



2011 Annual Meeting

“Professionals Helping
Kids be Kids”

ABSTRACTS

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The Program Committee has disclosed the following:

Janet L. Walker, MD (n-none); J. Ivan Krajbich, MD (n-none); Jorge A. Fabregas, MD (n-none); Kenneth J. Guidera, MD (n-none)

The ACPOC Staff has disclosed the following: *Angela Schnepf (n-none); Liz Frale (n-none) Jennifer Wolf-Jones (n-none); Carol Swift (n-none); Aimee Spellman (n-none)*

7:00 – 8:00 am	Continental Breakfast
7:00 am – 5:00 pm	Registration
8:00 am – 5:00 pm	Scientific Program
8:00 – 8:10 am	Welcome <i>Janet G. Marshall, CPO, President</i>

Session I – Upper Extremity**Moderator: Janet G. Marshall, CPO (n-none)**

8:10 – 8:30 am Research #1	Growing Up With Unilateral Congenital Below Elbow Deficiency: A Qualitative Study of Individuals Who Currently Wear an Upper Extremity Prosthesis <i>Vivian J. Yip, OTD (n-none)</i>
8:30 – 8:40 am Paper #1	Estimating Joint Loads in Normally Limbed Children and Children using Upper Limb Prostheses <i>Katelynn Craig, BEng (n-none)</i> <i>Carly Genn, BEng (n-none)</i> ; <i>Wendy Hill, BsOT (n-none)</i> ; <i>Edmund Biden, PhD (n-none)</i> ; <i>Greg Bush (n-none)</i>
8:40 – 8:50 am	Discussion
8:50 – 9:10 am Research #2	Electromyography Patterns During Swinging in Children with Upper Limb Loss: Wearing Their Prosthesis Versus Not Wearing It <i>Carly Genn, BEng (n-none)</i> ; <i>Katelynn Craig, BEng (n-none)</i> ; <i>Wendy Hill, BsOT (n-none)</i> ; <i>Victoria Chester, PhD (n-none)</i> ; <i>Edmund Biden, PhD (n-none)</i>
9:10 – 9:20 am Creative Solutions #1	Innovative Silicone Technique: Bilateral Wrist Disarticulation Myoelectric Prostheses Using a Unique Silicone Socket Design <i>Benjamin J. Koch, BS, CP (n-none)</i> ; <i>Sandra Ramdial, CP (n-none)</i>
9:20 – 9:30 am	Discussion
9:30 – 10:00 am	Break
10:00 – 10:30 am	New Investigators Awards <i>Janet G. Marshall, CPO</i>
10:30 – 11:00 am	ORA Vernon Nickel Award Risky Situations: Reducing Falls on the Orthopaedic Ward <i>Grant Richardson Lohse, MD (n-none)</i>
11:00 am – 12:00 pm	Introduction of the Hector W. Kay Lecturer <i>Janet G. Marshall, CPO</i> Hector W. Kay Lecturer The Interwoven Histories of Amputation Surgery & Prosthetics: The Rig-Veda to the Age of Bionics <i>John H. Bowker, MD (8-Mosby/Elsevier)</i>
12:00 – 1:00 pm	Lunch – Kokopelli 3

Symposia I

1:00 – 1:20 pm The History of Prosthetics and Orthotics in the United States
Russell J. Hornfisher, Becker Orthopaedics (3a, Becker Ortho)

1:20 – 1:30 pm Discussion

Symposia 2

1:30 – 2:20 pm Complications in Wound Healing Among Apparently
Healthy Adults and Children
Brian Giavedoni, MBA, CP, LP (n-none);
Jorge Fabregas, MD (n-none)
Colleen Coulter-O’Berry, PT, DPT, PhD, PCS (n-none)

2:20 – 2:30 pm Discussion

Workshop Session I

2:30 – 3:30 pm Clinical Experience of Designing, Aligning and
Workshop A Tuning AFO Footwear Combinations Based on
Segment Kinematics
Donald McGovern, CPO, FAAOP (n-none); Larissa Pavone, MD (n-none);
Corrine Jordan, DPT (n-none); Debora Gaebler, MD (3b, Merz & Hacoma)

or

Workshop B Physician Guided Case Study
Robin C. Crandall, MD (n-none)

3:30 – 4:00 pm Break

Workshop Session II

4:00 – 5:00 pm Clinical Experience of Designing, Aligning and
Workshop A Tuning AFO Footwear Combinations Based on
Segment Kinematics
Donald McGovern, CPO, FAAOP (n-none); Larissa Pavone, MD (n-none);
Corrine Jordan, DPT (n-none); Debora Gaebler, MD (3b, Merz & Hacoma)

or

Workshop B Physician Guided Case Study
Robin C. Crandall, MD (n-none)

7:00 – 8:00 am **Continental Breakfast**

7:00 am – 5:30 pm **Registration**

8:00 am – 5:10 pm **Scientific Program**

Session II – Lower Extremity

Moderator: Janet L. Walker, MD (n-none)

8:00 – 8:10 am External Joint Mounting and Various AFO Plastic Configurations to
Creative Solutions #2 Achieve Coronal Control and Sagittal Restraint to the Foot and Ankle
Complex
Marc D. Kaufman, LPO (n-none)

8:10 – 8:30 am Research #3	Using Gait Analysis to Compare the Sagittal Plane Biomechanical Effects of Three Designs of Ankle Foot Orthoses <i>Todd Dewees, CPO (n-none); Brock Sande, CPO (n-none)</i>
8:30 – 8:40 am Paper #2	Treatment of Walking Children and Failed Surgery Cases With Ponsettis Protocol and Modified Thermoplastic Braces <i>Vipul Shah, MD (n-none); Garima Singh (n-none); Sunil Singh (n-none); Prakash Mishra (n-none); Ghanshyam Yadav (n-none)</i>
8:40 – 8:55 am	Discussion
8:55 – 9:15 am Research #4	Why Do Children With Cerebral Palsy Stop Wearing Their Lower Extremity Orthoses? <i>Melissa Malkush, CP, MSPO (n-none)</i>
9:15 – 9:25 am Creative Solutions #3	Use Of Adjustable Dynamic Response AFO Braces To Address Common Gait Abnormalities in an Adolescent with Diplegic Cerebral Palsy <i>Andrew Sutphin, DPT (n-none)</i>
9:25 – 9:35 am Paper #3	Use of Supra-Malleolar Ultra-flexible Dynamic AFOs to Improve Function in Adolescents and Adults with Moderate to Severe C.P. <i>Nancy Hylton, PT, LO (n-none)</i>
9:35 – 9:50 am	Discussion
9:50 – 10:30 am	Break

Session III – Spine and General Interest**Moderator: Eric L. Miller CPO (n-none)**

10:30 – 10:40 am Creative Solutions #4	A Surprising Outcome to a Severe Infantile Scoliosis Using a Dynamic Elastomeric Fabric Orthotic Intervention <i>Martin J. Matthews, M.Phil, CO (3a, DM Orthotics); Selin Bridges, M.Sc, MCSP (n-none); Jim Wynne, CPO, FAAOP (3a, Boston Brace)</i>
10:40 – 10:50 am Paper #4	Spinal Deformities Following Selective Dorsal Rhizotomy: A Review of Available Observational Cohort Studies <i>Phillip M. Stevens, Med, CPO (n-none); Allison Oki, MD (n-none)</i>
10:50 – 11:00 am	Discussion
11:00 – 11:20 am Creative Solutions #5	Hand Transplantation: Review of Indications, Complications, and a Look into the Future <i>Robin C. Crandall, MD (n-none)</i>
11:20 – 11:30 am	Discussion
11:30 am – 12:30 pm	Orthopaedic Rehabilitation Association Symposium Wartime Pediatric Amputees: The Humanitarian Effort <i>Joseph F Alderete MD, MAJ, MC (n-none)</i>

12:30 – 1:30 pm	Members Business Meeting Lunch
1:30 – 2:30 pm	Introduction of the Presidential Speaker Janet G. Marshall, CPO
	Presidential Speaker Empowering the Generation of Transformation Robert Gailey, Jr., PhD, PT (3b, Ossur North America)

Session IV – Cerebral Palsy Upper Extremity & General**Moderator: Joanne L. Shida -Tokeshi MA, OTR/L (n-none)****Symposia 3**

2:30 – 3:30 pm	Managing the Hand and Upper Extremity in Children with Cerebral Palsy Allan Peljovich, MD, MPH (9, Georgia Ambulatory Surgery Society)
3:30 – 4:00 pm	Break
4:00 – 4:10 pm Paper #5	Correlation of Motor Function and Stereognosis Impairment in Upper Limb Cerebral Palsy Wendy A. Tomhave, OTR/L (n-none); Elspeth Kinnucan, MD (n-none) Ann Van Heest, MD (n-none)
4:10 – 4:20 pm Paper #6	Changes In Stereognosis Function In Children With Cerebral Palsy Wendy A. Tomhave, OTR/L (n-none); Ann Van Heest, MD (n-none); Kate Pico, MD (n-none)
4:20 – 4:35 pm	Discussion
4:35 – 4:45 pm Creative Solutions #5	Quick, Easy and Cost Effective Ways to Measure Outcomes in Children Receiving Orthotic and Prosthetic Services Colleen Coulter-O’Berry, PT, DPT, PhD, PCS (n-none)
4:45 – 4:55 pm Paper #7	Orthopaedic Sequelae of Childhood Meningococemia: Management Considerations and Outcome J. Ivan Krajchich, MD (n-none); Federico Canavese, MD (n-none) B. Lafleur (n-none)
4:55 – 5:10 pm	Discussion
6:00 – 8:30 pm	Friday Night Social

7:00 – 8:00 am **Continental Breakfast**
7:00 am – 1:00 pm **Registration**
8:00 am – 12:40 pm **Scientific Program**

Session V – Lower Extremity**Moderator: Owen A. Larson, CP (n-none)**

8:00 – 8:10 am Syme vs. Boyd Amputation for Fibular Deficiency: A Two
Paper #8 Center Functional Assessment Study
Joel A. Lerman, MD (n-none); Brian Louie (n-none);
Janet Walker, MD (n-none); Sherry Middleton, (n-none),
Kimberly Savarino (n-none); Anita Bagley, PhD (n-none)

8:10 – 8:20 am Review of Bilateral Transverse Fibula Deficiency Patients
Paper #9 **Kenneth J. Guidera, MD (n-none); Robin C. Crandall, MD (n-none);**
Matt Morel, CPO (n-none)

8:20 – 8:30 am Elective Transtibial Amputation of a Severe Clubfoot to
Challenging Case #1 Obtain Higher Function
Karl B. Barner, CPO, LPO (n-none)

8:30 – 8:40 am Tibial Deficiency Associated with Femoral Bifurcation:
Paper #10 Management Options
David E. Westberry, MD (n-none)

8:40 – 8:55 am Discussion

8:55 – 9:05 am Tibial Hemimelia - Brackett Epiphysis Variant -
Challenging Case #2 Treatment Discussions and Follow-up
J. Ivan Krajbich, MD (n-none)

9:05 – 9:15 am The Role of a Prosthetic Knee on Temporal and Spatial
Paper #11 Parameters of Crawling
Mark Geil, PhD (n-none);
Colleen Coulter-O’Berry, PT, DPT, PhD, PCS (n-none)
Carolyn Heriza, PT, EdD, FAPTA (n-none)

9:15 – 9:25 am Clearance Adaptations in Children with Limb Loss
Paper #12 During Early Walking
Mark Geil, PhD (n-none);
Colleen Coulter-O’Berry, PT, DPT, PhD, PCS (n-none)

9:25 – 9:35 am Clinical Use of Rollover Shape
Creative Solutions #8 **Jeremy C. Farley, CPO/L (3a, Fillauer Co. Inc.)**
Gerald E. Stark, MSEM, CPO/L, FAAOP, (3a, Fillauer Co. Inc.)

