2016 Annual Meeting
April 13-16
Omni Interlocken Resort
Broomfield, Colorado

“Professionals Helping Kids be Kids”

ABSTRACTS
### Thursday, April 14

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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<tr>
<td>7:00–8:00 AM</td>
<td><strong>LIGHT BREAKFAST</strong> in Centennial Ballroom EF</td>
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<tr>
<td>6:30 AM–5:00 PM</td>
<td><strong>REGISTRATION</strong> in Centennial Foyer</td>
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<tr>
<td>7:30 AM–5:00 PM</td>
<td><strong>SCIENTIFIC PROGRAM</strong> in Interlocken Ballroom BCD</td>
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<tr>
<td>7:30–7:40 AM</td>
<td><em>Welcome – David B. Rotter, CPO, President</em></td>
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<td>7:40–7:50 AM</td>
<td>New Investigator Research Award Presentation – <em>David B. Rotter, CPO</em></td>
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<tr>
<td>7:50–10:15 AM</td>
<td><strong>SESSION I – NEUROMUSCULAR LOWER LIMB INVOLVEMENT</strong></td>
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<tr>
<td>7:50–8:00 AM</td>
<td>Challenging Case 1, <strong>Multi-Disciplinary Approach: Treatment Of Idiopathic Toe Walking With Severe Contracture</strong></td>
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<td>8:00–8:10 AM</td>
<td>Paper 1, <strong>Functional Evaluation Of The Foot Drop Stimulator In Children With Hemiplegia</strong></td>
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<td>8:10–8:25 AM</td>
<td>Challenging Case 2, <strong>Cloves Syndrome: A Presentation Of 2 Cases</strong></td>
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<td>8:25–8:35 AM</td>
<td><strong>Discussion</strong></td>
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<td>8:35–8:45 AM</td>
<td>Creative Solution 1, <strong>A KAFO Design For Marked Genu Valgum Related To CIPA</strong></td>
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<td>8:45–9:00 AM</td>
<td><strong>Discussion</strong></td>
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<td>9:00–9:15 AM</td>
<td><strong>MEET &amp; GREET VENDORS / REFRESHMENT</strong> (in Exhibitor Hall)</td>
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<td>9:15 AM–12:25 PM</td>
<td><strong>SESSION II – CRANIAL AND SPINAL INVOLVEMENT</strong></td>
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<td>10:45–10:55 AM</td>
<td>Paper 2, <strong>Clinical Outcomes Of The Michigan Cranial Reshaping Orthosis: A Retrospective Review Of Outcomes Measured By Three-Dimensional Laser Scanning</strong></td>
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<td>10:55–11:05 AM</td>
<td>Paper 3, <strong>Development Of Clinical Practice Guidelines For The Orthotic Management Of Deformational Plagiocephaly</strong></td>
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<td>11:05–11:15 AM</td>
<td><strong>Discussion</strong></td>
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<td>11:15 AM–12:15 PM</td>
<td><strong>Scientific Workshop 2</strong> – <strong>Surgical And Non-Surgical Management Of The Skeletally Immature Spine</strong></td>
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<td>12:15–12:25 PM</td>
<td><strong>Discussion</strong></td>
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<td>12:25–1:25 PM</td>
<td><strong>LUNCH</strong> in Centennial Ballroom EF</td>
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<td>1:25–2:25 PM</td>
<td><strong>Hector Kay Memorial Lecture – Melissa Stockwell, CP</strong> From Baghdad to Beijing and Beyond</td>
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<td>2:25–3:15 PM</td>
<td><strong>SESSION III – PHYSICIAN’S GUIDED FORUM</strong></td>
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<td><strong>Moderator: J. Ivan Krajbich, MD</strong></td>
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FRIDAY, April 15

