours spent in study versus change in score, correlations were completed.

RESULTS:
The twenty subjects had a median age of 24.5 with a range from 22-48 years. 85% of the subjects were female and 15% were male. There was no significant difference between groups with respect to age, gender, discipline and university.
Since the interrater scores were highly correlated the average of the two scorers was calculated and used to determine the difference between the pre and posttests resulting in a change in the grand total (cgt). The results showed no significant difference ($p= 0.488$) in cgt between training groups.
The total number of hours of training was significantly related to change in test score ($r2=0.612$). As the number of hours increases the change in correct grand total score between the pre and posttest is improved. Hours of training were significant ($p= 0.047$) between the four groups, with group three having the highest average of hours (24.6 (4.8).

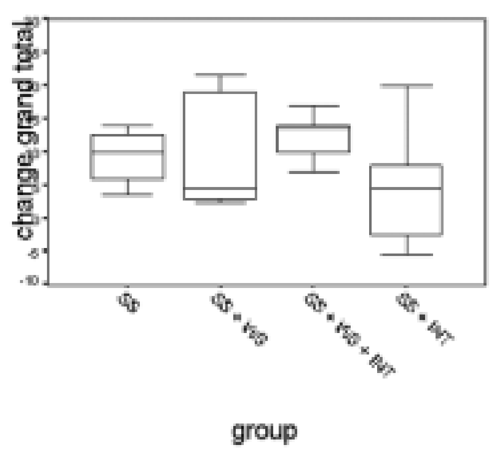

Figure 1. Mean change in grand total score between pre/posttest score for four educational intervention groups. SS=self-study, WS= workshop, INT= internship

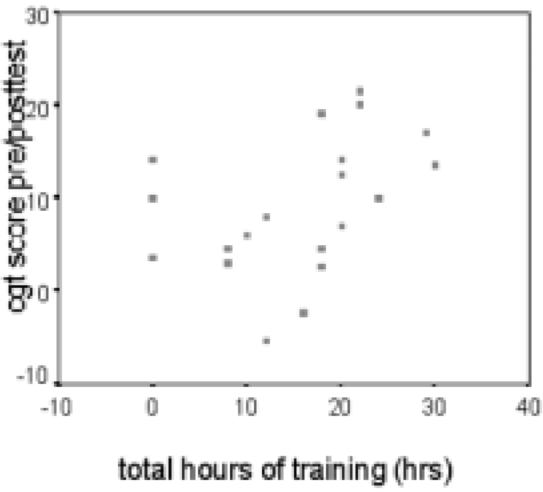

Figure 2. Change in grand total score between pre/posttest scores in relationship to total hours of training

DISCUSSION:

This study examined the relationship between the type of educational intervention and the wheelchair seating and mobility prescription of entry-level PT and OT clinicians. The quality of the prescription was calculated by taking the difference between the pre and post-tests scores of two sample patient evaluations.

Results from this pilot study suggest that the type of intervention may not be as influential on impacting the quality of wheelchair seating and mobility prescription as the total hours of education. These results should be interpreted cautiously as the length of each educational intervention (weeks for self study, hours of workshop, and length of internship) may not have been adequate to demonstrate a difference between interventions and the sample size was small. The development of a scoring system to interpret the pre/posttest scores was found to correlate for two independent scorers. In the future this scoring system may be applicable to other studies testing educational interventions related to assistive technology.

Future studies will be needed to determine if in fact educational interventions impact on the quality of wheelchair seating and mobility services to the consumer.

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Teaching seating and wheeled mobility prescription

Quantification of Forces Associated with Full Body Extensor Thrust in Children

Dalthea Brown, MS, PT, ATP; Andrew P. Zeltwanger, B.S.; Gina Bertocci, Ph.D., P.E.

ABSTRACT
Wheelchair users with muscle spasticity manifesting in extensor thrust events are at risk for injury and damage to their seating system. To reduce these risks, a dynamic seating system that adjusts to allow dynamic movement throughout an extensor thrust event, while still supporting the patient, has been proposed. This study was designed to investigate the characteristics of episodic extensor spasticity in terms of peak seatback force and force-time history. The goal of this study was to input the force-time history into a computer model of a dynamic seating system. This information is needed to guide the design of dynamic wheelchair seating systems.

BACKGROUND
Children with Cerebral Palsy with abnormal muscle tone presenting as full body extensor spasticity have unique challenges in maintaining a functional seated posture in their wheelchairs. The strong, persistent and often sudden increase in extensor tone has the potential to result in abnormal posturing and thrusting out of the desired position.

Effects such as 1) loss of optimal body alignment resulting in the need to be repositioned; 2) discomfort to the sitter; 3) bruising of body parts from broken or poorly fitting components; and 4) equipment breakage have been observed to occur after intermittent extension episodes.

The concern of seating specialists is to attain and maintain the client's seated posture. Extensor thrusting is managed is to prevent the extension pattern from developing. The control of the pelvis becomes a crucial factor in this endeavor. A properly fitted wheeled mobility device is the first line of defense. If the pelvis is still able to migrate forward, stabilization is attempted through pelvic positioning devices, modifying the support surface, the use of lower extremity positioning aides and/or therapeutic inhibition techniques. For a small few, extensor thrusting continues to interfere with the ability to maintain a seated position. Many caregivers have given in to the apparent need to extend and are utilizing an alternative seating system that is more forgiving of the sitters extension movements. Seating devices such as the Floorsitter and Carrie Seat by Tumbleforms are the devices of choice by some.

Clinicians and manufacturers are beginning to modify standard wheelchairs on a case-by-case basis using springs or shock absorbers to permit limited movement in the seating system [1,2,3]. However, there is currently no documentation examining movement as a feasible approach for individuals exhibiting extensor thrusting. While traditional therapeutic principles have dictated that preventing movement is the cornerstone for treatment, some benefit has been seen with individuals provided with modified chairs allowing some movement [1,2,3].

RESEARCH QUESTION
Our long-term goal is to study the interaction of wheelchair users exhibiting extensor thrust and dynamic seating systems. To accomplish this task, an instrumented laboratory dynamic seating system will be developed. Computer modeling can aid in the selection of components and can predict the response of the dynamic seating system to individuals having extensor thrust events when utilizing the system. This study focused on examining the force response of extensor thrust in a select population and the development of a computer model of dynamic seating.

The goal of this study was to use the computer model to select the design specifications for the resistive elements that will control the seatback in the instrumented laboratory system.

METHOD

To select appropriate resistive elements to allow for seat back rotation, clinical data was obtained from individuals with a history of extensor thrust events. Subjects were seated in their current seating systems with a Force Sensing Array (FSA) secured to the seatback (Figure 1). FSA data was collected as the subjects were exposed to various auditory and visual stimuli to elicit an extensor thrust. The magnitude and location of the pressure on the seatback was recorded with the FSA mat throughout the duration of testing, which was approximately 30 minutes.

Fig. 1 - Subject with FSA mat

The dimensions of a LaBac manual recliner wheelchair (Figure2) were used to develop the computer model (Figure 3) utilizing Working Model 3D. The sliding elements and brake system of the chair were replaced in the model with a spring-damper element, which allowed the seatback to open as the subject extended against it. The magnitude and location of the force recorded in the experimental trials were entered as input to the model. The values of the spring and damping constant were incrementally varied to determine the seat back response. Seatback opening angle, resistive element tension, and resistive element length were calculated and displayed (Figure 4) by the model for each spring-damper combination tested.

RESULTS

There was a minimal reaction of the subjects to three pre-recorded sound burst intended to facilitate full-body extension. Table 1 shows subject demographics and the force (lbs) and torque (ft-lbs) each produced. Peak total forces for the group ranged from 18.9 to 236.1lbs. with a mean of 92.3 ± 61.5 lbs. Peak torque values were calculated as the product of the maximum vertical centers of pressure (COP_v) times the peak force. Peak torque ranged from 13.9 ft-pounds to 227.0 ft-pounds with a mean of 80.4 ± 58.9 ft-lbs. The COP_v ranged from 7.9 inches to 19.7 inches above level of the seat with a mean of 14.6 ± 2.8 inches.