9:35 – 9:50 am Discussion

9:50 – 10:20 am Break

Session VI - Lower Extremity and Neuromuscular Disorders

Moderator: Jorge A. Fabregas, MD

Symposia 4

- 10:20 – 11:00 am Neuromuscular Disorders in Children: Interdisciplinary Management
Samuel R. Rosenfeld, MD (2, Zimmer Spine)
- 11:00 – 11:15 am Discussion
- 11:15 – 11:25 am
Paper #13 Optimizing Gains from Botulin Toxin and the Value of Assistive Splintage
Vipul Shah, MD (n-none); Garima Singh (n-none); Sunil Kumar (n-none); Prakash Mishra (n-none); Ghanshyam Yadav (n-none); Himmanshu Singh, (n-none)
- 11:25 – 11:35 am
Creative Solutions #8 Lightweight Carbon Fiber Knee Extension Assist Orthosis for Severe Crouch Gait
Nancy M. Hylton, PT, LO (n-none)
- 11:35 – 11:45 am Discussion

Symposia 5

- 11:45 am – 12:30 pm Medically Based Evidence Relating to Deformity Prevention in Early Intervention Pediatric AFOS
Robert Meier, CO, BOCO (3a, Allard, USA)
- 12:30 – 12:45 pm Discussion
- 12:45 pm Adjourn

POSTERS

Poster #1

A Locally Developed Hip Disarticulation Prosthesis: Affordable Mobility and Body Image Restoration for the Filipino Amputee

Amiel C. Adajar, MD (n-none); Josephine R. Bundoc, MD (n-none)

Poster #2

Bike Adaptations for Upper Extremity Limb Deficiencies

Lisa K. McIntyre, BS, OTR (n-none)

Poster #3

Long-term Follow Up of Van Ness Rotationplasty for Congenital PFFD

Ann Flanagan, PT, PCS (n-none); Jeffrey Ackman, MD (n-none); Haluk Altioik, MD (n-none) Mary Peer, PT, PCS (n-none); Sahar Hassani, MS (n-none)

Poster #4

Goals and Considerations in Orthotic Treatment of a Young Child with Spastic Diplegia

Karl B. Barner, CPO, LPO (n-none)

Thursday, 8:10 am / Research #1

GROWING UP WITH UNILATERAL CONGENITAL BELOW ELBOW DEFICIENCY: A QUALITATIVE STUDY OF INDIVIDUALS WHO CURRENTLY WEAR AN UPPER EXTREMITY PROSTHESIS

Vivian J. Yip, OTD

Abstract

With many pieces of literature that debate whether children with upper extremity limb deficiencies should be fitted with upper extremity prostheses (Biddis & Chau, 2007; Biddis & Chau, 2008; James et al., 2006; Wagner, Bagley, James, 2007), it remains uncertain why adults with congenital upper extremity limb loss continue to wear prostheses into adulthood. Our childhood stories contain details of how we have become the persons we are today (Clark, 1993). What childhood experiences have influenced adults with unilateral congenital below elbow deficiency (UCBED) to continue to wear a prosthesis? This study used qualitative methods to capture childhood experiences that have impacted the lives of adults who currently wear a below elbow prosthesis. A phenomenological approach using in-depth narrative interviews of three adults with UCBED targeted 1) positive and negative stories remembered from childhood 2) stories related to use and non-use of the prosthesis, 3) perceived quality of life and identity, and 4) influences to wear a prosthesis. Analysis of these interviews resulted in themes consisting of the participants' backgrounds, growing up and coping with "facts of life", how the individuals continue to cope as adults, the influences to wear a prosthesis, and each individual's personal recommendations for families with a child with UCBED.

Introduction

The occurrence of persons born with congenital limb deficiencies has remained stable at 25.64 per 100,000 live births. Of these births, persons with upper extremity limb deficiencies are the most common at approximately 60 percent. Unilateral congenital below elbow deficiency (UCBED) is the most common congenital limb deficiency. The term UCBED can also be identified as unilateral congenital trans-radial deficiency. Gender and race do not predominate in these occurrences. In most cases, the cause of congenital limb deficiencies is still unknown and is classified as idiopathic. These conditions occur sporadically and are believed to be nonhereditary (Meier and Atkins, 2004).

When informed that their newborn has a congenital limb deficiency, parents often experience many emotions and wonder how this will impact their child's life. Many times they contemplate whether or not to fit their child with a prosthesis and look for resources to assist with their decision (Talbot, 1979).

The value of fitting a child with an upper extremity prosthesis has been questioned by many in the field. The research of James et al. (2006) reviewed the effect of an upper extremity prosthesis on function and quality of life of children with UCBED. The study suggests that prostheses do not assist children with UCBED in daily life function and do

not affect their quality of life positively or negatively. The researchers revealed concerns about whether it is necessary to fit a child with UCBD with a prosthesis. However, they do not indicate that individual children will not benefit from a prosthesis, and they suggest that factors influencing why certain individuals wear prostheses should be investigated.

Reviews about factors that may contribute to the use and abandonment of upper extremity prosthetic devices have demonstrated mixed results. Data gathered from a survey of two hundred forty-two adults and children with upper extremity limb loss recorded twenty percent of the participants had abandoned the use of their prostheses (Biddis and Chau, 2007). Predisposing factors for abandonment included origin of limb absence, gender, bilateral limb absence, and level of limb absence. Use of a prosthesis was influenced by perceived need. Researchers advise that the client should be more informed and involved in the process of fabricating the prosthesis to ensure that their needs from the prosthesis are met.

In another study, an attempt to increase the rate of prosthetic acceptance was explored through a questionnaire (Biddis & Chau, 2008). The data revealed that individuals fit within two years of birth or six months of amputation were sixteen times more likely to continue use of a prosthesis. The study suggests that in order to increase rates of prosthesis acceptance, clinical directives should focus on timely, client-centered fitting strategies and the development of improved prostheses.

Wagner et al. (2007) found in their literature review that rejection rates of upper extremity prosthesis for children ranged from ten to forty-nine percent. They distributed a survey to one hundred sixty-eight children with UCBD who did not currently wear a prosthesis and their parents. In response to the question, "What are the reasons for not wearing a prosthesis?" fifty-three percent answered "prosthesis did not help function." Other responses included "dislike of appearance", "teasing", "burden of appointments and maintenance of the prosthesis", "poor fit of the prosthesis", and an "other category". It was suggested that all of these categories needed to be addressed to acquire more successful fittings and use of a prosthesis by children with UCBD (Wagner et al., 2007).

The literature available demonstrates many controversies about fitting an upper extremity prosthesis for a child with an upper extremity limb deficiency. The array of studies shows a variety of percentages of rejection and success rates of using or wearing a prosthesis. Unfortunately there is no comprehensive or organized data base to provide more accurate numbers and percentages about this unique population. Furthermore the inconsistent data collected leaves professionals to question whether children with UCBD should be fit with upper extremity prostheses, in particular because there is considerable time, energy, effort, and resources invested by the families and the professionals to provide these custom prosthetic devices. Regardless, there are individuals who continue to wear their prosthesis into adulthood.

Analysis of adults with UCBD is an unexplored area. There are an unrecorded number of adults with UCBD who continue to wear prostheses. Exploring why these individuals

wear prostheses and what experiences have influenced them to wear a prosthesis may help determine why someone may or may not be a candidate for prosthetic fitting. This may better inform the decision-making process that clinicians and parents must face when determining if prosthetic fitting is the best option, as well as minimize the abandonment of prostheses.

Reflections by adults with UCBED on their childhood stories and the meaning of a prosthesis in their life experiences are important to consider and were the focus of this study. A phenomenological approach permits the uncovering of the “lived experience” (Patton, 2002, p. 104). Phenomenology focuses on exploring how human beings make sense of experience and transform experience into consciousness, both individually and as shared meaning. These qualitative methods allow the researcher to capture the point of view and the “lived experience” of the individuals of interest, rather than an outsider’s, researcher’s, or clinician’s point of view. Qualitative methods also provide more experiential evidence to be incorporated into best practice by clinicians.

Thursday, 8:30 am / Paper #1

ESTIMATING JOINT LOADS IN NORMALLY LIMBED CHILDREN AND CHILDREN USING UPPER LIMB PROSTHESES

Katelynn Craig, BEng

Carly Genn

Edmund Biden

Wendy Hill

Greg Bush

Institute of Biomedical Engineering, Fredericton, New Brunswick, Canada

The goal of this study has been to investigate joint loading in children using a below elbow upper limb prosthesis, both within that population and in comparison to normally limbed children. This has been accomplished using an experimental protocol involving two playground style gross motor tasks- swinging on a swing and riding a bicycle. These tasks used instrumented handgrips and were performed in a VICON Motion Capture Lab. Forces were measured at the hand and overall movements were captured during each activity. This data set allowed estimation of joint loading up the arm to the shoulder using a quasi-static model.

Fifteen normally limbed children and five prosthesis using children have been tested; the prosthesis users have performed the protocol while wearing their prosthesis, and again without it. The testing has been done in collaboration with the on-site prosthetist and occupational therapist.

Results show noticeable postural effects for both tasks with the limb deficient children. Postural effects are an important consideration because different or awkward postures can affect how much force is experienced by joints on the sound side versus the limb deficient side.

During the bicycling task, it was observed that limb deficient children leaned towards the sound limb while performing the task without their prosthesis. The angle of the shoulders relative to the hips ranged from 8° to 24° for the prosthesis users in this case, compared to less than 6° while wearing their prosthesis. This angle was also less than 6° for the normally limbed children.

While swinging, it was observed that using the prosthesis resulted in the swing twisting, likely due to the awkward posture necessary to hold the chains while wearing the prosthesis. This posture caused the elbow of the prosthesis using side to move approximately 10 cm laterally throughout the swinging cycle, while the elbow on the sound side remained relatively stationary.

Data from the force transducers showed that the joint loads increase from the wrist to the shoulder, with the largest increase seen between the forces experienced at the wrist as compared to those at the elbow. The majority of the force is experienced in the plane of the segment for the hand and forearm, and plane perpendicular to the segment at the upper arm.

While normally limbed children demonstrate force symmetry between their hands while swinging, prosthesis users show force asymmetry between the sound side and prosthesis using side. Forces experienced on the sound side are between 25% and 50% greater than those

experienced on the limb deficient side throughout the swinging cycle. When bicycling, however, prosthesis users exhibit force symmetry, similar to the normally limbed children.

The data resulting from this study have shown that there are measurable joint load differences between the two populations while performing these specific gross motor tasks. In addition this, joint loading differs within the prostheses using population while wearing and not wearing their prosthesis. Future work will include assessing these force differences in order to determine whether the prosthesis using population is at risk for overuse injury.

Thursday, 8:50 am / Research #2

ELECTROMYOGRAPHY PATTERN'S DURING SWINGING IN CHILDREN WITH UPPER LIMB LOSS: WEARING THEIR PROSTHESIS VERSUS NOT WEARING IT

Carly Genn, BEng

Katelynn Craig, BEng

Wendy Hill, BsOT

Victoria Chester, PhD

Edmund Biden, PhD

Institute of Biomedical Engineering, University of New Brunswick.

Abstract

This study focused on the question of how a child with unilateral limb loss performed activities of daily living while wearing a prosthesis compared with not wearing it.

The aim of this study was to determine if patterns of muscle activity in a child with unilateral limb loss were within normal limits during swinging and biking compared to normally limbed children doing the same task. This was done by looking at bilateral muscle symmetry, agonist/antagonist muscle pairs, activation timing and length of activation for each muscle.

The methods used included comparing a sample population of normally limbed children with a sample population of children with unilateral limb loss. The data collected included motion data captured using a motion analysis system called Vicon from Oxford Metrics and a wireless EMG system called Zero-wire from Aurion. Each subject had reflective markers placed on anatomical landmarks in order to observe their motion as well as 10 electrodes placed on 5 muscles on each side of the body.

During swinging there were statistically significant differences between the symmetry of the biceps, triceps, and deltoids of the control population compared to both test groups (prosthesis users wearing and not wearing their prosthesis). However, no statistically significant differences were observed between children with limb loss while wearing their prosthesis versus not wearing it.

Introduction

Upper extremity limb loss is uncommon compared to lower extremity limb loss but is more prevalent in children because of the incidence of congenital cases. Upper extremity limb loss may occur traumatically, surgically, or congenitally.

Currently there are two very opposite schools of thought in terms of fitting unilateral, below elbow children with congenital deficiencies with electric prostheses. The first is to fit the child with a passive prosthesis when they can sit up and subsequently fit them with an electric device between 12 and 15 months (1) (2). The second is that since this group of children are able to perform most activities of daily living (ADL's) independently, the prosthesis provides little to no increase in functionality (3) (4). An interesting factor to consider in this argument could be the risk level of these children at acquiring repetitive strain injuries. There have been some studies that have already indicated that upper limb amputees have had overuse problems (5) (6)

The main focus of this thesis was to describe the muscle activity in children with unilateral limb loss and to decipher whether this activity lies within normal limits during activities of daily

living. The three activities chosen were swinging, biking, and walking, however this paper will focus only on the swing task. The hypothesis was that throughout the activities chosen for study, children with unilateral limb loss would have muscle symmetry and activation patterns, which lie outside the normal range. A companion study is being done concurrently to look at the effects the prosthesis may have on joint loads when performing activities of daily living.