7:00–8:00 AM  LIGHT BREAKFAST in Centennial Ballroom EF
7:00 AM–5:15 PM  REGISTRATION in Centennial Foyer
8:00 AM–5:15 PM  SCIENTIFIC PROGRAM in Interlocken Ballroom BCD
8:00–9:10 AM  SESSION V – NON-SURGICAL OUTCOMES IN LOWER LIMB DEFICIENCIES AND AMPUTATIONS
   Moderator: Colleen P. Coulter, DPT, PhD, PCS
8:00–8:10 AM  Preliminary Data Assessing The Five Factor Model Of Personality Traits, PODCI, OPUS Survey Results In Adolescents With Below Knee Amputations
   Hank White, PT, PhD; Juanita Jean Wallace, MS; Samuel F. Augsburger, MS; Chris B. Burke, CP; Janet L. Walker, MD; Henry J. Iwinski, MD
8:10–8:20 AM  Comparison Of Ground Reaction Forces Between Correct Fitting And Incorrect Fitting Prosthesis For Children With Unilateral Below Knee Amputations
   Hank White, PT, PhD; Juanita Jean Wallace, MS; Samuel F. Augsburger, MS; Chris B. Burke, CP; Janet L. Walker, MD; Henry J. Iwinski, MD
8:20–8:30 AM  Axial And Rotational Stiffness Of Pediatric Leg Prostheses
   Paolo Taboga, PhD; Alena M. Grabowski
8:30–8:40 AM  Discussion
8:40–8:50 AM  Factors Impacting Participation In Sports For Children With Amputations: A Pilot Study
   Marena Lamy; Batoul Sayed Ahmed; Debra L. Cameron, OT, PhD; Lisa Artero, MSc (OT), OT Reg. (Ont); Sandra Ramdial, CP(c); Matthew J. Leineweber; Jan Andrysek, P.Eng
8:50–9:00 AM  Pediatric Outcomes Data Collection Instrument In Pediatric Amputees: Parent And Adolescent- Reported Outcomes
   Kelly A. Jeans, MS; Lori A. Karol, MD
9:00–9:10 AM  Discussion
9:10–9:15 AM  SESSION VI – LOWER LIMB AMPUTATIONS AND SURGICAL OUTCOMES
   Moderator: Phoebe R. Scott-Wyward, DO
9:10–9:25 AM  Challenging Case 3
   Patient With Bilateral Congenital Longitudinal Deficiency And Fibular Hemimelia Type 2, With Difficulty Ambulating As An Adolescent
   Ryan A. Mooney, PA-C; Corey Beebe, MS; Travis C. Heare, MD
9:25–9:40 AM  Challenging Case 4
   Tibial - Fibular Bone Synostosis Permanent Solution In Pediatric Transtibial Amputations. Case Review Of Two Bilateral Transtibial Amputees
   Burhan Dhar, CPO; Zayed Al Zayed, MD
9:40–9:50 AM  Creative Solution 2
   Guided Growth Physeal Surgery in Bilateral Longitudinal Fibular Deficiency
   Robin C. Crandall, MD; Gabriela Ferski, RN, MPH, MS
9:50–10:05 AM  Challenging Case 5
   How Does Energy Cost, Efficiency Of Movement, And Satisfaction With Mobility Change With Prosthetic Practice In A Patient With Arthrogryposis And Bilateral Knee Disarticulations?
   Jesse L. Kowalski, PT, DPT; Kelly A. Jeans, MS
10:05–10:15 AM  Discussion
10:15–11:00 AM  MEET & GREET VENDORS / REFRESHMENT (in Exhibitor Hall)
11:00 AM–12:00 PM  Presidential Guest Lecture – Gregory L. Dumanian, MD
Targeted Reinnervation: From Napkin Drawing to Standard of Care Treatment of the Upper Extremity Amputee

12:00–1:15 PM  BUSINESS MEETING LUNCH (Members Only) in Interlocken Ballroom BCD

1:15–5:15 PM  SESSION VII – PFFD/SARCOMA/ AND ROTATION PLASTY
Moderator: Jorge A. Fabregas, MD

1:15–2:05 PM  The Rotationplasty: An In-Depth Discussion Of The Surgical, Prosthetic And Rehabilitation Interventions – PART I – SURGICAL
Brian J. Giavedoni, MBA, CP, LP; Colleen P. Coulter, DPT, PhD, PCS; J. Ivan Krajbich, MD; David B. Rotter, CPO

2:05–2:15 PM  Discussion

2:15–3:05 PM  The Rotationplasty: An In-Depth Discussion Of The Surgical, Prosthetic And Rehabilitation Interventions – PART II – PROSTHETIC and REHABILITATION
Brian J. Giavedoni, MBA, CP, LP; Colleen P. Coulter, DPT, PhD, PCS; J. Ivan Krajbich, MD; David B. Rotter, CPO

3:05–3:15 PM  Discussion

3:15–4:00 PM  MEET & GREET VENDORS / REFRESHMENT (in Exhibitor Hall)

4:00–4:10 PM  Proximal Focal Femoral Dysplasia: Creative Solution Of Prosthetic Fitting To Incorporate Native Knee Flexion, A Case Series
Phoebe R. Scott-Wyrd, DO; Jack Mark, CPO

4:10–4:25 PM  Rethinking Proximal Brim Design Of PFFD Sockets
Rebecca A. Hernandez, CPO/LPO