Figure 2 - LaBac Reclining Wheelchair to be modified as a dynamic seating system

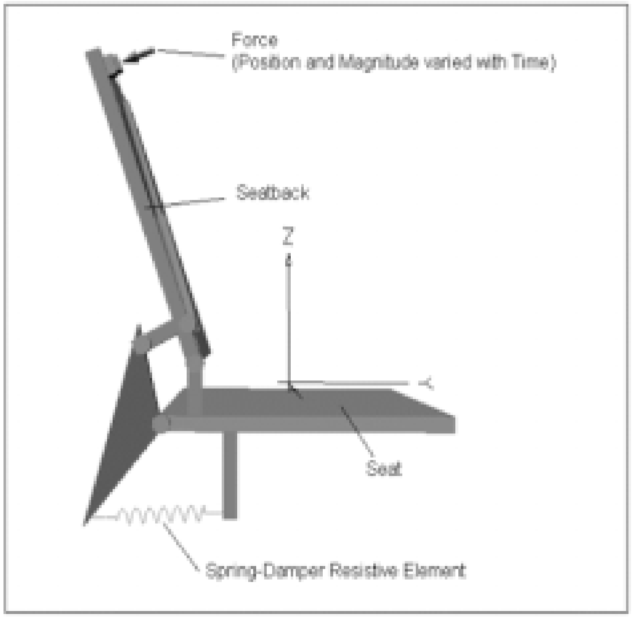

Figure 3 - Rigid-body Dynamic Model

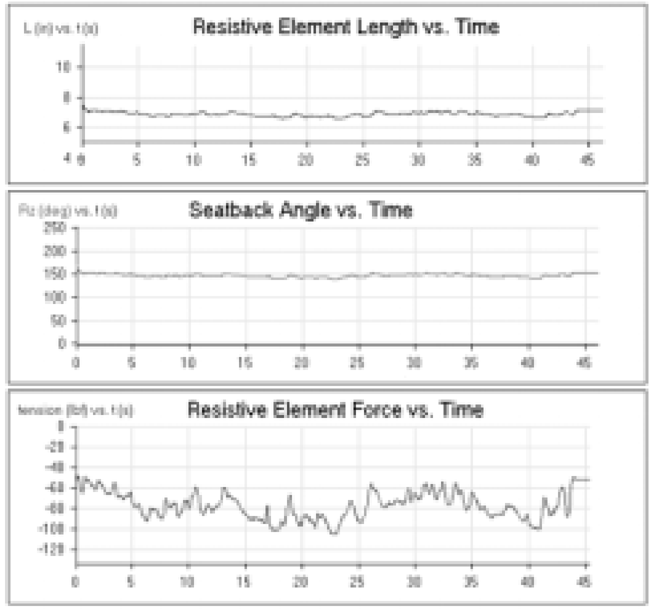

Figure 4 - Sample Model Output Describing Resistive Elements and Seatback Response

Subjects	Diagnosis	Age (years)	Gender	Weight (lbs.)	Back height (in)	Peak Force (lbs)	Peak COP_v (in)	Peak Torque (ft-lbs)
1	Glutaric Aciduria	15	M	33.8	17.5	133.1	19.7	119.8
2	Cerebral Palsy	7	M	52.4	17.0	158.6	8.0	89.4
3	Cerebral Palsy	11	M	64.9	16.5	85.4	12.4	73.2
4	Lesch-Nyhan	13	M	51.0	16	236.1	15.8	181.6
5	Cerebral Palsy	11	F	59.0	19.5	142.4	17.4	133.7
6	Cerebral Palsy	8	F	42.4	17.25	94.9	18.5	93.5
7	Cerebral Palsy	16	F	92.0	20.5	187.9	15.9	227.0
8	Cerebral Palsy	11	F	61.6	18	34.4	10.6	28.2
9	Cerebral Palsy	9	F	49.7	17.5	58.8	13.2	40.9
10	Cerebral Palsy	12	F	52.2	17	29.1	15.4	13.9
11	Cerebral Palsy	9	M	50.1	15	75.6	14.5	75.1
12	Cerebral Palsy	9	M	50.8	16	47.3	14.3	44.7
13	Cerebral Palsy	12	F	53.7	17	60.8	12.5	39.8
14	Cerebral Palsy	10	F	76.1	17.5	77.1	17.1	106.4
15	Lesch-Nyhan	7	M	36.9	13.5	45.9	13.5	31.7
16	Cerebral Palsy	14	M	74.0	18.5	142.9	13.5	106.7
17	Cerebral Palsy	11	M	513	17.5	18.9	15.9	16.5
18	Cerebral Palsy	5	M	43.0	11.5	31.3	15.3	25.9
Group Mean		10.5 ± 2.6		53.3 ± 14.0	16.8 ± 2.0	92.3 ± 61.5	14.6± 2.8	80.4 ± 58.9

Table 1 - Subject demographics with peak force and peak torque data

Two key specifications where determined from the use of the model:

1. The compressed length of the spring element was determined to be 3.5 inches, which limits the seatback-opening angle to 150 deg. from horizontal. This was done to avoid the possibility of increasing extensor muscle activity upon reclining the subjects [4].

2. Spring-damper resistive elements are typically characterized by the force needed for full compression or extension. By varying resistive coefficients within the model, we determined the range of forces the element would be exposed to while limiting the seatback to a rotation of no greater than 150 deg. The range of forces was 115 to 1200 lbs, depending on the subject.

DISCUSSION

Force and torque values showed tremendous variability within and between subjects. The maximum pressure that each sensor of the FSA mat can accurately measure is 200 mmHg, which is approximately 4.7 pounds per sensor producing a ceiling effect for 14 of the 18 subjects; a major limiting factor of this study. Over a one-half hour period of time, the number of sensors that registered this false peak ranged from less than 0.1% to 98%. Of the remaining 4 subjects unaffected by the false ceiling, 2 reached a maximum of 4.6 pounds per sensor and 1 each peaked at 4.2 and 3.6 pounds per sensor. The number of sensors registering at peak values among these 4 subjects ranged from less than 0.1% to 0.5%.

Another problem encountered was that the size of the mat was larger than the seat back panels of the seating systems. This set-up permitted movement of the mat, potentially effecting the location of the center of pressure. A third factor to be considered was that it was assumed that by using a loud sound, an auditory startle could progress into an extension event however, this was not true in many cases. It is believed that one possible reason why subjects did not respond to the stimulus was that it was not loud enough. Koch [5] stated that an auditory startle is elicited at greater than 80 decibel (dB) sound pressure level (SPL). The SPL of the facilitating stimulus in this study was not measured but the recorded air horn blast is estimated at much less than 80 dB.

The use of a computer modeling and simulation program allowed a wide variety of design variables to be investigated without the expense of physically building and testing each different scenario. By applying the model, the spring-damping elements and torque sensor ranges were specified for the next phase of development and testing. Resistive elements and sensors have been purchased and adapted to the LaBac Reclining Wheelchair (Fig. 2) to develop our dynamic seating system. Future studies will further define design criteria for dynamic seating systems.

CONCLUSION

This study illustrates the effectiveness of computer simulation as a tool to model the Human - Assistive Technology interface. An instrumented laboratory dynamic seating system is under development to test the response of wheelchair users who exhibit extensor thrust events to dynamic support in a controlled setting. The dynamic seating system will be a modification of a LaBac Manual Reclining Wheelchair (Figure 2). The LaBac Reclining Wheelchair requires an attendant to release the brakes unlocking the seatback to move the seatback from an upright to a reclined position, and return upright. The modifications of the dynamic seating system will remove the need for an outside party and allow the seatback angle to change in response to the user.

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What Consumers Contribute to Wheelchair Selection: The Results of a Study

Mary Ellen Buning, MS, OTR/L, ATP

Statement of the problem

The 1.4 million Americans of all ages (Jones & Sanford, 1996) who use manual and powered mobility devices (Krause, Stoddard, & Gilmartin, 1996) rely on mobility devices for independence in the activities of their every day lives. Consumers who are full time users of wheelchairs replace their wheelchairs every 3 to 5 years (Cooper et al., 1997). These numbers lead to a conservative estimate that 200,000 wheelchairs are purchased each year. It follows that information to support decision-making in the selection of mobility devices would be needed periodically by wheelchair users. Each replacement event is an opportunity to reassess ones mobility needs and to reconsider the match between daily living realities and a mobility device. It is important to maximize the outcomes of these events with the best decision-making strategies and resources. While a partnership with an educated and informed assistive technology supplier or provider who can provide expert advice is optimal, many individuals live in parts of the US where this expertise is lacking or available only at a great distance.