The tools that will be used to identify these potential differences are encompassed in the state-of-the-art motion laboratory located in the Institute of Biomedical Engineering at the University of New Brunswick. Included in this laboratory are an infrared eight-camera VICON motion capture system, a Zero Wire electromyography (EMG) system, and four Kistler forceplates embedded into the floor of the laboratory. The VICON motion capture system was utilized to observe how the patient moved while performing these gross motor tasks in terms of body segment angles and rotations. The surface electromyography (SEMG) system monitored the muscle activity of ten major upper body muscle groups while performing two activities. The force plates were used specifically for one of the activities (walking).

Individuals eligible to be included in the study were children between the ages of 5 and 14 years old. The control group had to have two asymptomatic arms. The prosthesis users were recruited from the clinical population of the Institute of Biomedical Engineering. They were in the same age range and had unilateral, below-elbow limb loss. The prosthesis users were tested once while wearing their myoelectric prosthesis and once without.

These experiments attempt to clarify muscle activity for the upper limb child amputee, and to determine whether this activity lies outside normal limits. Currently, there is little to no research that has reported the EMG activity of children with unilateral upper limb loss. There have been a few studies that have reported these individuals to be at a greater risk for repetitive strain injuries (6) (5) however there is not enough evidence currently to confirm this. This research attempts to initiate more interest in these problems in order to eventually provide a clearer prosthesis prescription plan for individuals who have unilateral limb loss (particularly those in the congenital populations). Table 1 contains the demographic information for the subjects included in this paper.

Subject	Subject Type	Age	Gender	Dominant Side	Non-Dominant Side
D	Control	7	female	right	left
S	Control	7	female	right	left
U	Control	7	female	right	left
L	Control	9	female	right	left
A	Control	11	female	right	left
C	Control	11	female	right	left
N	Control	11	female	right	left
O	Control	11	female	right	left
T	Control	4	male	right	left
M	Control	6	male	right	left
H	Control	8	male	right	left
B	Control	10	male	right	left

E	Control	11	male	right	left
G	Control	11	male	left	right
V	Control	11	male	left	right
F	Control	14	male	right	left
				Sound	Prosthesis
I	Test	14	male	left	right
R	Test	6	female	right	left
P	Test	10	female	left	right
W	Test	13	female	right	left

Table 1: Demographic information for control and test groups

Range for the control group was between 4 and 14, and had an average of 9.3 years, with 50% males (8), and 50% females (8). The range for the test group was between 6 and 14, and had an average of 10.8 years, with 75% females (3) and 25% males (1).

Thursday, 9:10 am / Creative Solutions #1

**INNOVATIVE SILICONE TECHNIQUE: BILATERAL WRIST
DISARTICULATION MYOELECTRIC PROSTHESES USING A
UNIQUE SILICONE SOCKET DESIGN**

Benjamin J. Koch, BS, CP

Orthotic Prosthetic Center, Inc., Fairfax, VA

Sandra Ramdial, CP

Otto Bock HealthCare Canada, Ltd., Burlington, ON, Canada

The purpose of this case study is to share a unique silicone technique used for a three year old male with bilateral wrist disarticulation amputations fit with myoelectric prostheses. The patient was previously fit with conventional body powered and passive prostheses with rigid carbon frame and flexible inner liners at the age of two.

As he matured, the patient began to reject the prostheses mostly due to the rigidity and unnatural feel of the frames, despite their full functionality. The challenge was to create a more natural and streamlined dynamic socket that incorporated the components of a myoelectric prosthesis (wrist, electrodes, electronics and battery). This case study will share the steps taken to achieve a successful outcome using the silicone technique and discuss integrating the components of a myoelectric prostheses within the silicone.

Thursday, 10:30 am / ORA Vernon Nickel Award

RISKY SITUATIONS: REDUCING FALLS ON THE ORTHOPAEDIC WARD

Grant Richardson Lohse, MD

In-hospital falls can result in significant morbidity and even mortality, and, as of 2008, were declared “never events” by the Center for Medicare Services. Interventions intended to reduce the incidence of falls based on patient risk factors have not been successful in the acute inpatient setting. This phenomenon may be related to the dynamic nature of acute post-operative patients.

Addressing common high risk situations is a critical component of fall prevention in the acute inpatient setting. The identification and subsequent modification of these situations can be effectively accomplished through system-based practices.

The systems-based fall-prevention program to be presented was effective in reducing falls with injury and total falls on an acute care orthopaedic ward. The approach taken used standard Continuous Quality Improvement methodology, and should generalize well to other settings. Despite a thoughtful, multi-disciplinary, intensive approach to the problem, falls did occur. The investigators believe it is unrealistic to consider all falls as preventable.

Thursday, 11:00 am / Hector W. Kay Lecturer

**THE INTERWOVEN HISTORIES OF AMPUTATION SURGERY & PROSTHETICS:
THE RIG-VEDA TO THE AGE OF BIONICS**

John H. Bowker, MD

The histories of amputation surgery and prosthetics, two distinct but interdependent fields, are examined from antiquity to the present. Medical, social and geopolitical forces leading to expansion and retraction of indications for amputation over the millennia are discussed. The evolution of prostheses is traced from early attempts by military surgeons and armorers to later successful designs by prosthetists and by amputee-inventors themselves. Lastly, the socioeconomic and political forces determining the availability of prosthetic services since the 1860s are presented.

Thursday, 1:00 pm / Symposia 1

THE HISTORY OF PROSTHEMTC AND ORTHOTICS IN THE UNITED STATES

Russell J. Hornfisher
Becker Orthopedic

Here is a presentation that will explain the history of the O&P industry. Learn who first coined the name Orthotics. Who founded the Almanac and its name? Who first created the technique of casting? In the past 100 years how has the delivery process changed? How has the industry changed...or stayed the same.

Russell J. Hornfisher is Director of Sales and Marketing for Becker Orthopedic Company located in Troy, Michigan. Prior to that Mr. Hornfisher held positions as District, Regional, and National Sales Manager with three different companies in the medical equipment industry and Sales Trainer with four different companies. He has enjoyed success in the Pharmaceutical, Home Health Care, and Orthotic and Prosthetic Industries.

Russell earned a Bachelor's of Science Degree from Central Michigan University and a Master's degree in Organizational Behavior and Development from Eastern Michigan University. He has been an adjunct instructor for the Marketing Department in the School of Business at the University of Northern Iowa and Eastern Michigan University.

Mr. Hornfisher has published numerous articles on the topic of selling skills, marketing, and management. He has lectured at state, regional, and national association meetings on topics related to sales, marketing, and management. Current sits on the Board of Directors for American Orthotic and Prosthetic Association and chairperson of the national assembly. He has served in the position as Chairperson of the Marketing Committee for American Board of Certification for Orthotics and Prosthetics.

Thursday, 1:30 pm / Symposia 2

COMPLICATIONS IN WOUND HEALING AMONG APPARENTLY HEALTHY ADULTS AND CHILDREN

Brian Giavedoni, MBA, CP, LP

Jorge Fabregas, MD,

Colleen Coulter-O'Berry, PT, DPT, PhD, PCS

Children's Healthcare of Atlanta, Atlanta, GA

Everybody has heard the term "children heal quickly". The longer you treat them the more you realize that is not always true, specifically in the population with amputations requiring prostheses. Many of these children and adults are patients who had cancer with chemotherapy or acquired their amputations due to trauma with associated soft tissue defects, and bony infections.

Delayed wound healing can be attributed to many causes including local infection, underlying necrotic tissue, specific infections, poor blood supply, anemia or vitamin deficiency, chemotherapy, immune compromised status, and improper socket fit resulting in repeated trauma. Despite medical advances in medications, liners and suspension technology, prosthetic components, wound management, and nutritional support, we struggle with wounds, ulcers, blisters and recurrent skin breakdowns.

At Children's Healthcare of Atlanta, we have encountered a number of these patients who, despite advanced medical care, continue to struggle with their residual limbs. Some have had chronic infections and others recurrent skin breakdown. In several cases, the time span of non-healing wounds has been measured in years, not months. These complications create a huge burden on the healthcare system and on the patient's physical and emotional well being.

A retrospective analysis of 5 patient's past medical histories receiving IRB approval was performed through review of their medical records. A questionnaire was completed by the patients asking their perception of their health, quality of life, activity level and participation in the home, community and workplace. A review of the literature was also performed to establish current research in the area of delayed wound healing specific to the pediatric population with and without amputations. This study was conducted with the goal for ongoing review and with consideration for future prospective studies.

The study involved patients treated at Children's Healthcare of Atlanta over the past 13 years. Included are patients with wound delay healing of a minimum of 12 months. Data recorded include:

1. Patient demographics age, gender, cause of amputation, age at time of amputation
2. Number of hospitalizations
3. Duration of hospital stay measured in days
4. Number of surgical revisions
5. Number of surgical debridements
6. Time out of prostheses

7. Requiring new socket following surgical debridement or revision
8. Medications oral and IV antibiotics
9. Additional treatments such as whirlpool and hyperbaric treatments
10. Sensation of the residual- report absent, inconsistent, intact
11. Patient perceptions and feelings of their health, quality of life, activity and function and perception of their medical condition

Objectives

The objectives of this symposium are to:

1. Describe the predisposing conditions leading to complications of wound healing in patients with lower limb amputations
2. Discuss clinical presentation of wounds, acute and chronic
3. Describe additional wound care management of hyperbaric treatments and wound vac dressings
4. Present the impact the delay healing and open wound on the patient's mobility,

Goals

Following the presentation the ACPOC participants will:

1. Appreciate some of the obstacles that can have an effect on wound healing and prosthetic treatment
2. Gain knowledge of multispecialty treatment options for healing the challenging wounds
3. Recognize patients that have a high risk for potential complications.
4. Understand the impact of the delayed healing has on the patient's quality of life, prosthetic management, and the cost to the patient and society.

Thursday, 2:30 pm / Workshop A

CLINICAL EXPERIENCE OF DESIGNING, ALIGNING AND TUNING AFO FOOTWEAR COMBINATIONS BASED ON SEGMENT KINEMATICS

Deborah Gaebler-Spira, MD

Corinne Jordan, DPT

Donald McGovern, CPO, FAAOP

Larissa Pavone, MD

Rehabilitation Institute of Chicago, Chicago, IL

This course aims to introduce participants to the importance of segment kinematics in understanding and classifying standing and gait as well as designing, aligning and tuning of Ankle Foot Orthosis Footwear Combinations (AFO-FC). The biomechanics of normal and pathologic gait will be reviewed with attention to segment kinematics and kinetics. We will also discuss the initial clinical assessment and medical interventions prior to gait analysis. This approach will be placed within the context of the International Classification of Functioning, Disability and Health.

The importance of segment kinematics in standing and gait, and their effect on joint kinematics and kinetics will be demonstrated. The use of shank kinematics for the designing, aligning and tuning of AFO-FC will be reviewed. The importance of Footwear design in AFO-FCs will be established. The difference between optimal Angle of the Ankle and the Shank to Vertical Angle in an AFO-FC will be clarified.

The experiences of utilizing these concepts will be included from the viewpoint of the Physician, Orthotist and Physical Therapist. The initial experiences of the RIC AFO Tuning Clinic will be shared. Orthotic and Physical Therapy assessment, treatment goals and strategies will be presented.

Goals

Maximizing stability and mobility to improve function often includes the use of orthotics. This course presents a fresh approach to the analysis of normal and pathological standing and gait. Manipulation of lower extremity segment alignment as opposed to the common focus on joint position will be presented as an improved method for lower extremity orthotic alignment resulting in improved standing and gait. A more objective understanding of standing, gait and optimum orthotic intervention will be offered. Once the Orthosis is optimized the user has a new opportunity to improve control of their body, Physical Therapy can exploit this opportunity to improve function and address issues previously obscured by compensations. Strategies to take advantage of these opportunities will be explored.

Objectives

1. Describe the kinematics and kinetics of normal and pathological gait and standing, with equal emphasis on the kinematics of the segments and the joints.
2. Discuss a clinical algorithm to determine the optimum sagittal Angle of the Ankle in an AFO.
3. Discuss the biomechanics of AFO and Footwear Combination designs and a clinical algorithm to design, align and tune AFO-FCs.
4. Discuss the influence of optimally designed and aligned orthotics within the ICF model.

Friday, 8:00 am / Creative Solutions #2

**EXTERNAL JOINT MOUNTING AND VARIOUS AFO PLASTIC CONFIGURATIONS
TO ACHIEVE CORONAL AND SAGITTAL RESTRAINT TO THE FOOT AND
ANKLE COMPLEX**

Marc Kaufman, LPO

Atlanta Prosthetics and Orthotics, Inc., Atlanta, GA, USA

A challenge that every pediatric orthotist struggles with is how to achieve maximum coronal and transverse stability while still being able to allow sagittal range of motion. Historically if there was such severe coronal instability at the foot and ankle complex, or there is a lack of midfoot structural integrity, a solid AFO would be indicated due to the thought that if sagittal motion is allowed then the coronal/transverse control could not be achieved. Using an ankle joint that has the ability to provide rigid stops or various resistance in both dorsiflexion and/or plantarflexion, fine tuning a child gait for optimal results and structural integrity is possible even if there is significant coronal instability. The mounting of the joint externally instead of being pulled into the plastic, and using the joint either medially or laterally, allows superior coronal/transverse control through having a more total contact orthosis. Through several case presentations, including videos, various patients with different diagnoses and gait presentations will be shown using these joint and plastic configurations. The goal of this presentation is to bring an alternative solution to a difficult problem and also stimulate research that will assist in helping the orthotist determine optimal joint settings when aligning an AFO.