4:25–4:35 PM  Health-Related Quality Of Life Among Patients That Underwent Lower Limb Rotationplasty Reconstruction Versus Limb Salvage For Treatment Of Malignant Tumors
Corey Beebe, MS; Ryan A. Mooney, PA-C; Shelley Dell’Orfano, NP, RN, MS; Travis C. Heare, MD; Nathan Donaldson, DO

4:35–4:45 PM  Discussion

4:45–4:55 PM  Overground Walking Following A Unilateral Van Ness Rotationplasty: A Biomechanical Comparison
Susan Kanai, PT, OCS, CSCS; Travis C. Heare, MD; Anne K. Silverman, PhD; Corey Beebe, MS; Nathan Donaldson, DO

4:55–5:05 PM  Can A Person With Van Ness Rotationplasty Walk Symmetrically?
Madhurima M. Baliga, BSE; Travis C. Heare, MD; Nathan Donaldson, DO; Susan Kanai, PT, OCS, CSCS; Anne K. Silverman, PhD

5:05–5:15 PM  Discussion

5:15 PM  Adjourn

6:00–10:30 PM  Optional Friday Night Event – Night on the town in Boulder. Transportation only(pre-registration required)

SATURDAY, April 16

7:30–8:30 AM  LIGHT BREAKFAST in Centennial Ballroom EF

7:00 AM–12:00 PM  REGISTRATION in Centennial Foyer

8:00 AM–12:00 PM  SCIENTIFIC PROGRAM in Interlocken Ballroom BCD

8:00–11:10 AM  SESSION VIII – HIGH LEVEL & MULTIPLE LEVEL AMPUTATIONS AND DEFICIENCIES
Moderator: Brian J. Giavedoni, MBA, CP, LP
The 2016 Annual Meeting evaluation is on-line ONLY. Completion is required to obtain your Certificate of Attendance. Access the survey at https://www.surveymonkey.com/r/ACPOCAM16 Directions on completing the survey: Once you have accessed the evaluation, you can go back to previous pages in the survey and update existing responses until the survey is finished or until you have exited. If you do not complete the survey before exiting, your responses will be captured however, you will not see your previous answers, when you subsequently access the survey form. Your IP address is stored in the survey results to verify that you have completed the survey. Once you have answered all the questions, you will be directed to the certificate of attendance. Feedback is important and is considered in planning future educational events.

Please complete the online survey by Tuesday, May 31, 2016.
POSTERS

Poster #1  Development Of Low Cost 3D Printed Transitional Prostheses  
*Jorge M. Zuniga, PhD; Jean M. Peck OTL, CHT; Rakesh K. Srivastava, MS, CPO; Dimitrios Katsavelis, PhD; John Stollberg, OTD, OTR/L, CKTP*

Poster #2  Use Of Prosthesis Simulators In Preparatory Training Prior To Delivery  
*Debra Ann Latour, MED., OTR/L*

Poster #3  Potential RSI Risks In One Handed Texting  
*Reza Alavi, MS; *Edmund N. Biden, D.Phil*

Poster #4  The Use Of Botulinum Toxin And Splinting For External Rotation Contractures In Birth Related Brachial Plexus Lesions  
*Pamela E. Wilson, MD; Patricia B. Kenyon, OT, CHT; Anne Stratton, MD; Aaron Powell, MD; Jason L. Bradshaw, CO*

Poster #5  A New Prosthetic Model For Management Of Pediatric Partial Foot Amputations  
*Robert Meier, CO, BOCO; Vincent DeCataldo, BOCO, BOCP*

Disclosure Statement
The presenting authors on papers and posters are printed in boldface. All authors are required to complete a financial disclosure statement online disclosing whether or not he or she, or immediate family member, has received something of from a commercial company or institution, which related directly or indirectly to the subject of their presentation.

ACPOC does not view the existence of these disclosed interests or commitments as necessarily implying bias or decreasing the value of the author(s) participation in the course.

An indication of the participants’ disclosures appear after each individual name, in the program schedule, as well as the name of institution or company that provided the support.