The Internet when used in homes, workplaces and in community libraries, etc., is being used to search for and locate information to assist in making informed decisions. Recently, quality information on wheelchair technology, products and services, and wheelchair selection has also become available on the Internet (Buning, 2000; Silverman & Bergen, 2000). Data collected during routine. A survey completed by the Disability Statistics Center (Kaye, 2000) suggests that only 25% of people with disabilities use the Internet. However, the disability definition used in this survey excluded persons with disabilities who are employed therefore this estimate seems too conservative. Persons with mobility impairments who have achieved educational and employment goals appear to use the Internet to the same extent as the general population (Schmalzer, 1997). It seems intuitive that a person with a mobility impairment, given a computer adapted to meet his or her input and output needs, may experience even *greater* benefits from Internet use than a typical user. Travel obstacles are eliminated, bad weather and inaccessible buildings circumvented, and easy access to formal and informal education, employment, social interaction, shopping, and entertainment are created.

The interest in and the extent of the participation of consumers in the wheelchair selection process are not currently known nor is there research that substantiates their use of the Internet as a source of information to prepare for decision-making or selection. Following the development of a comprehensive website, WheelchairNet.org, a study was designed to determine whether consumer readiness to participate in decision-making could be affected by use of this comprehensive website.

Hypothesis

Several hypotheses were developed for this study. First, participants in the experimental group with access to enhanced WWW resources will have increased scores on all study measures on locus of control, life goals, self-assessed wheeled mobility device knowledge, desire for device characteristics, and readiness to participate in decision-making. Second, national participants are not significantly different from participants in the Pittsburgh area with its known geography, climate, and range of rehabilitation and mobility device-related services. Third, consumers will rate WheelchairNet as a helpful source of information.

Method

Several instruments were developed for the study. A demographic questionnaire was developed to collect data on participant's education, years of wheelchair use, prior wheelchair selection experience, accessibility of living environments, attitudes and adaptive behaviors. Additionally, three other surveys were developed to the measure variables assumed to influence consumer participation in wheelchair decision-making, i.e., clarity of personal goals, attitude toward decision-making and knowledge about wheelchairs. Validity and reliability of these instruments was assessed and reported (Buning, In review). Additionally, the Multidimensional Health Locus of Control (Wallston & Wallston, 1978) was used to assess attitudes of personal responsibility for health in the population sampled.

The study sample was comprised of Internet-using, community living persons 18 and older with static impairments that required them to use wheelchairs as a primary means of mobility. In order to use the natural motivation of participants it was required that their current wheelchair be older than three years. To control the influence of other sources of information pertaining to wheelchair selection they were also required to have not begun any actions related to replacing this wheelchair. Participants were required to use the WWW weekly and regularly communicate through email. Recruitment occurred by means of notices on electronic bulletin boards, listserves, and "electronic" word of mouth from informal networks of professionals and consumers. All recruitment notices guided potential participants to a study website containing complete information about the study and downloadable study documents. Those who were interested and felt they qualified to participate supplied contact information to the investigator through a form on the website. A telephone interview ensued to guarantee that participants were eligible and understood study expectations. Additionally, participants were asked to substantiate their wheelchair use by giving their permission for the investigator to contact their health care provider and obtain signed verification. Following receipt of the signed consent form (downloaded from the website), participants were randomized to experimental or control groups.

All questionnaires were completed on the study website using Lasso as an interactive interface with a FileMaker Pro 5 database designed to capture survey responses. Most communication with participants was by personalized email messages automatically generated to advise them about study phases completed and their next actions. Following completion of the pretest questionnaires, participants randomized to the experimental group were given access to a clone of WheelchairNet. Through use of a login ID and password each of their visits and their activities during each visit to this site were recorded.

The control group after completing the pretest was asked to use the Internet in usual ways without purposely researching wheelchair-related topics. They were promised complete access to an information-rich website following their completion of posttest questionnaires. Both experimental and control groups were given the post-test 6 weeks after pretest completion.

A sample size of 70 was identified as sufficient to determine a medium effect size with statistical power of .80 (Cohen, 1988). Efforts were made to recruit equivalent sized samples of participants from both the Pittsburgh area with its known geography, climate, and range of rehabilitation and mobility device-related services and from all other regions of the United States. In reality it was very difficult to recruit participants in this region. Only 20 participants from this region were recruited and randomized.

Analysis

A full descriptive analysis of the data contained in the demographic questionnaire will be used to fully understand the sample's history with wheelchair selection and their satisfaction with current wheelchair and the selection process used to obtain it. Additionally, their attitudes toward their impairment, accessibility, and their expectations for their wheelchair's performance will also be studied.

An analysis of covariance, using the pretest as the covariate, will be used to compare the performance of experimental and control groups on the three of the questionnaires administered pre and post. A chi-square analysis will determine if the access to information and interactions on WheelchairNet significantly affected consumer knowledge and confidence related to the decision-making process. A qualitative analysis of participant's life goals will be completed using NUD*IST (Richards, 1998) to identify common mobility goals and daily living themes.

Anticipated results and discussion
Since the period of data collection was extended, actual results from the study were not available for publication in these proceedings. This information will be provided at the time of the presentation and, following the conference, formal results regarding the impact of WheelchairNet on Consumer Decision-Making will be published in peer reviewed journals.

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Back Support Options: Functional Outcomes in SCI

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Introduction & Rationale: For the person with spinal cord injury (SCI), the wheelchair and seating system provide mobility, pressure relief, postural support and comfort. Part of this system, the back support, influences sitting comfort, postural alignment, buttock pressure and functional abilities. For portability, the standard sling back upholstery has been the choice of most wheelchair manufacturers however, there are distinct disadvantages. The material stretches, there is limited adjustability of the back, and this often results in a postural position that is less than optimal. In addition to these static components, the nature of the seat and back can affect the wheelchair user's ability to propel themselves on varied surfaces, up and down inclines and over obstacles such as curbs. Alternatives to the upholstered sling back include the Jay• J2 back and the PinDot•PaxBac™. Despite a lack of published scientific evidence, manufacturers of these seating options claim multiple benefits such as protection against spinal deformities, pressure sores and discomfort as well as improved function and appearance. Because of the cost of wheelchair components, clinicians and their clients need to make informed choices when selecting the most appropriate wheelchair and seating options.

Purpose: The purpose of this study is to compare, from a clinical perspective, the functional outcomes for individuals with a recent spinal cord injury when using a wheelchair with the traditional sling back and the manufactured J2 and PaxBac™ back supports.

Subjects and Methods: A total of 28 individuals with a SCI less than 2 years duration who use a wheelchair as their primary method of mobility. To date, 21 individuals have completed the study evaluations. In this patient as their own control design, a randomized crossover method is used to determine the order of testing of the back support alternatives. To determine adjustments and increase familiarity the participants undergo a "trial" period of one to three days prior to testing. Four functional activities are then evaluated: timed forward wheeling, measurement of maximum forward vertical reach, timed ramp ascent, and maximum distance in one push on a carpeted surface. As these assessments were designed for this study, test-retest and inter-rater reliability was determined prior to commencement of the study ($r = .99$). As an additional outcome, participants answer a satisfaction questionnaire to assess comfort, appearance, ease of use, and overall function after completing the tests with all three back support alternatives. The total possible score is 20.

Results: The 21 participants, all with a level of injury above T10 (14 cervical, 7 thoracic), range in age from 17 to 71 years (mean = 30.3). The time since injury ranges from 1 month to 13 months (mean = 3 months). The J2 facilitates the furthest reach when compared to the sling upholstery ($p < .05$). The PaxBac also promotes further reach than the sling upholstery but the results are not statistically significant. The differences between the back supports for the ramp ascent activity approach significance ($p = .06$) with the fastest time associated with use of sling upholstery. The results for the timed forward wheeling and the push on carpet activities are not statistically significant and the descriptive scores are essentially the same. The satisfaction questionnaire results indicate there is an overall preference for the J2 ($p < .05$). The individual item analysis for the questionnaire shows that the J2 has significantly higher scores for the items relating to comfort and appearance ($p < .01$). Although not statistically significant, the J2 also scored higher for overall function and the sling upholstery scored highest for ease of use. Interestingly, more of the participants would chose the J2, even if they were required to pay for it on their own.