Friday, 8:10 am / Research #3

USING GAIT ANALYSIS TO COMPARE THE SAGITTAL PLANE BIOMECHANICAL EFFECTS OF THREE DESIGNS OF ANKLE FOOT ORTHOSES

Todd Dewees, CPO
Brock Sande, CPO

Background

Ankle foot orthoses (AFOs) are a common treatment for patients with a wide range of lower extremity disability. Through the phases of the gait cycle AFOs resist detrimental motions and promote beneficial forces to improve each patient's gait. After clinical evaluation and gait observation, the physician prescribes and the orthotist designs an AFO to specifically suit each patient and their gait. There are a few general brace designs to choose from such as solid ankle, articulated, and posterior leaf spring. Each design affects the biomechanics of the leg differently, but the goal of every AFO is to promote the most functional motions and forces of gait.

Gait is a complex system of simultaneous motions and corresponding forces acting through several joints in the body. Through years of studying gait, the medical community has widely adopted a system of defining the phases, motions, and forces associated with gait.¹ This study will focus on the biomechanics in the sagittal plane because those characteristics are the most pertinent to forward progress. The weight bearing events at the ankle are divided into three stages called first, second, and third rockers.² The first rocker occurs during the loading response phase of gait and consists of the dorsiflexor muscles eccentrically contracting to allow 10 degrees of plantarflexion.³ As the tibia is pulled forward by the first rocker the knee consequently undergoes a knee flexion moment which is resisted by the activation of the quadriceps muscles in order to maintain stance stability. The second rocker occurs during the midstance phase of gait and consists of the plantarflexor muscles eccentrically contracting to allow the tibia to advance to 10 degrees of dorsiflexion.² Lastly, the third rocker occurs in late stance and consists of the plantarflexors contracting to decelerate the advancement of the tibia and create a distal lever arm for propulsion.² The primary propelling force in reciprocal gait is created by gravity acting on the body weight through the limb.³ The propelling momentum is primarily absorbed and maintained by rockers in the ankle-foot complex and moments at the knee. In normal gait, the transfer of body weight onto the extended limb has been documented to be 60% of the person's body weight in 0.02 seconds.³ In pathological gait, the forces are often even greater and more abrupt.

Patients who are treated with AFOs typically have musculoskeletal involvement which prevents them from utilizing the anatomical rockers.⁴ Depending on the severity of strength deficient, solid ankle AFOs are used to substitute for the rockers and promote tibial advancement by limiting the plantarflexion motion at the ankle. However, by limiting the plantarflexion motion the solid ankle AFO transfers a greater flexion moment to the knee and consequently requires a greater knee extension contraction from the quadriceps.^{5,4} To prevent knee instability, it is generally recommended that patients have at least fair (3/5 MMT) knee extension strength to be suitable candidates for treatment with a solid ankle AFO.⁴ Although patients with knee instability are better candidates for using posterior leaf spring or articulated AFO design, those designs can have

drawbacks as well.⁶ For example, the posterior leaf spring (PLS) design allows relative plantarflexion at loading response and thus reduces knee flexion moment, but the design also allows excessive dorsiflexion in late stance due to an inadequate distal lever arm. Although articulated AFOs can be aligned to allow some relative plantarflexion and consequently reduce the excessive knee flexion moment, this alignment would also allow some plantarflexion during swing phase of gait and can cause toe drag. Select patients would benefit from a brace that allows some heel compression and reduction of knee flexion moments while still maintaining appropriate alignment and distal lever arm for propulsion.

After observing patients with excessive knee flexion moments, orthotists at Shriner's Hospital's for Children-Portland designed a solid ankle orthosis which allows the heel to compress at loading response. A literature review found no other published research that studied a comparable AFO design. The purpose of this research is to compare the biomechanical effects in the sagittal plane of an AFO designed with a compression heel to the standard solid ankle design.

Hypothesis

1. The solid ankle design orthoses promote knee flexion moments significantly greater than that of normal gait.
2. When compared to standard solid ankle design, the orthoses designed to allow the heel to compress leads to an increase in the relative plantarflexion at initial contact and a reduction of knee flexion moments.
3. When compared to the plastic compression heel orthoses, the carbon laminate compression heel orthoses will deflect less and provide an increased extension moment in midstance.

Friday, 8:30 am / Paper #2

TREATMENT OF WALKING CHILDREN AND FAILED SURGERY CASES WITH PONSETTIS PROTOCOL AND MODIFIED THERMOPLASTIC BRACES

Vipul Shah, MD

Garima Singh

Sunil Singh

Prakash Mishra

Ghanshyam Yadav

Indian Cerebral Palsy, Lucknow, India

Introduction

Ponsettis method of treatment of clubfeet is a standard accepted modality of treatment in infants, not much is published in relapse and neglected congenital, arthrogropic and meningomyelocele cases, the paper looks into these population subsets and also attempts to establish the efficacy of a thermoplastic corrective brace with better compliance in walking children.

Method and material

30 consecutive children aged 2yrs-9yrs mean age 4.5 yrs,18 males/12 females were studied all were evaluated by pirani score preoperatively and at follow up. Ctev-18 cases virgin feet, arthrogroptics-6, mmc-2,relapsed surgery-4 cases All were serially casted according to ponsettis protocol, achievement of 60 abduction was the end point of casting after which a percutaneous TA tenotomy was done in children less than 3 years and open z lengthening in others followed by A/K cast for 6 weeks . Average no of casts was 5.8 ,changed at weekly intervals Maintenance was done with thermoplastic splint with straps to bring the foot in abduction and dorsiflexio n to be worn at night and ctev shoes during daytime till 3 years post treatment or age of 5 years whichever was earlier.

Results

All children had full correction at end of procedure with average pirani score of .29 from average preop of 6, follow up (1 yr -5 yrs average 3.7yrs) showed average pirani score of .83. All parents were fully satisfied with treatment except 1 child with severe arthrogroptosis who had multiple relapses and now awaiting final surgery. With the modified braces the compliance with bracing was 100%.

Discussion

Ponsettis protocol can be used in salvaging difficult situations eg relapse after surgery ,arthrogroptosis and meningomyelocele it gives excellent correction but needs more casts per child ,use of novel thermoplastic braces can be used in walking children specially as in this category there is high failure rate in maintenance of correction with dennis brown splints due to poor compliance.

WHY DO CHILDREN WITH CEREBRAL PALSY STOP WEARING THEIR LOWER EXTREMITY ORTHOSES?

Melissa Malkush, CP, MSPO, Orthotic Resident

MH Mandelbaum Orthotic & Prosthetic Services, Port Jefferson, NY

Abstract

Through mere observation, it is apparent that more children with cerebral palsy (CP) than adults are seen in the orthotic clinic. The purpose of this study is to determine why these children stop wearing their lower extremity orthoses. Of the 102 patients that were contacted, 13 were included in the study. Most patients, 54%, stopped wearing orthoses because they were no longer prescribed by their physician. About a quarter of the patients, 23%, stopped wearing orthoses because their families felt that they should discontinue them. Only 15% of the patients chose not to wear the orthoses because they did not like them. One patient, 8%, felt that the orthoses were ill-fitting and did not follow-through with orthotic treatment. The study suggests that the severity of the child's impairment may play a key role in whether orthotic treatment is continued or not. In conclusion, the patients and families should know that individuals with CP have muscle imbalance and a tendency towards contracture for the rest of their lives. They should communicate with their physicians about potential contracture management.

Introduction

Cerebral palsy (CP) is a generic term used to describe certain clinical syndromes that present with abnormal voluntary muscle movement, posture and muscle coordination. This is consequence to a non-progressive upper motor neuron (UMN) lesion that occurs during fetal development or shortly after (1,2). As the child with CP ages and neuromuscular milestones are achieved, the true extent of the pathology becomes evident. Approximately 10,000 babies and infants are diagnosed with CP and 1,200-1,500 preschool age children are also recognized to have CP in the United States annually (1).

There are 5 commonly defined forms of cerebral palsy: spastic, athetoid, ataxic, hypotonic, and a mixed form (3). Spastic CP, or hypertonia is the most common form (2). As per the content of this study, the other pertinent form of CP is hypotonia. Where hypertonic children present with increased muscle tone, muscle tightness, and possibly limited range of motion (ROM), hypotonic children present with general lack of muscle tone, or what appears to be "floppiness".

According to the International Society for Prosthetics and Orthotics (ISPO), the aim of orthotic management of CP is to: 1) correct and/or prevent deformity, 2) provide a stable base of support, 3) facilitate training in skills, and 4) to improve the efficiency of gait (4).

As the severity of CP increases, more joints are affected by the muscle imbalance. Many children with mild presentations may have ankle/foot involvement only. These children are commonly prescribed ankle-foot orthoses (AFOs) with or without ankle joints to discourage plantarflexion (equinovarus), encourage heel strike and discourage pronation during stance phase, and to encourage toe clearance and increased step length during swing phase (4).

For the child with hypotonia, the lower extremity often presents with pronation or pes plano valgus. Physicians often prescribe supra-malleolar orthoses (SMOs) to support the subtalar joint and arch during stance phase of gait (4).

Most CP literature focuses on the child. In 2005, the O&P Edge published an article titled, "Where are they now?", referring to the adult population with CP. This article summarizes feedback from members of the medical team, including the patients (5). It focuses on the moderately to severely impaired individuals, leaving the impression that most adults with CP ultimately end up in wheelchairs. The author writes that, "at some point, almost all cerebral palsy patients are going to have surgery... Ambulation becomes less functional for them, and they just decide to use a wheelchair."

Through mere observation, it is apparent that most patients with CP in the orthotic clinic are indeed children. The numbers drastically drop off into adolescence and few adults continue to use orthoses unless they are moderately to severely involved. It did not seem likely that the great percentage of children with CP that stop coming into orthotic clinic are inevitably in wheelchairs as the mentioned article suggests.

The purpose of this study is to determine why children stop wearing their lower extremity orthoses, specifically in their pre-adolescent and adolescent years.

Friday, 9:15 am / Creative Solutions #3

**USE OF ADJUSTABLE DYNAMIC RESPONSE AFO BRACES TO ADDRESS
COMMON GAIT ABNORMALITIES IN AN ADOLESCENT WITH DIPLEGIC
CEREBRAL PALSY**

Andrew Sutphin, DPT
Cindy Miles and Associates, Whitehall, PA

The creative solution addresses improving common gait abnormalities such as achieving a heel strike as well as allowing for a proper push off in the terminal stance phase for a teenager with the diagnosis of Spastic Diplegic Cerebral Palsy. The patient's history includes physical therapy twice a week, previously worn bilateral SMOs, as well as heel cord and hamstring lengthening procedures. Drake experienced a growth spurt which caused impaired balance, reduced ROM and decreased strength. The surgical procedure addressed the above clinical concerns as well as necessitated new braces. At this time we recommended braces that would provide LE stability, dynamic balance, alignment, and address gait abnormalities. The patient was fitted with Ultraflex Adjustable Dynamic Response™ (ADR™) AFOs. These braces have a tension-adjustable component that allowed incremental increases of controlled AROM in both dorsiflexion and plantarflexion throughout his gait cycle. The results included achievement of heel strike and tibia advancement, improved balance and ambulation, maintenance of improved PROM, and freedom from pain.

Friday, 9:25 am / Paper #3

USE OF SUPRA-MALLEOLAR ULTRA-FLEXIBLE DYNAMIC AFOS TO IMPROVE FUNCTION IN ADOLESCENTS AND ADULTS WITH MODERATE TO SEVERE C.P.

Nancy Hylton, PT, LO

Dynamic Orthotic Systems, Div. of Dynamic Family Services, Kent, WA

Our Center, Children's Therapy Center of Kent, in Kent, Wa. now has more than 25 years of experience with long-term wear of ultra-flexible supra-malleolar Dynamic AFOs. In some instances, persons with moderate to severe CP have worn these orthoses successfully from 1-2 years of age into adulthood. In other instances they have begun to wear this type of orthosis as teenagers or adults.