The Program Committee has disclosed the following:

*Jorge A Fabregas, MD: Submitted on: 11/01/2015*
Integra: Paid consultant

*J Ivan Krajbich, MD: Submitted on: 11/02/2015*
Association of Children's Prosthetic and Orthotic Clinics: Board or committee member
K2m: Paid presenter or speaker
Scoliosis Research Society: Board or committee member

*Robert D Lipschutz, CP: (This individual reported nothing to disclose); Submitted on: 10/28/2015*

*Kristine Kay Nolin, CPO: (This individual reported nothing to disclose); Submitted on: 01/04/2016*

*Nicole Soltys, CP: Submitted on: 01/04/2016*
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*Hank White, PT, PhD: (This individual reported nothing to disclose); Submitted on: 09/28/2015*

The ACPOC Staff has disclosed the following:

*Elizabeth Frale: (This individual reported nothing to disclose); Submitted on: 10/12/2015*

*Susan Shannon: (This individual reported nothing to disclose); Submitted on: 10/1/2015*

*Amy Sherwood: Submitted on: 10/01/2015*
Merck: Stock or stock Options

ACPOC 2016 Annual Meeting Participant Disclosures

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Medtronic: IP royalties; Other financial or material support

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*Madhurima M. Baliga, BSE*  
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*Corey Beebe, MS*  
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Bristol-Myers Squibb: Stock or stock Options
Pfizer: Stock or stock Options
Procter & Gamble: Stock or stock Options
Stryker: Stock or stock Options

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Submitted on: 10/09/2015

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Submitted on: 10/15/2015

Susan Kanai, PT, OCS  
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Lori A. Karol, MD  
Submitted on: 01/28/2016
Journal of the American Academy of Orthopaedic Surgeons: Editorial or governing board; Publishing royalties, financial or material support
Pediatric Orthopaedic Society of North America: Board or committee member
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<th>Name</th>
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<tr>
<td>Lori A. Karol, MD (cont.)</td>
<td>Saunders/Mosby-Elsevier: Publishing royalties, financial or material support</td>
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<td>Dimitrios Katsavellis, PhD</td>
<td>This individual reported nothing to disclose; Submitted on: 12/15/2015</td>
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<td>Patricia B. Kenyon, MA, OTR, CHT</td>
<td>(This individual reported nothing to disclose); Submitted on: 10/14/2015</td>
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<td>Jesse L. Kowalski, PT, DPT</td>
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<td>Submitted on: 11/02/2015 Association of Children's Prosthetic and Orthotic Clinics: Board or committee member K2m: Paid presenter or speaker Scoliosis Research Society: Board or committee member</td>
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<td>Marena Lamy</td>
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<td>Phoebe R. Scott-Wyward, DO</td>
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<td>(This individual reported nothing to disclose); Submitted on: 08/17/2015</td>
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<td>Anne Stratton, MD</td>
<td>(This individual reported nothing to disclose); Submitted on: 02/17/2016</td>
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Paolo Taboga, PhD  (This individual reported nothing to disclose); Submitted on: 10/05/2015
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Hugh G. Watts, MD  (This individual reported nothing to disclose); Submitted on: 09/20/2015
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David E. Westberry, MD  (This individual reported nothing to disclose); Submitted on: 10/01/2015
Hank White, PT, PhD Submitted on: 09/28/2015
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  Actelion: Unpaid consultant
  Amgen Co: Research support
  Amicus: Research support; Unpaid consultant
  Armagen: Research support
  BioMarin: Research support; Unpaid consultant
  Genzyme: Paid consultant; Research support
  Protalix: Research support
  Roche: Research support
  Shire: Research support
Pamela E. Wilson, MD  (This individual reported nothing to disclose); Submitted on: 10/12/2015
Shane R. Wurdeman, PhD, MSPO, CP  Submitted on: 09/28/2015
  Ability Dynamics: Research support
  American Academy of Orthotists and Prosthetists: Board or committee member
Vivian J. Yip, OTD, MA, OTR/L  (This individual reported nothing to disclose); Submitted on: 02/09/2016
Jorge M. Zuniga, PhD  (This individual reported nothing to disclose); Submitted on: 08/16/2015
Multi-Disciplinary Approach: Treatment Of Idiopathic Toe Walking With Severe Contracture

Nicole M. Harris, PT, PCS, BOCO
The Children’s Hospital Colorado, Aurora, CO

**Problem:** The patient was referred to PT (physical therapy) from orthopedic department for idiopathic toe walking. Physician referred to PT with the hopes of gaining DF (dorsiflexion) ROM (range of motion) so that surgery could be more successful considering extreme contracture. For PT evaluation, patient presented with DF ROM of -40 degrees, bilaterally. He walked in full PF with weight borne solely on the metatarsal heads. He could not stand flat-footed and could not stand still without stepping to adjust his balance. The family’s primary concern was frequent tripping as well as the fact that toe walking seemed to be getting worse over the past few years.