Conclusions: The increased lumbar support and enhanced anterior pelvic tilt provided by the J2 and PaxBac appears to facilitate forward reaching. It seems that the positioning facilitated by the back supports does not affect the ability to perform timed forward wheeling. It is unclear how positioning affects the strength test of the one stroke push since the participants demonstrated almost identical performance regardless of back support used. If the positioning is the key element, it would be expected that the J2 and PaxBac would provide similar results. The fastest times for ramp ascent when using the sling upholstery may be indicative of a “wrap around” effect providing security for the participants while performing this activity. It is unlikely that practice effects significantly influenced the results since the order of back support use was random. As indicated by both the objective scores and the subjective comments, the preference for the J2 reflects satisfaction with comfort as well as a feeling of support and security. As we continue to collect data until the final sample size is achieved and power is improved, we expect that we may find some other significant results. However, this study does provide information on clinically feasible tests that may help the equipment decision process.

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Seventeenth International Seating Symposium

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A Study On The Relationship Between Buttock-Seat Cushion Interface Pressure And Pressure Ulcer Incidence In At-Risk Elderly Wheelchair Users

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Although interface pressure is the most common parameter used for comparing support surface performance, the relationship between interface pressure and pressure ulcer (PU) incidence has not been adequately studied. As a secondary analysis of data from a randomized clincal trial, we studie the relationship between interface pressure measurements and pressure ulcer incidence.

Thirty-two subjects (male and female) were recruited from two skilled nursing facilities. Criteria for inclusion were: 65 years of age or older; Braden Score of 18 or less with a combined activity/ mobility sub-scale score of 5 or less; a mobility impairment requiring the use of a wheelchair for 6 or more hours per day; free of existing sitting-surface pressure ulcers; and could be accommodated by the study wheelchair, including a body weight of 250 pounds or less.

Subjects were randomized into generic Foam or pressure-reducing (PRC) seat cushion groups. All subjects received a seating assessment, including an individually prescribed, highly adjustable wheelchair. Re-assessments and modifications were made to the seating systems as needed throughout the study. The subjects assigned to the Foam group received a generic, three-inch, convoluted foam cushion fitted with an incontinence cover and solid seat insert. The subjects assigned to the PRC group received a cushion based on individual seating needs and interface pressure mapping. The pressure-reducing cushions were commercial cushions designed specifically to improve tissue tolerance in sitting by providing more surface area and/or reducing peak pressures over bony prominences of the sitting surface. If the pressure-reducing cushion did not include a solid seat insert of incontinence cover, they were provided.

Weekly skin and risk assessments were performed by research staff simultaneously with the completion of the Braden Scale from the time of enrollment in the study until the subject reached an endpoint defined as: first incidence of a pressure ulcer, discharge from the facility, voluntary withdrawal from the study, death or study end-date. The National Pressure Ulcer Advisory Panel definition of a pressure ulcer and skin reaction classification system were used. Lesions occurring on any aspect of the sitting surface, not just over bony prominences, were documented as sitting-acquired pressure ulcers. Exceptions to the required six-hour sitting time were documented weekly. Interface pressures were recorded for all subjects during the initial seating assessment, after a one-week re-assessment and as needed following modifications to the seating system.

Of the 32 subjects that were eligible for the study, 17 were randomized to standard foam cushions and 15 were randomized to pressure-reducing cushions. Excluding death, discharge and transfer, there were 14 and 11 in the Foam and PRC groups, respectively, who reached the endpoints of either a pressure ulcer or end of the study period. No significant differences were found between the groups for the primary outcomes of pressure ulcer incidence, initial peak interface pressure and total days to endpoint (with or without inclusion of death and discharge/transfers). Failure to reach statistical significance was expected due to the small sample size and low statistical power (0.21) of the pilot study.

Significant differences were found between the groups for sitting-time variances ($p<0.05$). The Foam group failed to meet the required minimum sitting-time of six hours per day more frequently than the PRC group. Additionally, the clinical determination of postural asymmetries ($p<.001$) and peak interface pressure measurement ($p<.05$) were both significantly more predictive of pressure ulcer site for the Foam group than for the PRC group; indicating the inability of the foam cushions to support or reduce deformities. A significant difference also existed between the groups in terms of pressure ulcer location ($p<.005$). No ischial ulcers occurred in the PRC group; indicating that pressure-reducing cushions were more effective in preventing these ulcers. Ischial ulcers are considered to be the primary sitting-acquired ulcers. No difference was found between the groups for the ratio of total days subjects were rated as at-risk (<18 Braden Score) to total study days.

Pressure ulcers developed in 16 of 32 subjects in this study. This rate exceeded our expectations based on more recent estimates of sitting-acquired pressure ulcers. The incidence of pressure ulcers in the Foam group was 10/17 (59%). Three hundred subjects (150 per group) is the approximate sample size that would be needed in the multi-center study using the same broad definition of a sitting-acquired pressure ulcer as used in the pilot study. The broad definition was used to prevent the loss of clinically relevant data necessary to project an adequate sample size for the full-scale clinical trial. However, since our results indicated appropriate use of more restrictive definitions of “sitting-acquired pressure ulcers” such as 1) exclusion of all shear injuries or 2) exclusion of all shear and non-ischial lesions, we would expect to have lower incidence rates. Using the most restrictive definition, a sample size of 100-200 (50 to 100 per group) may be projected.

Data analyses of the pressure ulcer and no pressure ulcer groups were also performed. Interface pressure measured on wheelchair seat cushions was higher ($p\leq0.01$ for both peak pressure and average of highest four pressures) for patients who developed pressure ulcers. Therefore, higher interface pressures were associated with a higher incidence of pressure ulcers in this study; supporting the use of pressure measurements as an aid in determining pressure ulcer risk. No significant group differences ($p>0.05$) were demonstrated for initial Braden Scores, sitting-time variances, or ratios of days at-risk to total days.

Function and Performance of the Rocket Multi-directional Powered Wheelchair

Geoff Fernie PhD PEng, Gerry Griggs, Pam Holliday PT MSc, Mauro Pacitto BASc, Phil Wilcox OCAD

Introduction

The objective of this presentation is to provide insight into the design process that was used in developing the multi-directional powered wheelchair known as the Rocket™. Typically, innovative design is accomplished by an iterative process. A need is identified and some brainstorming process results in a concept that might be able to meet that need. Usually a series of prototypes are built beginning with very simple models and working upward to fully-functioning pre-production units. Each prototype is evaluated against the needs, preferably including exposure to consumers.

The process is characterized by a sequence of partial successes and failures. Inevitably, design decisions must be made that involve compromise. Typical compromises involve balancing performance against cost or complexity, or some aspect of performance against another aspect of performance (e.g. indoor manoeuverability versus outdoor performance). We believe that there is as much to be learned from the reporting of the ideas that were abandoned as from those that were pursued.

Outline of the Presentation

1 Need for combination of indoor and outdoor features
2 Discussion of manoeuverability requirement
3 Selection of mechanism to achieve multi-directional movement
4 Selection of control algorithm
5 Discussion of requirements for outdoor performance
6 Selection of configuration and suspension s ystem

1 Need for combination of indoor & outdoor features

Early in the project, consumers told us that they would not be able to afford the cost of two powered chairs. The option of providing one that was optimized solely for indoor use was therefore rejected. In addition to the problem of cost, there is frequently a significant amount of effort required to transfer between two chairs and the situation where travel outdoors is required to reach a different indoor destination could not be met easily with two separate chairs.

2 Discussion of manoeuverability requirement

2.1 Spinning 360° within the smallest possible diameter circle

Accessibility codes specify a 5' diameter turning circle. Architectural drawings of living and working environments show these 5' circles in each of the rooms. If this could be reduced to a 4' diameter circle, then the area of the circle would be reduced by 36%. The most easily understood and least ambiguous method of reporting turning radius is to visualize placing the wheelchair with its rider inside a cylindrical wall and determining the smallest diameter of this cylinder that will still allow the chair to rotate through 360°. By this definition, it is clear that in order to achieve the smallest turning radius the chair should spin about the geometric center of the chair and rider combination.