We are continuing to collect data through patient or parent questionnaire of all person's who have worn this type of orthosis for more than 5 years, with focus on improvement and maintenance of functional abilities, number and type of surgical interventions while wearing DAFOs, number and type of other interventions including, drug therapy, serial casting, Botox, etc, other medical problems including seizure meds. Of special interest is an open ended question about "the use of DAFOs in their daily life."...What is helpful? What is problematic? We hope to include person's living also in Germany, Great Britain and other areas who have worn this type of orthosis to gain a broader perspective on their use.

Friday, 10:30 am / Creative Solutions #4

A SURPRISING OUTCOME TO A SEVERE INFANTILE SCOLIOSIS, USING A DYNAMIC ELASTOMERIC FABRIC ORTHOTIC INTERVENTION

Martin J. Matthews, M.Phil, CO

Selin Bridges, MSc, MCSP

Jim Wynne, CPO, FAAOP

Cambridge University Hospitals NHS Foundation Trust, Cambridge, UK

These are 10 minute presentations* of the results of new or innovative prosthetic, orthotic, or other therapeutic interventions. Designs **MUST** be focused on original, inventive or imaginative approaches to problems afflicting children with limb deficiencies rather than a specific manufacturer's product. These presentations are intended to inspire discussion and collaboration among meeting participants, to provide new ideas for participants to implement immediately in the day-to-day care of their patients, and to stimulate future scientific investigation. Include 'how you solved it' and solicit audience feedback.

Case Study

A male child (aged 4 years old) presented with myotonic dystrophy in March 2009. Sitting X-rays indicated a left sided 70° thoracic curve with an apex at T8. Vertebral rib angles were in excess of 20° (45°) with a marked protruding pectus carinatum evident that affected his breathing. The S1 perpendicular line was to the left of his neck showing major asymmetry to the left resulting in a sharp compensatory curve in the cervical spine. He was unable to tolerate rigid or semi-rigid spinal bracing and had a history of non-compliance. He was unable to walk independently and could stand only with plenty of support. The treating therapists had concerns over re-trying to use rigid bracing based on the previous experiences and were keen to try a non-invasive technique if possible that wouldn't affect his poor muscle tone. Surgical intervention was out of the question due to his poor health.

The Solution

Curves of this magnitude are known to be difficult to treat orthotically, and corrective interventions over 50° are often used to hold spinal curves prior, to surgical interventions. The concern regarding the loss of muscle tone indicated that repetition of conventional spinal orthotics would not be appropriate in this case. Based on blueprinting of the x-rays a dynamic elastomeric fabric orthosis (DEFO) as a suit, was used to try to provide some sensation of mid-line via proprioceptive feedback coupled with three point management and counter-rotation of the spinal segments. V-shaped translation panels and counter rotation compression bands were incorporated to initiate the corrective moments.

Follow up sitting x-rays in March 2010 indicated that the child's curve had reduced to 35° from 70°. The left side curve was now one vertebra lower at T9 with the S1 perpendicular line now to the right of the cervical spine, even with a marked positional pelvic asymmetry to the left. There was a 33% reduction in the lateral shift seen at the apical vertebra. The pectus carinatum was visibly reduced and the vertebral rib angles had reduced.

Parents reported that he was now able to stand independently and could walk with support through his hands.

Discussion Points

Could this method of spinal treatment provide us with a new tool to cope with the child with neurological and developmental scoliosis? Does the use of dynamic orthotic interventions offer a new concept in the treatment of infantile and possibly idiopathic scoliosis?

Friday, 10:40 am / Paper #4

**SPINAL DEFORMITIES FOLLOWING SELECTIVE DORSAL RHIZOTOMY: A
REVIEW OF AVAILABLE OBSERVATIONAL COHORT STUDIES**

Phillip M. Stevens, MEd, CPO

Allison Oki, MD

Salt Lake City, UT

A Medline search ultimately identified nine cohort studies in which the incidences of spinal deformities following selective dorsal rhizotomy were reported. Reported spinal deformities variously included scoliosis, spondylolysis, spondylolisthesis, lumbar hyperlordosis and thoracic hyperkyphosis. Cohort studies were predominantly retrospective with only one prospective study identified. Cohort sizes ranged from 30 to 163 subjects with a mean cohort size of 74.2. Operative techniques included both laminectomies and laminoplasties. Mean ages at the time of rhizotomy were consistently between 5 and 7 years old. Mean durations from rhizotomy to post-operative assessment were generally between 3-6 years with the exception of two studies with longer mean follow up times of 8.6 and 21.4 years respectively.

Formal syntheses of available data sets were challenged by tremendous variability in reporting techniques, including pre and post operative assessment variables and the functional classification levels of subjects. However, the follow trends were observed. Severe scoliosis was infrequently reported and generally limited to more severely disabled, non-ambulatory patients. Among ambulatory subjects, post-operative scoliosis was common but usually mild in curve magnitudes. Spondylolysis and spondylolisthesis were commonly observed in ambulatory subject post rhizotomy. However, the deficits were generally mild and while detected radiographically, were typically otherwise asymptomatic. Increases in mean lumbar lordosis values post rhizotomy were common. Mean cohort values for thoracic kyphosis experienced only minimal change following rhizotomy. The impact of these trends is further compromised by a paucity of data regarding the natural history of these spinal deformities in the absence of selective dorsal rhizotomy.

While spinal deformities are frequently reported in the early years following selective dorsal rhizotomy, they are generally mild in their magnitudes and largely asymptomatic. The impact of these deformities on functionality during the adult years is unknown.

Friday, 11:00 am / Creative Solutions #5

**HAND TRANSPLANTATION: REVIEW OF INDICATIONS, COMPLICATIONS, AND
A LOOK INTO THE FUTURE**

Robin C. Crandall, MD

Shriners Hospital for Children, Minneapolis, MN

Bilateral upper extremity amputees represent some of the most devastating and difficult patients to manage. The functional loss in this group of patients is devastating and often prosthetic fitting is abandoned due to a variety of factors. The concept of upper extremity limb transplantation has been viewed as a possible partial solution to this problem. The concept of upper extremity limb transplantation has recently been promoted by the Mayo Clinic in Rochester, Minnesota. A clinical trial has been started with a selection process being developed for bilateral upper extremity amputees. The purpose of this presentation is to introduce members of ACPOC and ORA to the concept of upper extremity limb transplantation. Development of a list of possible patient candidates would perhaps be a useful function for the ORA and ACPOC. This paper will include a discussion of upper extremity limb transplantation, a review of the literature, complications, and outlook for the future.

Friday, 11:30 am

WARTIME PEDIATRIC AMPUTEES: THE HUMANITARIAN EFFORT

Joseph F. Alderete MD, MAJ, MC
Orthopaedic Surgery Residency, San Antonio Military Medical Center

Introduction

The humanitarian medical effort has gained momentum in the last 5 years of Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF). As the coalition military continues to support combat operations we have seen a shift in focus to nation building campaigns. Part of winning the hearts and minds of the local population is sustainment through pediatric care.

Methods

We performed a literature search on relevant topics and examined the Joint Theatre Trauma Registry (JTTR) for pediatric patients treated by coalition forces as part of OIF and OEF. The percentage of admissions for pediatric patients compared to the overall civilian health care burden was investigated as well as demographics and disease processes. Statistics from the 555th Forward Surgical Team were examined and extrapolated to anticipate pediatric support needs. Amputation characteristics and available prosthetics were investigated from the Red Cross (ICRC), and other Non-Government Organizations (NGO's). We looked at prosthetic fitting and use characteristics and formed a protocol for supply and treatment based on local resources for the kids.

Results

3500 pediatric admissions accounted for 32% of OEF and 13% OIF patients treated from 2002 to 2009. Orthopaedic wounds accounted for 32%, closed fractures 12%, burns 10%, and open fractures 9%. Majority of amputations performed in the pediatric population was for trauma and burns. Data extrapolated from multiple Forward Surgical Team databases suggest pediatric amputations account for 5% of the local national health care burden. The Red Cross (ICRC) is the main source for prosthetic supply; however, there is still an acquisition crisis. Data derived from these experiences has allowed the formation of standard treatment protocols in a more efficient pediatric resupply chain.

Conclusion

Pediatric trauma care, especially for the amputee population in Iraq and Afghanistan has gone a long way in forwarding our nation's best interests. We should remain committed to helping the Iraqi and Afghan physicians reduce pediatric mortality in their country. In studying the data from our collective experiences we can make an enormous difference in the lives of these people.

THE COMBAT AMPUTEE: THE LONG ROAD HOME: FROM THE DESERT TO CFI AND BEYOND

Introduction

Approximately 17,700 soldiers have been injured and returned to duty as part of Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF). Equally humbling is the 13,000

wounded in action soldiers who have not returned to duty. As a result of multiple factors from body armor to the battlefield tourniquets and the large scale trauma systems and advanced evacuation we are seeing a 90% survival rate. 80% of these survivors will have an extremity injury. 7-10% of these individuals will have an amputation.

Methods

We performed a literature search on relevant topics and examined the Joint Theatre Trauma Registry (JTTR) and CFI database for amputation statistics and characteristics over the last 10 years. The data has been used to describe the experience of the combat amputee.

Results

As of July 2009 803 patients had a major limb amputation. 22% have had multiple limbs amputated. 39% have additional fractures. 45% will have infection. 12% will have severe complex nerve injuries with 41% having some other soft tissue catastrophe. Early challenges include associated trauma, critical care nutrition, soft tissue damage, infection, and burns. Late complications that affect the amputee include infection, heterotopic ossification, and pain. We will discuss the latest return to duty statistics and compare them with the limb salvage cohort.

Conclusion

With increased awareness generated from the Extremity War Injury consensus, we have seen a great many soldiers survive devastating injury. However, they do not always return with intact extremities. We must understand the challenges to limb salvage, the complications awaiting an amputee patient, and the hurdles associated with return to active duty or civilian reintegration in order to best care for our wounded warriors.

Friday, 1:30 pm / Presidential Speaker

EMPOWERING THE GENERATION OF TRANSFORMATION

Robert Gailey, Jr., PhD, PT

The days of children with limb loss or absence being told that they cannot participate in physical education, sports or any other physical activity are rapidly coming to an end. For the past two decades the worldwide movement toward participation in recreational and competitive sports has focused attention on the athletic abilities of the physically challenged population. Many of the pioneers who once participated in sports are now leaders in business and their communities. Unfortunately, there still exist many hurdles in changing the attitudes of the established generation. A prime example was the story of Oscar Pistorious, a bilateral transtibial amputee whose bid for the 2010 Olympics in Beijing was met with extreme prejudice towards a disabled athlete competing with other Olympians. Today's children have the opportunity to educate their peers throughout their formative years on the abilities of people with disabilities so future generations of bureaucrats, employers, colleagues and friends will accept them for who they are, breaking all stereotypes.

This presentation will briefly discuss the past events that have made it possible for future generations to continue the education of society as to the capacity of people with disabilities. The primary discussion will focus on therapeutic interventions that may assist children in attaining their physical capabilities with a prosthesis. Two functional outcome measures will be offered as objective means to prescribe, treat and quantify the child's progress. The neurophysiological basis for balance and speed training and the prescription of evidenced-based exercise and training programs, including a simple system of teaching children to run will be discussed. Moreover, suggestions for getting children involved in community recreation and sports programs will be presented. By facilitating children to reach their full physical potential, they will be empowered to educate their peers and remain involved in the decisions that guide their future.

Friday, 2:30 pm / Symposia 3

MANAGING THE HAND & UPPER EXTREMITY IN CHILDREN WITH CEREBRAL PALSY

Allan Peljovich, MD, MPH

Goals/Objectives

1. Understand what Cerebral Palsy is, and how the condition affects the hand and upper extremity.
2. Understand how to evaluate a child with Cerebral Palsy in order to understand what treatment options may be available to treat the particular child's needs and goals.
3. Understand the various treatment modalities, their indications, applications and outcomes.

Management of the upper extremity in children with cerebral palsy (CP) involves the efforts of many disciplines. From therapists to surgeons, optimization of hand function requires varied inputs. This symposia will review the fundamentals of evaluating a treating the hand and upper extremity in children with cerebral palsy.