2.2 Passing through narrow doorways

Section 93 of the ANSI/RESNA standard requires that wheelchairs that are primarily intended for indoor use should not exceed an overall width of 700 mm (approximately 27.5"). The Canadian Barrier-Free Code (CSA-B651-00) states that the minimum clear opening of doorways shall be 810 mm (approximately 32") when the door is open at 90°. However, much narrower doorways are often encountered in people's homes, especially to the bathroom

2.3 Lateral approach to objects where a frontal approach is not possible

Functional objectives often include getting as close as possible to targets such as banking machines, sinks, refrigerators, cupboards and wall phones where there is no toe room for a frontal approach. If there is sufficient space, there is no problem since any chair can be driven parallel to the surface and positioned close. However, space is usually restricted and the situation is analogous to attempting to park a car close to the curb between two other cars. Drivers quickly learn that it is necessary to back into the space. This is rather awkward but is a manoeuver that is necessary for wheelchairs that have their steering wheels (swivel castors) at the front. Front wheel drive chairs, with their steerable wheels (swivels) at the back, have the advantage of being able to do this in the forwards directions. But all vehicles need to have a space longer than the vehicle itself. The smaller the space, then the larger the number of shunting moves that will be needed to position close to the curb and then to exit. Since this is such a common situation, it was decided that there is a need to be able to move sideways.

2.4 Negotiating tight corners in restricted pathways

Two common errors are made when attempting to execute a manoeuver around a tight corner in a very restricted space. In the first, the approach is too close to the inside corner. This is particularly a problem with rear wheel drive chairs. The situation is reached where there is no room to continue turning without hitting the inside corner. If the approach is too wide, the chair may not be able to turn sufficiently because the back corner will hit the outside wall. This is particularly a problem with front wheel drive chairs. Both problems are experienced to some degree when driving mid-wheel drive chairs. A brief sideways movement, away from the inside corner or away from the outside wall will resolve this situation.

3 Selection of a Method to Implement Multi-directional Movement

Option 1: One central steerable wheel with outer swivel castors
This option was rejected because of unstable steering. Small changes in the resistance of the stabilizing wheels (e.g. contacting an obstruction) cause abrupt changes in steering direction because the single wheel has almost only point contact with the ground and cannot exert a significant steering moment to keep the wheelchair on its original course.

Option 2: Three or more steerable wheels (at least two usually being driven)
The use of three or more steerable wheels is potentially a workable solution, but needs some form of hardware or software linkage so that the wheels steer appropriately together. It also, typically, needs a motor to control the steering, in addition to drive motors. This option was rejected because of a tendency to be more complex and costly.

Option 3: Compound wheels which can provide both forward and sideways motion
The various designs of compound wheels tend to have poor obstacle and soft ground performance. This option was rejected because of the need for combining indoor manoeuverability with outdoor performance.

Option 4: Two central driven wheels on a steerable axis with outer swivel castors
This option involves mounting the usual pair of wheelchair drive motors on an axis that is connected to the body of the wheelchair by a vertical shaft. This shaft can be locked or can be allowed to rotate freely about a vertical axis. If it is locked, then the chair will behave similarly to any other powered chair and will steer by varying the speeds of the two motors. If the vertical shaft is unlocked and is allowed to rotate, then the two motors can be used to rotate the drive "tractor" alone instead of spinning the whole chair. It can then be locked in the new position and the chair can be driven with steering along this new vector. This option was selected because of its simplicity. Only the two drive motors are required. All that is required is the method of locking the vertical shaft at the chosen angles.

4 Selection of control algorithm

The first control strategy defined two modes "transition" and "reaching". When in "reaching" mode, movements of the joystick caused the chair to rotate clockwise and anti-clockwise and to raise and lower. When in the "transition" mode, the joystick would first be moved to its full extent in the desired direction of travel and then released. The tractor would move to align with this direction, such that the subsequent movement of the joystick would cause the chair to move along that axis and to steer as it moved. Various other control strategies were considered, including providing an additional degree of freedom to the joystick so that twisting the stick would cause rotation; whereas, displacement of the joystick would result in vector movements.

Tests with these early prototypes resulted in the observation that users found it really only necessary and much easier to just move in the forwards and sideways directions, since all of their maneuvers could be achieved by a combination of these moves with steering. The most successful strategy was found to consist of a mode switch which selected either forwards or sideways driving. When the switch is pressed, the control computer takes over and causes the realignment of the tractor. Users found it easier if the axes of the joystick were automatically rotated through 90^0 when the mode changed between forwards and sideways. Thus, when in sideways mode, pushing the joystick to one side results in straight line movement in the direction of the joystick. Moving the joystick upwards or downwards causes the chair to steer in the usual manner to the left and the right to that vector.

5 Discussion of requirements for outdoor performance

In considering what outdoor performance would be required, the following were addressed:

- Ramps are considered to be the way of increasing accessibility to level changes for wheelchair users. North American cities are increasingly incorporating curb cuts. It was determined that the chair must be capable of ramps of at least 10^0 and, preferably, 15^0 with care.

- Curbs. A brief survey was conducted of curb heights in the greater Toronto area. The average curb height was found to be 5.3" and the average distance that would be saved by being able to traverse up or down this curb height would be 72 feet with typical timesaving of 15 seconds. Of the 100 curbs that were measured, 44% were at or below 4.5" and 73% at or below 5.5".

- Stairs or Flights of Outside Steps. Various attempts have been made to design powered wheelchairs that will safely and independently accomplish flights of steps. To date, all of them have been very complex and expensive. The general view has been that it is easier to avoid stairs. Perhaps that will change in our future design, but the decision was made not to attempt this task with this product.

- It was decided that the chair should at least be able to travel on soft grass without becoming stuck. The ability to travel through soft sand and mud, although desirable, was determined to be beyond the current design effort.

6 Selection of configuration and suspension system

With two centrally-mounted wheels, it is necessary to have swivel castors toward the outside to stop the chair tipping forwards, backwards or sideways. The usual solution has been to place the drive wheels slightly ahead or behind of the center of gravity and to provide anti-tip wheels that are either slightly above the ground or are spring loaded. This tends to produce "lurching" and a sense of instability. It would also be impractical for sideways movement.

The selected strategy was to provide a firmly-attached swivel castor at each corner and to spring load the central vertical shaft of the tractor, so that it could rise above and fall below the level of the castors maintaining continuous contact with the ground. A spline allowed this to happen whilst maintaining control of the angular orientation. The advantages of this system are stability for transfers and a very secure feeling. The disadvantages are the cost of the spline and the adverse effects of the downward compression force on stability.

Most powered wheelchairs use two 12 volt batteries, but it was not possible to achieve the energy storage that we required (equivalent to two group 24 batteries) within the constraints of the chair. The problem was solved by using four smaller U1 batteries. This provided the advantages of very compact design, energy equivalent to a pair of U 24s and minimal additional cost. It also offers the future potential advantages of a 48 volt supply.

Note: The Rocket design is protected by patents issued and pending.

The Psychometric Properties of the Seating Identification Tool (SIT)

William C Miller, PhD, OT; Francine Miller, BScOT, Karen Trenholm, BScPT; Kris Goodman, BSc

There is a growing body of knowledge that supports the premise that an optimum fit between a person and their wheelchair/seating system will improve mobility, function and comfort while reducing the need for restraint and repositioning and potentially decrease the incidence of decubiti ulcers. Clinical experience suggests that the fit is not always optimum and that frequently wheelchairs are used to 'store' individuals, especially in long-term care facilities. Ensuring that there is a good fit necessitates that an individual, usually a therapist with seating experience, assesses the situation. Unfortunately few long-term care facilities have seating therapists on staff. The health care providers in long-term care facilities generally make the decisions regarding the need for wheelchair and seating despite having little knowledge in this area. Identifying the need for assessment and intervention is the first step in ensuring appropriate equipment is provided.

A review of the literature revealed that there was are no assessment tools that can aid health-care providers who have limited understanding of issues related to wheelchair and seating prescription, to identify individuals who need a formal assessment. Given this dilemma a screening tool, the Seating Identification Tool (SIT), was designed to fill this need.

Development of the Seating Identification Tool (SIT)

To develop the SIT we used a modified form of the Delphi-Technique. The seating team, consisting of a PT and OT developed a list of 25 items that were considered important indicators of the need for wheelchair/seating intervention. The list was circulated to 13 other health professionals in the fields of OT, PT and nursing in order to ensure that all possible indicators were included. The final list was compiled and operationalized into a question format and circulated to the 13 member panel for feedback regarding the wording of the SIT items and identification of those items that panel members thought were critical to include.

The SIT was subjected to two separate studies in order to determine the reliability and validity. The second study was conducted to assess the psychometric properties after the SIT had been modified to improve the operationalization based on results and feedback from the first study. In this talk we present the results of the psychometric testing of the SIT from the second study. The study objectives were to assess the: i) inter-rater reliability; ii) test-retest reliability; and iii) the concurrent validity of the SIT.

Design/Participants/Protocol

A test-retest design was used to assess the psychometric properties of the SIT on a sample of 43 residents. The subjects were randomly selected from a list of all wheelchair users at a long-term care facility in London, Ontario, Canada. To be included subjects had to be 60 years of age or older and had to be using a wheelchair as their primary seating and/or mobility device. Two assessors, both health care providers with no wheelchair/seating experience, who knew the residents, were selected to administer the SIT on two separate occasions, two weeks apart. As there is no gold standard the assessment of an experienced seating therapist provided an indication of the concurrent validity. The seating therapist assessed the subjects within 2-6 hours of the first application of the SIT. At no time did the seating therapist have access to the results of the SIT.

Measurement/Analysis

The SIT consists of 11 items that assess five areas related to seating (pressure areas, discomfort behaviors, mobility, positioning, stability). Responses are recorded as either a yes (1) or no (0). A score is given for a positive response (yes) to all items except item 10, which is reversed. All responses are scored as 1 except for items **1, 2, 4 and 10,** which are weighted as 2. The responses are summed to provide an total score that ranges from 0 to 13. A score of 2 or higher is indicative of a need for a formal assessment.

The intra-class correlation coefficient (ICC) was derived to assess total score test-retest and intra-rater reliability and Cohen's Kappa was used to assess item by item reliability. Sensitivity and specificity statistics were derived to assess the validity of the SIT.

Results

One resident died before the final study was complete. Of the remaining 42 subjects, 40 were female. The sample had a mean age of 83.2 years. Inter-rater reliability was ICC=0.83 and the two week test-retest reliability was 0.86. Individual item inter-rater agreement ranged from 0.29-1.00 and test-retest agreement ranged from 0.25-1.00. The sensitivity of the SIT was 100% and the specificity was 65%. The positive predictive value was 80%.

Discussion

The SIT was found to have good repeatability and validity when used among health care providers who had little or no seating experience. It is possible that further development of the SIT may improve the specificity, however, as there are no serious implications resulting from having an assessment, improving the specificity is not considered to be critical. In summary the SIT is tool a that can assist untrained health providers who work in nursing facilities to identify individuals who need a formal seating/wheelchair assessment.

The Prevalence and Type of Wheelchair and Seating Needs among the Institutionalized Elderly

William C Miller, PhD, OT; Francine Miller, BScOT, Jennifer A Forward, MClScOT, Kris Goodman, BSc; Karen Trenholm, BScPT

Most individuals who live in long-term care facilities spend the majority of their time sitting in wheelchairs. Clinical experience suggests that maximal function and comfort are often overlooked when providing the individual with a wheelchair and seating system as the systems often do not fit individual needs. Further, most residents do not receive a formal wheelchair and seating assessment. This can lead to a variety of complications reducing quality of life and may indirectly lead to medical complications and even premature death. Early studies suggest that the prevalence of the need for seating intervention in long-term care facilities range from 40-80%, however, the limitations in the design of these studies limit the precision of the estimates. Further, estimates have not been provided for Canada. Knowledge of the demand for intervention now may assist in preparing for the next 20 years when the number of individuals aged 65 and over is expected to double. This study was conducted to address two objectives; i) estimate the magnitude of need for a formal wheelchair and seating assessment; and ii) determine the type of need among residents of long-term care facilities in London-Middlesex Health Region of Southwestern Ontario Canada.

Method

An institutionally based population study was conducted to address the study objectives. The subjects for the study were drawn from all ten long-term care facilities in the London-Middlesex Health Region. A single list of all wheelchair users (approximately 1100 individuals) who were living in the long-term care facilities was constructed and a simple random sample of 255 subjects was selected. To be eligible for the study individuals had to be permanent residents of the facility and using a wheelchair as their primary source of mobility and seating device. Individuals were excluded if they had not been residing in the facility for at least 4 weeks or if they were considered palliative. Measurement was conducted using the Seating Identification Tool (SIT). The SIT, a clinical screen specifically developed to identify individuals who have wheelchair and seating needs, has been found to be reliable and evidence of validity has been found. Individuals who score two or more on the SIT are deemed to be in need of a formal seating assessment. Data collection was conducted by nursing staff from each facility who were trained to use the SIT by the study coordinator and a member of the Parkwood Hospital Seating Program.

Results

The final sample consisted of 169 individuals, 34 men and 135 women, with an average age of 84.1 years (SD=10.15). Of the other subjects selected for the study 67 refused to participate, eight died, and 11 moved or were no longer using a wheelchair. The majority of the sample (63%) owned their wheelchair, and 78% sat in their chair for eight or more hours a day (average 8.93 hours, SD=2.86). A total of 106 (63%) subjects were found to be in need of a formal evaluation with 64 (38%) subjects identified as having four or more problems with their wheelchair and/or seating device. Only 15% were identified as having no problems at all. The most common problem was discomfort (46%) followed by the presence of red areas on the buttocks (41%). Evidence of additional pressure areas was also identified in 22% who had red areas on their back, while 21% had an open sore on either their buttocks or back. Seating issues such as repositioning were identified in at least one third of the sample.

Table 1 Frequency and Type of Wheelchair and Seating Problems

	Frequency	**Proportion**
Pressure		
Red Area – Buttocks	70	41.4
Ulcer – Buttocks	27	16.0
Red Area – Back	37	21.9
Ulcer – Back	9	5.5
Discomfort	78	46.2
Mobility (difficulty propelling)	54	32.0
Seating issues		
Repositioning required	61	36.1
Restraint used	42	24.9
Pillow/homemade supports used	25	14.8
Seat cushion **not** used	56	33.1
Stability (tipping)	12	7.1

N=169

Discussion

The majority (63%) of the sample who live in London-Middlesex long-term care facilities may benefit from a formal wheelchair and seating assessment. The estimate falls in the middle of earlier published estimates. It is difficult to generalize this estimate to other regions of the province of Ontario as London/Middlesex has better than average access to health care services than most regions and therefore it is likely this estimate is conservative. Further study comparing different regions of the province of Ontario is recommended to determine if the degree is similar in the various health regions. Pressure areas and discomfort were identified as being the most common type of problem.

Psychosocial and Functional Benefits of Service Dogs

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ABSTRACT

The population of wheelchair users has almost doubled between 1980 and 1990[1], accelerating both the development and use of assistive technologies to increase independence for wheelchair users. Service dogs have been used as a viable solution for many wheelchair users. In addition to reports of improved level of independence and increased psychological well-being, service dogs are reported to reduce the expenditure of time and physical exertion by the owner, allowing individuals more efficient use of limited energy. A comprehensive questionnaire was administered to investigate differences in psychosocial and functional outcomes between wheelchair users who own a service dog (n=20) and wheelchair users who have not yet received a service dog (n=29). Results indicate that service dog ownership is associated with psychosocial benefits.

RATIONALE

The United States wheelchair user population is currently estimated at 1.4 million individuals[2]. The needs of this population have accelerated the development of assistive technologies to increase independence and enhance opportunities for wheelchair users. Service dogs have been used as a viable solution for many wheelchair users. Service dogs are trained to retrieve items, pick up things that have dropped, assist with opening and closing doors, help maintain sitting balance, help with mobility issues such as pulling the wheelchair, assist with transfers (body support/bracing) and seek emergency help. They also provide constant companionship. Recent estimates indicate that approximately 10,000 individuals currently use a service dog for mobility related impairments.

In addition to reports of improved functioning, there is a small but growing body of research indicating that people with disabilities who use a service dog report improved psychological well-being, engage in more social interactions and have more friends than people with disabilities who do not utilize a service dog. Scientific literature has shown that psychosocial factors play a significant role in adapting to, and living with, chronic conditions. Conditions such as spinal cord injury, multiple sclerosis, cerebral palsy and muscular dystrophy affect not only physical function and well-being but also significantly impact self-esteem and lead to distressing emotions such as anxiety, depression, resentment, and helplessness. The loss of key roles and disruption of social interactions and future plans are also correlated with chronic conditions and can negatively impact social functioning. We know through numerous studies that an individual's social network and social support system are related to psychological well-being and healthy functioning. The introduction of a service dog represents an intervention believed to positively affect psychosocial aspects of an individual, leading to increased social integration and social functioning.