The topics we will cover include:

1. Understanding the nature of cerebral palsy. It is critical to appreciate that CP is not one thing, but any variety of conditions that lead to loss of upper motor neuron control of the extremities. Whether by hypoxia, prematurity, bleeding or other, CP manifests itself as a combination of aberrant motion and abnormal posturing due to problems of the central nervous system.
2. Evaluating the child with CP. Treatment hinges on understanding the particular child's manifestation of CP. This involves both physical examination, and assessment of the child's particular need's and goals. Physical examination requires a complete evaluation of motor control, sensation (higher order), and standard musculoskeletal examination principles. Adjuvant studies are often employed to help the evaluation, including local motor blocks, dynamic electromyograms, functional testing, and radiography. Once completed, a viable treatment plan can be employed.
3. Treatment of CP. Based upon a thorough evaluation combined with an understanding of a child's needs and goals, treatment seeks to improve his/her ability to use their upper extremities for routine activities or help their assistants with issues concerning hygiene and care. Physiotherapy, orthotics, medications and surgery are all utilized in various combinations as needed. Treatment cannot produce an 'able bodied' hand and upper extremity, nor can it cure CP. Our goals and success in children with mild CP are different from those with severe neurological involvement and severe upper extremity contractures. We will review these modalities, their indications and applications in sufficient detail.

A program that incorporates a multidisciplinary team approach to treating children with CP is ideal. At the conclusion of the symposia, attendees should have a thorough appreciation of evaluation and treatment.

Friday, 4:00 pm / Paper #5

CORRELATION OF MOTOR FUNCTION AND STEREOGNOSIS IMPAIRMENT IN UPPER LIMB CEREBRAL PALSY

Elsbeth Kinnucan, MD

Ann Van Heest, MD

Wendy Tomhave OTR/L

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Shriners Hospitals for Children- Twin Cities, Minneapolis, MN

Purpose

To correlate motor function, as measured by the Jebsen-Taylor test, and sensory function, as measured by the 12-object stereognosis testing, in the hands of children with spastic hemiplegia due to cerebral palsy.

Methods

A chart review identified children with hemiplegic and triplegic cerebral palsy with stereognosis and Jebsen-Taylor testing between 1997 and 2008. Forty-one children were included in the study, including 22 girls and 19 boys, with an average age of 8.7 years (range 6-16 years). The right side is affected in 23 children; 34 children have hemiplegic cerebral palsy, and 7 have triplegic cerebral palsy. The initial Jebsen-Taylor and stereognosis test results were recorded for each subject, as well as age, diagnosis, affected side, and prior treatment and hand therapy, botulinum toxin injection, or surgery. Descriptive statistics, chi-square analysis, paired t-tests, and correlation measurements were used for analysis of the data.

Results

Statistically significant inverse correlations exist between the cards, small objects, checkers, light objects, and heavy objects on the Jebsen-Taylor subtests, as correlated with the stereognosis scores in the affected hand ($p \leq 0.04$). The stereognosis scores for the patients who were not able to complete the Jebsen-Taylor test with the affected hand were significantly lower than those who were able to complete the Jebsen Taylor test with the affected hand ($p = .04$). The stereognosis scores were significantly lower for the affected hand as compared to the contralateral side. The Jebsen-Taylor total test times were significantly longer for the affected side as compared with the contralateral side ($p < .001$).

Conclusions

In children with hemiplegic and triplegic cerebral palsy, the impairment of stereognosis is correlated with impairment in motor function, and the inability to complete the Jebsen-Taylor test with the affected hand is associated with impaired stereognosis function.

Friday, 4:10 pm / Paper #6

CHANGES IN STEREOGNOSIS FUNCTION IN CHILDREN WITH CEREBRAL PALSY

Kate Pico, MD

Ann Van Heest, MD

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Shriners Hospitals for Children- Twin Cities, Minneapolis, MN

Purpose

Stereognosis is the ability to identify objects without visual input.

Changes in stereognosis function in children with cerebral palsy have been reported after surgical reconstruction of the hand. It is not known whether stereognosis changes with maturation or changes due to treatment intervention.

Methods

A chart review identified children with hemiplegic cerebral palsy who have completed at least 2 stereognosis tests between 1998-2009. Their treatment interventions during this timeframe were identified and classified into three groups: Rehabilitation alone, Botox injections plus rehabilitation, and Surgery plus rehabilitation. Chi square analysis and Wilcoxon Rank Test were used to compare treatment groups and stereognosis testing scores.

Results

Thirty-three children with hemiplegic cerebral palsy met our criteria including 13 males and 20 females. The left side was affected in 14 children, and 19 had right hemiplegia. The average age at testing was 9 yrs old with a range of 6-16 yrs. Average time to follow up was 41 months with a range of 2-118 months. The treatment groups included 6 patients who had surgery with rehab, 10 patients had botox injections with rehab and 17 patients had rehab alone. In stereognosis testing of the affected arm 17 improved, 6 stayed the same and 10 decreased. There were no significant differences in changes in stereognosis results when comparing the 3 treatment groups ($p < 0.24$). When comparing within each treatment group, the rehabilitation group had the most significant changes in their stereognosis test results ($p < 0.04$).

Conclusions

Stereognosis test results change over time in children with hemiplegic cerebral palsy. The greatest changes were seen in the group treated with rehabilitation alone. Further studies are needed to determine what factors influence these changes

Friday, 4:35 pm / Creative Solutions # 5

QUICK, EASY, AND COST EFFECTIVE WAYS TO MEASURE OUTCOMES IN CHILDREN RECEIVING ORTHOTIC AND PROSTHETIC SERVICES

Colleen Coulter-O'Berry PT, DPT, PhD, PCS
Children's Healthcare of Atlanta, Atlanta, Georgia

The word *Research* can be a source of trepidation and apprehension for any clinician. Measuring outcomes for research takes time, money, and training not readily available to most clinicians. However, measuring outcomes is extremely important to determine patient progress and satisfaction of the services we provide. Outcomes can measure our effectiveness as clinicians. Positive outcomes can be used to validate the services we provide and justify the need for continuation of care and for new devices.

There are standardized cost effective, time efficient, and easy to administer tools that are available to measure outcomes and require little to no training.

Some of these measurement tools include: Time Up and Go, TUG; Time Up and Go Down Stairs, TUGS; 6-minute, heart rate; Omni perceived exertion scale for boys and girls; and numerous pain scales. Equipment required to administer these tests include: tape measure, chair, tape or colorful stickers, flight of stairs, long hallway, and pulse oxymeter.

Examples of the application and effectiveness of these measurement tools will be explained through a case presentation of a 12 year old boy with Proximal Femoral Focal Deficiency, PFFD. The TUGS, TUDS, 6 minute walk test, heart rate, perceived exertion, and pain will be assessed pre and post surgical intervention. Results of the pre and post surgical tests will be compared.

Friday, 4:45 pm / Paper #7

ORTHOPEDIC SEQUELAE OF CHILDHOOD MENINGOCOCCEMIA: MANAGEMENT CONSIDERATIONS AND OUTCOME

Federico Canavese, MD*^{1,2}

J. Ivan Krajbich, MD²

B. Lafleur²

1 - Hopitaux Universitaires de Geneve

2 - Shriners Hospital, Portland, OR

Purpose

The purpose of this study is to describe our experience with purpura fulminans related to meningococemia with emphasis on musculoskeletal sequelae and their treatment.

Methods

Twenty-two boys and 26 girls (n=48) with a history of meningococcal septicemia were retrospectively reviewed. Sequelae were characterized into two groups: early, which were primarily amputations and required surgical treatment within 6 months from the onset of sepsis, and late, which required surgical management 6 months or more following initial infection and included growth disturbances, stump overgrowth, scar contractures, and infections. Fisher's Exact Test and Odds Ratio were used to analyze categorical data and to define the odds of complication occurring between the two groups. Statistical significance was established at $p \leq 0.05$.

Results

The mean age of onset of sepsis was 2.6 ± 3.0 years and the mean follow-up was 11.7 ± 5.1 years. The average number of surgical procedures required was 4.4 ± 2.9 per patient (n=212). Upper extremity amputations were less common [OR=0.30; 95% C.I.(0.13-0.70); $p=0.004$] and less severe [OR=0.18; 95% C.I.(0.08-0.44); $p < 0.001$] than lower extremity amputations. Growth disturbances leading to angular deformities were less common in the upper than in the lower extremity [OR=0.14; 95% C.I.(0.05-0.42); $p = > < 0.001$] and were more likely to occur in an intact lower limb compared to an amputated lower extremity [OR=6.94; 95% C.I.(1.73-27.81); $p=0.005$]. Stump overgrowth did occur only in 11 patients (22.9%) with lower extremity amputations. The incidence of scar contractures was similar when comparing upper and lower extremities [$p=0.19$]. Eight patients (16.7%) acquired an osteoarticular infection at the distal portion of the amputated stump 7.2 ± 5.4 years after initial sepsis. Thirteen patients (27.1%) were diagnosed with developmental delay on follow-up visit, being severe in 7 cases.

Conclusions

All patients who survive meningococcal septicemia should be reviewed by an orthopedic surgeon experienced in pediatric limb deformities and amputations. Children requiring surgery for purpura fulminans are limited by their physical disability related to amputations, scarring, and abnormal bone growth. Despite advances in management, children are still at risk of developing physical and developmental limitations.

Significance

Retrospective Study

Saturday, 8:00 am / Paper #8

SYME VS. BOYD AMPUTATION FOR FIBULAR DEFICIENCY: A TWO CENTER FUNCTIONAL ASSESSMENT STUDY

Brian Louie

Joel A. Lerman, MD

Janet Walker, MD

Kimberly Savarino

Sherry Middleton

Anita Bagley, PhD

Shriners Hospitals for Children-Sacramento, California and Lexington, Kentucky

Background

For children who have undergone amputation for deformities associated with fibular deficiency, it has been unclear whether Boyd and Syme amputations confer differing functional outcomes. Also, few data have correlated clinical outcomes of these amputees with severity of fibular deficiency. To evaluate possible differences, the American Academy of Orthopedic Surgeons Pediatric Outcomes Data Collection Instrument (PODCI) was utilized in this study.

Methods

Forty-three patients at two centers who had undergone either Boyd or Syme amputations for fibular deficiency were assessed. Informed consent was obtained, and all were administered the parent version of the PODCI. Comparisons were performed with type of amputation (Syme vs. Boyd), uni- vs. bi-laterality, and severity (Achterman and Kalamchi type 1 [fibula present] vs type 2 [fibula absent]¹). T-tests were used to compare PODCI domain scores between groups.

Results

As a group, bilateral patients had lower Transfers ($p=.04$), Sports ($p=.01$), and Global Function scores ($p=.04$) than unilateral patients. Comfort ($p=.04$) and Happiness ($p=.05$) were greater in unilateral Type 2 Boyd amputees compared with Syme amputees. No differences were noted between unilateral Type 1 Syme vs. Boyd amputees.

Conclusion

Patients with bilateral ankle disarticulations for fibular deficiency reported mobility and recreational limitations compared with unilaterally affected patients. While no differences were noted between Boyd vs. Syme amputations for type 1 patients, for the more severely affected Type 2 patients, Boyd amputees reported less pain and more happiness than Syme amputees, suggesting the Boyd amputation may be preferable in that population.

¹Achterman and Kalamchi, JBJS-Br, 1979, 61:133.

Saturday, 8:10 am / Paper #9

REVIEW OF BILATERAL TRANSVERSE FIBULA DEFICIENCY PATIENTS

Kenneth J. Guidera, MD

Robin C. Crandall, MD

Matt M. Morel, CPO

Shriners Hospitals for Children-Twin Cities, Minneapolis, MN

Purpose

This is a review of 16 patients with bilateral fibula deficiency having long term follow up. Their ambulation status, surgical procedures, prosthetic usage, and clinical outcome will be presented.

Methods

This is a retrospective review of 16 patients with transverse fibular deficiency who were treated at Shriners between 1990 and 2009.

Conclusion

This review will demonstrate that in the long term, this is a highly functional group that requires a high level of surgical and prosthetic care.

Significance

This is a long term follow up of a large group of patients with a rare diagnosis that has not been reported previously.

Saturday, 8:20 am / Challenging Case #1

ELECTIVE TRANSTIBIAL AMPUTATION OF A SEVERE CLUBFOOT TO OBTAIN HIGHER FUNCTIONS

Karl Barner, CPO, LPO

Children's Healthcare of Atlanta, Atlanta, GA

Clubfoot conditions are often very correctable and lead to a highly functional lifestyle. However, for a low percentage of patients with severe clubfeet, function can be very limited. An uncorrectable clubfoot can result in generalized weakness due to inactivity, poor gait pattern, pain, over usage of the more functional limb, leg length discrepancy, fatigue, postural compensation, and lack of recreational abilities. For a teenager, dreams of higher levels of activities and higher self-esteem require significant sacrifices.

This case describes one young man's journey of care with bilateral severe clubfeet, and his decision to have the painful, rigid and significantly deformed foot amputated to obtain higher functional life experiences. His goal to run and participate in community based events has been a long and challenging situation.

His post-amputation condition needed to be managed by a team of a physician, physical therapist, prosthetist, athletic trainer, and family support. His limitations included lack of extension range of motion in his knees, generalized weakness especially in his core and quadriceps, and moderate dysfunction of his contralateral limb. The patient also had to be taught to run, as he had never could run before his amputation. The prosthesis needed to be adjustable to change as he increased function.