Unfortunately, results of the existing research are limited in generalizability due to the retrospective nature of the majority of studies, small sample size, subjective self-report, and in some cases the use of unvalidated measurement tools. This analysis is part of a pilot study designed to both validate existing published results regarding healthcare utilization and psychosocial impact of service dogs, and to expand the research through investigation of social integration and functional outcomes. This paper presents the results of a cross-sectional analysis of psychosocial and functional data collected from existing service dog owners and individuals who have not yet received a service dog.

METHODS

Subjects

This pilot study has been conducted as a cross-sectional study. All subjects are ≥18 years of age, and use a wheelchair or scooter as their primary means of mobility. The S-DOG group is comprised of individuals who own a service dog. The NO-SDOG group is comprised of individuals who are listed on one of two national service dog agency waiting lists. Subjects were identified and recruited through one of two service dog agencies: PAWs With a CauseÒ, or Canine Companions for Independence. Selected subject demographic and socioeconomic data is presented in Table 1.

Table 1: Selected Subject Demographics

Variable	S-DOG (n=20)	NO-DOG (n=29)
Age	43 (S.D. ± 13)	41 (S.D. ± 11)
% Female	71%	72%
% Caucasian	89%	85%
Yrs of Disability	18 (S.D. ± 17)	18 (S.D. ± 13)
Yrs of Education	14 (S.D. ± 4)	15 (S.D. ± 2)
Yrs SD Owned	3 (S.D. ± 2.6)	----
% Employed	38%	45%

Instruments

Psychosocial well-being is measured using the following three instruments: 1) Positive and Negative Affect Scale (PANAS) **-** a 20-item scale assessing both positive and negative affect. Total scores range from 10–50; 2) Rosenberg Self-Esteem (RSE) scale **-** a 10-item Guttman scale assessing self-esteem, with scores ranging from 10 (low self-esteem) to 40 (high self-esteem); and 3) Social Provisions Scale (SPS) **-** a 24-item questionnaire assessing categories of perceived social support. SPS scores range from 24 (low social support) to 96 (high social support).

Functional outcomes and community integration are measured using the Craig Handicap Assessment (CHART). Dimensions analyzed for this report are mobility, occupation and social integration. For each dimension, a total continuous score is calculated. A score of 100 equates to no handicap in an individual's ability to perform the particular item/ function being measured.

Reliability and validity have been established and published in the literature for all psychosocial and functional questionnaires.

Data Analysis

All questionnaires were scored according to published guidelines. Statistical analysis was performed using SAS. For continuous variables, a comparison of results between groups was performed using the student t-test. For categorical variables, a comparison of results between groups was performed using chi-square.

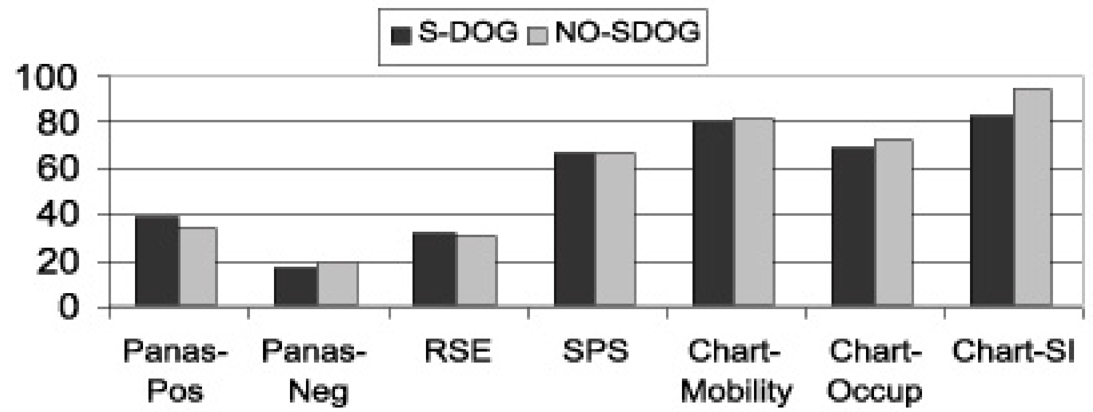
RESULTS

Questionnaires have been received, and data has been analyzed for 20 S-DOG subjects and 29 NO-SDOG subjects. As presented in Table 1, there are no significant differences between the groups with respect to age, gender, race, or years of disability or education. We have observed that S-DOG subjects who are not employed are more likely to self-report their employment status as due to personal choice, as compared to unemployed NO-SDOG subjects, who are more likely to self-report their employment status as due to disability.

Analysis of psychosocial measures indicates that limited differences exist between these groups. On the PANAS, S-DOG participants scored as having greater positive affect (38±5) and less negative affect (16±4) as compared to the NO-SDOG group (means=34±7 and 19±6, respectively). These differences are statistically significant at $p=0.04$ for both results. With respect to self-esteem, S-DOG participants exhibited modestly higher scores on the RSE (S-DOG mean =32±5) as compared to the NO-SDOG group (mean=30±6). No differences were observed regarding categories of social support received by subjects, as measured using the SPS (S-DOG mean =66±4, NO-SDOG mean=66±5).

Analysis of functional and community integration indicators using the CHART subscales indicates differences in all three subscales examined. Existing service dog owners self-reported slightly greater handicap in terms of mobility and occupational status as compared to non-service dog owners (mobility subscale: S-DOG mean=81+13, NO-SDOG mean =82+19. occupation sub-scale: S-DOG mean=68+27, NO-SDOG mean=72+31). With regard to social integration, S-DOG subjects also reported greater handicap (S-DOG mean=83+23) as compared to non-service dog owners (NO-SDOG mean=95+9). Differences in social integration scores are significant at $p<0.02$. Psychosocial and functional results are summarized in Figure 1.

Figure 1. Summary Results



Limitations of this study are sample size and cross-sectional design. Scientific evidence of changes in psychosocial and functional outcomes over time as a result of service dog ownership remains limited. It is possible that scores from existing service dog owners participating in this study represent significant improvements as compared to their pre-service dog ownership status. Future studies should follow service dog recipients over time to determine long-term psychosocial and functional benefits within this group.

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Policy Change: Can We Make A Difference

Moderator: Jean Minkel, MA, PT

Panel Members

Morris (Mickey) Milner, PhD, PEng, CCE
Emma Parry, SROT
Peter Thomas,Esq.
Lori Warren

An International panel will address the issues of changing policy related to assistive technology and seating/ wheeled mobility. Mickey Milner presents the perspective of a research director at Bloorview MacMillan Centre in Toronto, Canada. He was instrumental in obtaining and administering 1.5 million dollars directed to a wide research endeavor focused on developing new products for persons with a disability and transferring them into the commercial marketplace. Emma Parry, an Occupational Therapist in London, England has worked with a group of researchers and clinicians to demonstrate advanced service delivery methods can be used in an environment that has been slow to change. The demonstration project, Scamp -Specialist Centre for Advanced Wheeled Mobility and Positioning, has the hope of convincing consumers, professionals and government representatives to update existing service delivery practices. Peter Thomas is an attorney and a person with a disability. He has been very active in advocating for policy change in the government sector related to technical and other needs of persons with disabilities. His work includes policy changes to address both the technological and non-technical needs of the disability community. Last but not least, Lori Warren, a parent and advocate, will share her experience in opening doors in an educational environment for her daughter and others. She will share how persistence with a smile can be an effective tool for change.

The session will be lead by Jean Minkel, a professional experienced in service delivery, education and technology development. Jean's broad background will ensure the discussion following the presentations is lively and yet focused. Join us with your comments, problems and most important your positive experiences that have resulted in policy changes.

The Ontario Rehabilitation Technology Consortium (ORTC): A project that has made a difference

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Need for the Consortium The Ontario Rehabilitation Technology Consortium (ORTC) was initiated in 1992 with a 10-year commitment from the Ontario Ministry of Health at the level of $1.5-million (Cdn) annually. It came about as a consequence of the visions of a number of people who had much to do with the initiation of the Province of Ontario's Assistive Devices Program (ADP), which commenced in a phased manner from 1982 onwards. Essentially, ADP has, since its inception, provided up to 75% of the funding for a wide variety of assistive technologies. The program expends in excess of $100-million annually. The client is expected to provide the balance of the funding which may also come from various supportive community agencies. It was evident that virtually all of the assistive devices made available by the program were being imported. With the available technical and academic capabilities throughout rehabilitation centres, clinics and universities it seemed logical to develop a program of research, development, and technology transfer which would address this shortcoming. The ADP Advisory Committee to the then Minister of Health, in the early 1990's, initiated a Task Force to explore this matter. The Task Force recommended the establishment of a province-wide consortium to make an appropriate address to the issue. This was subsequently supported at all levels of the Ontario Government, and a request for proposals (RFP) for the envisaged consortium was issued.