The objective of this case is to demonstrate that functional goals may be obtained with appropriate management of care and determination by the patient. The teamwork of the prosthetist, athletic trainer and physical therapist outside of the clinic environment contributed to his achievement of participating in two community running events by the one year anniversary of his amputation.

Acknowledgements

We would like to thank the patient and his family for the hard work and support.

Saturday, 8:30 am / Paper # 10

TIBIAL DEFICIENCY ASSOCIATED WITH FEMORAL BIFURCATION: MANAGEMENT OPTIONS

David E. Westberry, MD
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Femoral bifurcation is a rare congenital anomaly often associated with severe forms of tibial deficiency. Fewer than 50 cases have been reported in the literature. This condition has been described in both the Gollop-Wolfgang complex and tibial agenesis-ectrodactyly syndrome. Management options including limb reconstruction versus amputation strategy can be considered for the unusual diagnosis. This report described 3 patients who presented with distal femoral bifurcation associated with tibial deficiency and required three unique surgical strategies to optimize the residual limb.

The initial case involved a 4 month old with an abnormality of the left lower extremity. Radiographs demonstrated tibial deficiency, partial absence of the 1st metatarsal, and bifurcation of the distal femur. At age 10 months, a left through knee amputation was performed. At age 4, due to the increased width of the distal femur and problems with prosthetic wear, closure of the femoral bifurcation with creation of a synostosis was performed. This procedure was complicated by postoperative wound infection and skin slough requiring surgical debridement and skin grafting. This patient now utilizes an above knee prostheses, Silesian belt, 4 bar knee, and dynamic response foot.

The second case involved a 6 week old male who presented with a shortened right lower extremity, absence of the tibia and 5th metatarsal, and bifurcation of the distal femur. Prosthetic fitting was achieved without surgical intervention initially. However, due to difficulty with prosthetic wear secondary to persistent knee flexion deformity, a decision was made to pursue a knee fusion. During the surgical exposure, it was noted that a cartilaginous tibial anlage was present medially. The femoral bifurcation was narrowed and the lateral femoral prominence was fused to the proximal fibula. The residual foot was maintained. Current radiographs now reveal continuing ossification of the tibia. He currently utilizes an above knee prosthesis.

The third case involved an 8 month old male with deformity of the left lower extremity. Clinical evaluation demonstrated protuberance along the medial distal femur, absent tibia, and equinovarus alignment of a four ray foot. At age 15 months, a through knee amputation was performed. In addition, the prominent medial femoral limb was resected and a distal femoral osteotomy of the lateral limb was performed. This was complicated by a postoperative wound infection and skin slough requiring early pin removal and use of a wound vac to gain closure of the soft tissues. He currently uses an above knee prosthesis.

The goal of treatment in cases of femoral bifurcation include optimization of the residual limb to allow for prosthetic fitting. As the above cases illustrate, treatment strategies often depend on the presenting anatomy of the extremity, reduction in size and width of the bifurcation, and attention in management of the soft tissues.

Saturday, 8:55 am / Challenging Case #2

**TIBIAL HEMIMELIA – BRACKETT EPIPHYSIS VARIANT – TREATMENT
DISCUSSIONS AND FOLLOW-UP**

J. Ivan Krajbich, MD

Two year follow on treatment of a child with brackett tibial epiphysis presenting as tibial hemimelia phenotype is presented. Child underwent brackett resection, restoring his growth and complex reconstruction of polydactyly foot, providing functional foot.

Saturday, 9:05 am / Paper #11

THE ROLE OF A PROSTHETIC KNEE ON TEMPORAL AND SPATIAL PARAMETERS OF CRAWLING

Mark Geil, PhD

Colleen Coulter-O’Berry, PT, DPT, PhD, PCS

Carolyn Heriza, PT, EdD, FAPTA

Georgia State University

Children’s Healthcare of Atlanta, Rocky Mountain University of Health Professions,

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Provo, Utah

Children with limb loss at or above the knee face specific challenges at different stages of development. When transitioning from crawling to walking, and during the intermediate activity of pull-to-stand, a prosthesis must accomplish multiple and sometimes disparate goals: the mobility necessary for crawling and the stability necessary for standing and walking. This investigation tested the hypothesis that crawling mobility would be reduced when the traditional treatment protocol of a prosthesis lacking an articulating knee joint is followed.

Crawling pattern, velocity, and cadence were measured in five children with unilateral limb loss at the knee disarticulation or transfemoral level. Testing occurred within three weeks of the fitting of each child’s first prosthesis, which included an articulating knee. Two conditions were tested: prosthetic knee in its fully articulating state and prosthetic knee locked into extension. Each subject’s motion was captured at 120 Hz for the two crawling conditions using an 8-camera Peak Performance optical capture system with a 10-marker set using landmarks on the torso and legs. Cadence and velocity were measured for successful trials as determined by completion of three successive crawling cycles without stopping along the 10 meter path. The start of the crawling cycle for each limb was identified by knee contact. Velocity was estimated based on the movement of any of the four torso markers (acromion or PSIS) along the anterior-posterior axis of the global coordinate system per unit time. Velocity and cadence were compared in each condition using paired two sample t-tests with significant differences based on an alpha level of 0.05. Additionally, each trial was observed to determine crawling pattern. Two patterns were possible: “step-to” crawling and “step-through” crawling, depending on whether the contralateral knee was advanced in front of the ipsilateral knee during crawling (step-through) or not.

The hypotheses were supported for both velocity and cadence. Across all subjects, average velocity in the unlocked condition was 0.327 m/s (\pm standard deviation 0.107 m/s), compared to an average velocity of 0.235 ± 0.124 m/s in the locked condition. Average cadence across all subjects in the unlocked condition was 127.30 ± 41.05 crawling steps per minute compared to average cadence of 105.19 ± 27.94 crawling steps per minute in the locked condition. With one exception, the children exhibited a more typical “step-through” crawling pattern when the knee was unlocked and a less efficient “step-to” pattern when the knee was locked.

Despite the wide variability present in infant crawling patterns, the results of this study were consistent across subjects. Although subjects used different patterns to achieve crawling with a

prosthesis and to accommodate to the locked knee condition, the locked knee slowed them down in every case. These data indicate that the traditional prescription protocol for children with transfemoral limb loss may inhibit crawling, which may in turn have long-term implications on motor development.

Saturday, 9:15 am / Paper #12

CLEARANCE ADAPTATIONS IN CHILDREN WITH LIMB LOSS DURING EARLY WALKING

Mark Geil, PhD

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Young children with limb loss who require a prosthetic knee joint present a unique rehabilitation challenge to clinicians. Historically, clinical protocols have placed the goal of stability over the goal of neuromotor development. The most stable knee is one that is locked into full extension at all times. However, this stability comes with disadvantages. A fully extended knee is a substantial hindrance during crawling, walking, and age-appropriate functional activities. Nonetheless, standard practice does not provide children with a flexing knee joint until they reach four or five years of age (1-3). This is conventional wisdom has not been supported with biomechanical evidence but has remained unchallenged until recently.

The objective of this study was to follow recently conducted research on infants with unilateral limb loss crawling with locked and unlocked knees to determine the impact of the knee following the transition to walking. The study tested hypotheses that children with transfemoral limb loss will adopt one or more of three gait adaptations (circumduction, hip hiking, or vaulting) when the prosthetic knee is locked into full extension, and that the magnitude of the adaptations will decrease kinematically when the knee is unlocked.

Seven healthy children with unilateral transfemoral amputation or knee disarticulation (≤ 5 years old) participated. Children were able to walk safely unassisted and had been fit with an articulating knee in their first prosthesis. Prior to data collection the parent/guardian provided consent for their child to participate in the approved study protocol. 15 eight-mm markers were attached to standard anatomical landmarks. Each participant completed three walking trials with the normally flexing prosthetic knee, three with the knee mechanically locked into full extension, and three with the knee flexing again. Kinematics were recorded at 120 Hz using a 7-camera motion analysis system. Trials were averaged for each participant and specific kinematic variables associated with each adaptation were compared between conditions using paired t-tests with an α - level of 0.05.

In the locked knee condition, every subject exhibited one or more of the three analyzed accommodations. One subject exhibited the same accommodation in the unlocked condition, though the magnitude was decreased. The remaining six subjects showed none of the three analyzed clearance accommodations in the unlocked condition, although some other gait abnormalities were present, typically associated with hip flexion and extension necessary to articulate the prosthetic knee. All subjects flexed the prosthetic knee effectively in the unlocked condition.

The children in this study had been provided with an articulating knee joint in their first prosthesis, so the unlocked condition represents their developing gait pattern. The presence of

acute accommodations in the locked condition and the general absence of any chronic clearance accommodations demonstrate the effectiveness of the “early knee” protocol in promoting more typical motor development.

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CLINICAL USE OF ROLLOVER SHAPE

Jeremy C. Farley, CPO/L
Gerald E. Stark, MSEM, CPO/L, FAAOP
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While the number and variety of prosthetic foot designs continues to expand, the prosthetist is left with relatively few paradigms by which to compare and match foot function to patient needs. Rollover shape, a concept developed by Andrew Hansen, Ph.D. et al at Northwestern University, has been especially helpful to describe the motion and compare the movement of various types of prosthetic foot designs. A deeper understanding of rollover shape with respect to support and motion results in a comprehensive understanding of how the rollover shape is affected and altered by walking environment and foot design. Rollover shape also aids the clinician observing dynamic gait by explaining how foot function may be optimized by alignment and positioning. A comparison was drawn from various research databases such as Medline, RECAL Legacy, and CINAHL using the terms: “roll-over shape, foot, prosthetics, and orthotics.” Presentation reviews the affects of incline/decline, speed, orthotic intervention, or change weight to the rollover shape and attempts to relate them to prosthetic alignment practice. Lecture will also describe other elements of prosthetic foot and ankle design using roll over shape as a reference.

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Saturday, 10:20 am / Symposia 4

**NEUROMUSCULAR DISORDERS IN CHILDREN: INTERDISCIPLINARY
MANAGEMENT**

Samuel R. Rosenfeld, MD

CHOC Children's Hospital, University of California, Irvine, Orange, California

This symposium reviews neuromuscular disorders in children and the principles of their rehabilitation. These disorders represent the paralytic conditions of childhood. The pathophysiology of neuropathic versus myopathic conditions are discussed including the diagnostic and therapeutic interventions. The role of interdisciplinary management is essential including pediatric, neurologic, orthopaedic, genetic, pulmonary, cardiology, metabolic, physical therapy, occupational therapy, social service, orthotics, nursing, and dietician.

The goal of this symposium is to understand the pathophysiology and rehabilitation principles in the management of neuromuscular disorders in children.

The objective of this symposium is to clarify interdisciplinary modalities in the comprehensive management of neuromuscular conditions in children.

Saturday, 11:15 am / Paper #13

OPTIMIZING GAINS FROM BOTULIN TOXIN & THE VALUE OF ASSISTIVE SPLINTAGE

Vipul Shah, MD

Garima Singh

Sunil Kumar

Prakash Mishra

Ghanshyam Yadav

Himanshu Singh

Indian Cerebral Palsy, Lucknow, India

Introduction

Botulin toxin is a known treatment of focal spasticity and recently dystonia but reversible in effect, care givers and parents obviously wish to optimizing the effects of botulin, the end point of the effect is the potential return to pre injection values of spasticity /dystonia and ROM, the reported effects of botulin stay for 4 -12 weeks but for many parents in developing countries the cost of repeated shots is a constraint and the paper looks at potential strategies to optimize the effect

Methods and Materials

148 consecutive children(2yrs -14yrs average 4.8yrs) who received botulin for spasticity/dystonia(98 spastics/50 dystonics) were taken up for a retrograde study according to hospital records All assessment as part of protocol were document under video including measurement of ROM and gait evaluation ,spasticity evaluation was done by Modified Ashworth Scale ,dystonia by BAD scale

All procedures were done under general anaesthesia to differentiate static and dynamic components and all children with static deformities were given 4-6 weeks of concurrent plaster in addition to the botulin,post procedure all children received oral baclofen for spasticity and levo-carbidopa combination for dystonia according to standard dosages

Post cast removal all children were put to intensive therapy with parents being given video tapes to replicate sessions at home with average 2 hours of therapy /day

All children were given night time A/K bracing with a wedge and dynamic AFO`s during the day

Results

The effect of combined botulin, oral medication,splints and intensive therapy stayed for more than 6 months in all children except one child, with average 9.8 months in return to pretreatment values(5.5 months -2.5 years) 66% children improved by 2 GMFCS grades,21% improved to 1 grade and the rest stayed at the same level in the interim follow up with obvious reduction in care taker burden

Discussion

Botulin has been shown to cause changes in brain plasticity (botulin toxin and the carry over effects on neuroplasticity- a diffusion tensor imaging study trivedi et al, journal of pediatric neurology) and perhaps this study has showed the effect of complimentary need of intensive therapy and augmentation of effects with assistive night bracing but children who often need splints don't wear one due to spasticity/dystonia (www.jbjs.org/abstracts/acpoc08.pdf) and the best strategy is perhaps combination of all together with intensive therapy and active participation of parents /caregivers.