Initiation of the Consortium Essence of the RFP The RFP expected an address to unmet needs through R&D in rehabilitation technology relevant to the following areas: Communication, Hearing, Mobility, Prosthetics and Orthotics, Respiration, Seating and Vision. Developments were to be pertinent to safety, effectiveness, reliability and suitability for consumers, and the consortium should promote Ontario industry in the field of assistive devices. It insisted on a partnership among consumers, researchers and developers, academic institutions, health care facilities, clinicians, industry, other granting bodies and government agencies, and the community. It was required that the consortium acquires matching resources amounting to at least $750,000 per year in cash or kind. Response to the RFP A response to the RFP was initiated by the Rehabilitation Engineering Department at what was then the Hugh MacMillan Rehabilitation Centre (now Bloorview MacMillan Centre), which issued a province-wide invitation for partnership in the proposed venture. Multiple meetings were held in an effort to develop a meaningful proposal. Essential conditions established by the key participants were team players with significant track records in the attraction of funding, and the accomplishment of set objectives, along with appropriate values relating to consumer participation and industrial involvement. The submission was reviewed by researchers, consumers and government officials, and was successful. In addition to the identified areas of R&D, there were included a secretariat, based at Bloorview MacMillan Centre, the Psychosocial Evaluation Team, and a commercialisation group relating to technology transfer and business development. Institutions and related clinics include: Bloorview MacMillan Centre, Centre for Studies in Aging - Sunnybrook and Women's Health Science Centre, Ontario Institute for Studies in Education, Queen's University, University of Toronto, University of Waterloo, University of Western Ontario, and West Park Hospital.

Administration of the ORTC Administration of the ORTC on a day-to-day basis rests with each of the Team Leaders in the areas identified above. A management committee comprised of the Consortium Director, Team Leaders and Institutional representatives, develops annual plans, related budgets and reports. Accountability of the enterprise is to an Advisory Board with representation from scientific, consumer, industry and service sectors.

Advancement of the ORTC The growth and development of the ORTC has been significant. From year to year the Ministry funding of approximately $1.5-million p.a. has been more than matched by funding in both cash and in-kind contributions, well in excess of the expected $750,000. Intellectual Property A considerable amount of intellectual property, including many commercialized devices has been generated. ORTC members hold 24 patents with 21 applications pending. Job and Business Development Over 40 jobs have been created in Ontario industry for 2000-2001, with over 8 jobs in the rest of Canada and the USA. As the ORTC has matured, the culture of business has been embraced alongside scientific research thrusts. It has 31 active business partners and has enabled the creation of 11 companies in Ontario. The ORTC has been responsible for the creation of several small high tech companies, especially in the areas of vision and mobility products. Prior to its inception, no vision related industry existed in Ontario. Creation of Products The ORTC has produced some 25 highly innovative products that have come to market, with 15 others at various stages of development/commercialization. Some of the products on the market are: WiViK(r) - a Windows-based Visual keyboard, KeyRep(r) - Word prediction and abbreviation expansion capability to accompany WiViK(r), and WiVox(r) - Voice output for the system; Desired Sensation Level Method for fitting hearing aids; an accessible bathtub; ToilevatorTM, a system to raise standard toilets by several inches; StaxiTM, a portering wheelchair; RocketTM, a highly manoeuvrable and versatile powered wheelchair; MyoMicroTM, a programmable prosthetic controller; The Maple Leaf OrthosisTM, a post-operative hip abductor brace; Psychosocial Impact of Assistive Devices Scale (PIADS); Powered Upper-Extremity Functional Index (PUFI); AquanautTM, an advanced toileting system for children; JoeyTM, an adaptive seating system and related components; VisableTM , a scientific calculator for people with low vision; Virtual Reality MouseTM, a tactile mouse; and, OcuTech VES-AF, a spectacle mounted autofocus telescope system.

Publications and Training A substantial amount of intellectual activity has occurred: Significant numbers of students have been trained in the field (e.g. 11 Ph.D. and 80 Masters degrees in diverse related disciplines have been awarded to date); numerous publications and presentations have been made (on average, 41 refereed papers, 30 conference proceedings contributions and 55 presentations annually) without compromise to commercialization of developed products.

The Future The ORTC can most certainly be regarded as a project that has made a substantial difference to the field of rehabilitation engineering.

In its future thrusts, the ORTC expects to build on its strengths and its acquired knowledge and experience to further meaningfully enhance the role of technology in rehabilitation. It is currently interacting with provincial and federal granting bodies to facilitate future funding to promote further endeavours along similar lines.

Experiences of being 'part of the solution' - an English perspective

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The services which provide wheelchairs and seating to permanently disabled people in England have undergone major and fundamental changes over the past 15 years. People with disabilities in the United Kingdom lag far behind in the use of modern technologies which provide independence and functional mobility in our communities.

There is a plethora of evidence to show that the gap between what is possible and what is provided is not as simple as just the shortage of funding. The systems used to deliver these services appear to have major weaknesses. These weaknesses were highlighted by the Audit Commission in their report published in March 2000. The Audit Commission identified that investment in equipment services delivers high quality at low cost. Specific problems with wheelchair and special seating services were identified, stating that budgets are under pressure, and the application of local eligibility criteria makes provision a lottery that is dependent on post code. Some trusts provide a wide range of wheelchairs and equipment without restriction on type or cost, whereas others have established tight eligibility criteria.

A further complicating factor in the provision of wheelchair and seating services for the people of the United Kingdom is the cultural milieu in which we live. The typically British 'stiff upper lip' is a strong cultural issue. This creates difficulties for clinicians when evaluating people's needs. It also creates difficulties for people with disabilities when trying to express their expectations and requirements. There is a 'make do with what you have' culture that is perhaps a relic of the second world war and subsequent depression.

Architectural barriers to independence are endemic within Britian. Historical buildings are notoriously difficult to adapt for disabled access, particularly in a sympathetic way. Recent legislation has changed the regulations for new buildings, however it has yet to be tested. One opinion group states that the legislation has no 'teeth', very similar to the Disability Discrimination Act that is being phased on over a number of years. It is not just architectural barriers that people with disabilities must overcome in order to live within British society, there are other less tangible barriers that present equally problematic challenges to independence.

There is definitely strong belief in the National Health Service (NHS) which for many reasons is often unable to deliver the 'ideal'. Private health care is not universally popular, but is a growing industry. From an industry perspective, there are two distinct markets in the UK; the NHS (purchases made by Wheelchair and Seating Services) and private (purchases made by individuals).

There are a growing number of clinically trained individuals employed within the private sector. The British Health Care Traders Association introduced in 2000 a registration scheme for individuals employed in the industry. This will in the future be linked to a competency programme, with the aim of raising and assuring standards. These initiatives will serve to raise standards within the industry, and offer users the opportunity of making an informed choice.

There have been numerous retrospective studies of wheelchair and seating services in the past. What seemed to be missing was a practical demonstration of how to provide the most effective service in the

UK context, studied rigorously in a prospective manner. The approach taken is one that is liberated of the constraints imposed by the prevailing perspectives of these services and their historical legacies. SCAMP (Specialist Centre for Advanced Wheeled Mobility and Positioning) is a two year research programme funded by the National Lottery Charities Board and undertaken by the Centre for Disability Research and Innovation, University College London in association with the charity ASPIRE. The focus of SCAMP is to develop, through professional consensus, a best practice model for the provision of wheeled mobility and seating. The model will be evaluated in terms of outcomes for the clients.

One of the most important tools for evaluating SCAMP's best practice model is a web based International Advisory Group (IAG). The IAG is comprised of recognised 'experts' in the field of wheeled mobility and seating from many different countries. Each client's case is presented to the IAG via a limited access website for feedback and guidance in terms of the development of the model. The IAG examines how the methods used throughout the intervention impact the practice of assessment for wheelchairs and seating. The outcome measures include objective evaluation of quality of life and functional level using recognised evaluation tools. A cost-benefit analysis is being carried out, along with measurement of the consumer's satisfaction with the process and outcomes using a questionnaire and interview format. A steering committee provides overall guidance for the direction of the project.

SCAMP will conclude its work by the end of 2001. Preliminary findings and experiences will be discussed, illustrated with case studies.