Saturday, 11:25 am / Creative Solutions #8

LIGHTWEIGHT CARBON FIBER KNEE EXTENSION ASSIST ORTHOSIS FOR SEVERE CROUCH GAIT

Nancy Hylton, PT, LO
Kent, WA

Severe crouch is one of the more difficult bracing challenges. We have used various types of knee extension bracing to help manage this with the disadvantage that the knee is locked in maximum extension.

We have been exploring the use of flexible carbon fiber spring assist to knee extension with several young persons with cerebral palsy and severe crouch gait (70-90 degrees of knee/hip flexion in supported standing). This system combines a full neoprene liner, thigh and lower leg cuffs and a posterior carbon fiber band, and is designed to assist active knee extension in standing and walking.

This orthosis has been fabricated in conjunction with Cascade DAFO and Benik, Inc. for component parts, but has been assembled at our facility, Dynamic Orthotic Systems, Kent, WA. Presentation will include comparison photos, videos of functional use and fabrication details.

Saturday, 11:45 am / Symposia 5

MEDICALLY BASED EVIDENCE RELATING TO DEFORMITY PREVENTION IN EARLY INTERVENTION PEDIATRIC AFOS

Robert Meier, CO, BOCO

Introduction

Pediatric populations generally develop deformities in the foot/ankle complex at the initiation of weightbearing and the earliest stages of gait development. Under current “common practice” principles, in some pediatric populations there is nearly a 100% incidence of the complex becoming hyper-pronated and dysfunctional. Orthotic intervention commences after the deformity is apparent.

Methods

A literature review was initiated to determine the effectiveness of current orthotic intervention techniques. A search was conducted in PubMed and three other data base literature search engines involving key words or phrases including AFO subtalar neutral, stability in AFO, AFO gait outcomes, and AFO functional outcomes.

Results

The searches led to finding no published data to support the early intervention concept. Only one reference was found relating to orthotic intervention and deformity outcomes, and that study indicates that traditional orthotic intervention has no effect on deformities. There are multiple data sources however to suggest that a “controlled motion” environment may enhance joint modeling and neuromuscular development and at the same time minimize disuse atrophy secondary to immobilization.

Discussion

Pediatric populations present with an extremely high incidence of foot/ankle deformities. Because there is no medical evidence to support early intervention, none has been used, but the outcomes of waiting for the deformity to develop before applying orthotic intervention has led to unacceptable outcomes.

Goals and Objectives

The objective of this course is to discuss the concept of early intervention based on related core medical evidence. Upon completion of the course, attendees will be able to:

- Describe the effects of delaying intervention until a significant deformity needs to be managed
- Describe the medical evidence in current orthotic intervention techniques
- Describe medical evidence relating to normal structural maturation process
- Predict the hypothetical functional and postural outcomes in patients with early intervention functional orthotic environments

Conclusions

Current intervention concepts and techniques lead to nearly 100% incidence of significant deformities in certain pediatric populations. Medical evidence is reviewed to create a new paradigm in an attempt to define new concepts to minimize these deformities and allow for more normal development of the lower quarter.

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Poster

A LOCALLY DEVELOPED HIP DISARTICULATION PROSTHESIS: AFFORDABLE MOBILITY AND BODY IMAGE RESTORATION FOR THE FILIPINO AMPUTEE

Amiel C. Adajar, MD

Josephine Bundoc, MD

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University of the Philippines

Osteosarcoma is a primary malignant tumor involving the distal femur and proximal tibia with an incidence of approximately 1 to 3 per 1 million per year. Management options include chemotherapy and radical amputation such as hip disarticulation which adversely alters the patient's body image and limits his activities of daily living, most especially mobility. The provision of a prosthesis as part of the post-amputation rehabilitation is therefore vital to ensure early return of function. However, this type of prosthesis is expensive thus, limiting their use in Filipino amputees and giving rise to the need to source and fabricate prosthesis components locally.

A 15-year-old, male, from Quezon Province who was diagnosed with osteosarcoma of the right distal femur with subsequent hip disarticulation in March 2009 consulted for possible fabrication of a hip disarticulation prosthesis. Physical examination revealed a surgically absent right lower extremity with no note of neuroma nor phantom limb pain. Patient was ambulatory with bilateral axillary crutches. He was subsequently admitted for prosthetic training with a hip disarticulation prosthesis with a locally made mechanical hip joint. At present, patient was independent in donning and doffing of his prosthesis, ambulatory using the prosthesis with lofstrand, independent in his activities of daily living and had improved body image.

Keywords: *osteosarcoma, hip disarticulation, hip disarticulation prosthesis, prosthesis*

Acknowledgements

This case report would not be possible without the help of the team that have shared their time and expertise. I would like to thank them for their contribution.

I would like to thank Josephine R. Bundoc, MD (Head, Prosthetic and Orthotic Section, University of the Philippines-Philippine General Hospital) for entrusting me this case and giving me an opportunity to learn more about this field.

Rafael Bundoc, MD, Engr. Dimetrio Bonifacio and who takes time to create and share ideas on making and improving the design

Cynthia Ang, MD for always have time to review our case and gives suggestion on ways to improve our work, thank you.

Orthotics and Prosthetic staff, Winnie D. Bellosillo and Edgar D. Bellosillo for taking time to improve the quality of our prosthesis. Marilyn P. Casero section secretary for providing

quotation and constantly reminding our technician and patient of the schedule. Michael M. Gascon for his patience and effort in training our patient.

The second most devastating and functionally impairing level of single amputation is hip disarticulation. In this regard, the hip disarticulation prosthesis is prescribed in order to restore lost functional mobility and complete body image. This goal is rarely achieved due to the high cost of the hip joint needed for fabrication of a hip disarticulation prosthesis. With the Department of Rehabilitation Medicine Prosthetics and Orthotics service's mission of rendering functional prosthesis affordable to all walks of life, it has come up with a prototype of hip joint to be used for our Filipino amputees. Our 15y/o S/P Hip disarticulation patient is the first to use this prototype and this case report documents the development of this local hip joint designed to facilitate ADL independence, especially mobility, and improve body image.

Poster

BIKE ADAPTIONS FOR UPPER EXTREMITY LIMB DEFICIENCIES

Lisa McIntyre, OTR

Children with upper extremity limb deficiencies are often trying to ride a bike either by holding onto the handle with one hand, or by holding onto the handle with short arm which pulls them off balance. This poster will show a low cost solution to adapting bikes for U/E limb deficiencies. This poster will have fabrication instructions and have pictures of several children with the adaptations attached to their bikes. I also have video of children riding their bikes which I could also show.

Poster

LONG-TERM FOLLOW UP OF VAN NESS ROTATIONPLASTY FOR CONGENITAL PFFD

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Jeffrey Ackman, MD

Haluk Altiok, MD

Mary Peer, PT, PCS

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Background

There are multiple controversial treatment options for children with congenital proximal focal femoral deficiency (PFFD). Little has been reported about long-term outcomes of individuals who have undergone Van Ness rotationplasty for PFFD.

Purpose

To assess the long-term functional and quality of life outcomes for individuals who have undergone rotationplasty surgery for congenital PFFD.

Methods

This is a prospective pilot study on 10 subjects (6 M, 4F), ranging in age from 16-57 years (average 31.6 ± 13.9 years). All subjects completed the following outcome questionnaires: SF-36, Revised-Faces Pain Scale, Harris Hip Score, Oswestry back pain score, Prosthetic Evaluation Questionnaire© (PEQ), and demographic/history/body image questionnaire developed by the authors. Seven of the ten patients were evaluated by the physical therapist using lower extremity range of motion (ROM), hand held dynamometry (HHD) and Timed 'Up& Go' (TUG).

Results

Rotationplasty was performed at an average of 4.8 years of age (range 1-12 years) with multiple additional surgeries on the hip and knee for adult subjects. 8 of the 10 subjects reported satisfaction with their surgical outcome. Only one subject had an unfused knee, two subjects used a cane or crutch for long distances.

On the demographic questionnaire, two subjects reported they are currently in high school, one in college, two completed high school only, two only completed some college and three completed college. All adults were working full time in a variety of manual and desk jobs. All subjects lived in a private residence with four still living with parents. Three subjects were married with one having biologic children and one subject divorced. All reported multiple close friends. No issues were seen for body image, except four subjects avoid some type of clothing and three subjects avoid the gym and bathing suits. On the date of testing, all subjects reported no pain on the Revised-faces pain scale, but two subjects reported mild hip pain on the Harris Hip Score and five reported minimal/moderate disability on the Oswestry back score for intermittent back pain.

All subjects had a moderate decrease in hip flexion, mild decrease in hip abduction and dorsiflexion and moderate increase in plantarflexion. Using the HHD, all subjects exhibited moderate/significant hip flexor weakness, moderate hip abductor weakness, hip adduction and extension and ankle dorsiflexion stronger on prosthetic side for half of subjects, and mild/moderate gastrocnemius weakness. Subjects scored an average of 8.2 ± 2.1 seconds on the TUG. On the SF-36, subjects scored high in role-emotional, social functioning, physical functioning and reported minimal pain (Table 1). For the PEQ, subjects scored lower in satisfaction, appearance, and sounds of the prosthesis. However, subjects reported others perceived them well and they did not see themselves as a social burden (Table 2).

Table 1 SF-36

Scales	Average scaled scores (max 100)	Norms*
Physical functioning	85.0	84.2
Role-function	95.0	80.9
Bodily pain	86.0	75.2
General health	78.4	71.9
Vitality	69.5	60.9
Social Functioning	92.5	83.3
Role- emotional	90.0	81.3
Mental Health	78.8	74.1

*Norms data from <http://www.sf-36.org/tools/SF36.shtml>

Table 2 Prosthetic Evaluation Questionnaire (PEQ)©

©1998, Prosthetics Research Study, Seattle, WA, USA

Scales	Average percent scored (max 100)
Satisfaction	60.1
Ambulation	77.1
Appearance	68.0
Frustration	77.4
Perceived response of others	90.4
Residual limb health	65.9
Social burden	95.0
Sounds	65.5
Utility	72.3
Well being	82.7

Conclusions

Overall long-term follow up of teens and adults with rotationplasty demonstrate general satisfaction with surgical outcomes and good life satisfaction with minimal disability. In the future we plan to enroll additional subjects and address gait pattern, postural stability and X-ray results.

Acknowledgements

This project was funded by the Helen Kay Charitable Private Foundation. We would like to acknowledge the assistance of Joseph Krzak, Adam Graf, Kathy Reiners and Vickie Young in the Motion Analysis Lab at Shriners Hospitals for Children; Scheck and Siress; and Bardach and Schoene prosthetic labs.

Poster

GOALS AND CONSIDERATIONS IN ORTHOTIC TREATMENT OF A YOUNG CHILD WITH SPASTIC DIPLEGIA

Karl Barner, CPO, LPO

Children's Healthcare of Atlanta, Atlanta, GA

A young child with cerebral palsy and associated spastic diplegia can have multiple functional limitations. There may be varying opinions between members of the multidisciplinary team in how to optimize gait and potentially correct deformities.

In the case of a three year old girl with spastic diplegia, a family sought necessary care for her condition. The characteristics of her foot / ankle complex include severe pes planus with rigidity between the midfoot and forefoot and slight plantarflexion contracture. Under weight bearing, the foot becomes rockered in the midfoot. The condition worsens with anterior tibial advancement beyond midstance. This resulted in pain and substantial pressures on the medial malleoli and navicular bone areas against the AFO.

The considerations in fitting her with ankle foot orthoses resulted in four opinions:

- Fit with an articulated AFO in plantargrade position. The patient was used to this position, but contributes to a rocker bottom foot.
- Fit a limited range of motion AFO and have a significantly inverted and adducted forefoot posting to optimize subtalar joint alignment. This is difficult to fit in a shoe.
- Compromise between the first two options.
- Or, a solid ankle AFO with moderate forefoot inversion and adduction.

The teamwork between the patient's most recent physical therapist and orthotist resulted in assisting higher function. The challenges of AFO design, therapy, the patient's initial condition and continued improvement will be discussed. Long term outcomes will also be reviewed.

Acknowledgments: Thank you to the patient and the family for letting me share your case and your patience in long term treatment.