**Solution:** A few options were considered to gain ROM. Serial casting was a possibility, but was postponed due to the extreme position of his ankle and possible complications with difficulty walking and skin breakdown. The orthopedic physician felt that surgery should be postponed due to the significant contracture and inability to gain enough ROM for normal ambulation. After consulting with the orthotist and the orthopedic physician, the following plan was instigated: Patient was fit with bilateral AFOs (Ankle foot orthoses) with adjustable joints to allow adjustment of DF angle. Shoes were modified with ~35 degree heel wedge to accommodate contracture, allow weight bearing through heel and provide normalized biomechanics. AFO joint was set with PF block and slight DF resistance to support tibia and encourage forward translation over stable foot (developing eccentric PF strength and control). After being assessed by PT, wedges and AFOs were adjusted by orthotist every 2-4 weeks (decreasing heel wedge and increasing DF angle). During these 6 months, patient reported having increased stability and comfort. Frequent falls were eliminated and DF ROM increased; Right = -15 degrees, Left = -25 degrees.

Once DF ROM plateaued, serial casting was initiated for 7 weeks. DF ROM improved: right = 0 and left = -3. Patient was transitioned to new AFOs: bilateral posterior leaf spring AFOs made of carbon fiber materials to allow ankle motion during stance phase while providing neutral ankle position during swing to allow for heel strike and toe clearance. Every other week therapy focused on gaining strength and balance in new ROM and posture. Patient began working on transitioning out of AFOs and into SMOs (supramalleolar orthoses). One more round of weekly serial casting was done, which resulted in improved DF ROM: right = 8 degrees and left = 6 degrees. After second round of casting he was able to walk heel toe with and without orthotics and transitioned to only wearing SMOs for most of the day. He had started running and jumping. He continued in PT to work on strengthening and gait refinement. Orthopedic surgery may be needed in the future if he loses ROM again, however the severity of the surgery has been lessened and he has a much higher potential for success.
Functional Evaluation Of The Foot Drop Stimulator In Children With Hemiplegia  
David E. Westberry, MD; Linda P. Wack, BS; Lisa Jameson, BS; Roy B. Davis, PhD  
Shriners Hospitals for Children, Greenville, SC

Introduction: Cerebral palsy (CP) is the most common neuromuscular disorder among children and often presents with impairments of movement and posture. Common gait abnormalities include difficulty with standing or walking, or increased risk of tripping and falling because of poor balance and lower extremity positioning. Poor strength and selective motor control of the muscles about the foot and ankle may lead to gait disruption because of insufficient ankle dorsiflexion during swing, or foot drop, and excessive plantar flexion during early to mid-stance phase of gait. Ankle foot orthoses (AFO’s) are commonly prescribed to control foot position and improve gait. Recently, functional electrical stimulation (FES) devices have been developed as an alternative to an AFO to improve gait in patients with foot drop patterns. The goal of this study was to characterize the functional changes in gait while utilizing a FES device.

Materials and Methods: A retrospective review of the medical record database was performed to identify patients who utilize a FES device for isolated foot drop. Four patients were identified who had motion analysis studies (kinematic, kinetic, and surface electromyography (EMG)) while ambulating with and without the active FES. The data was analyzed to determine changes or improvements in ankle position and loading pattern of the foot during gait. The patients’ tolerance of the device and perceived benefits were also reviewed.

Results: Three females and one male (average age 15.6 years, range 12.6-18.0) completed motion lab assessment while wearing the FES device. Diagnoses included spastic hemiplegia (2), asymmetric diplegia (1), and hemiparesis secondary to hemispherectomy (1). Interventions prior to use of the FES device included use of a posterior leaf spring orthosis in 1 patient, planter flexor Botox injection in 1 patient, and plantar flexor lengthening in 2 patients. Duration of use of the FES device averaged 19.3 months (range 2-48) prior to assessment in the gait lab. Of the 4 patients, there were no significant differences in walking speed, stride length, or cadence when comparing walking trials with and without the FES device. With the FES in place and active, achievement of 1st rocker and improvement in peak ankle dorsiflexion in swing phase was evident in only 1 of 4 patients. Dynamic EMG demonstrated electrical activity of the device during mid and terminal swing, extending into the loading response and mid-stance phases of gait. Subjectively, all patients preferred the WalkAide over traditional AFO’s and appreciated a benefit while utilizing the device.

Conclusion: Motion analysis studies can provide functional evaluation of FES devices. Although kinematic and kinetic outcomes are variable, patient experience with these devices is favorable. Children who are candidates for FES devices should be assessed by clinical gait analysis to determine appropriate treatment alternatives.
Cloves Syndrome: A Presentation Of Two Cases

Kyle Leister, MPO, ATC; Thomas V. DiBello, CO, FAAOP; Shane R. Wurdeman, PhD, MSPO, CP, FAAOP
Hanger Clinic, Houston, TX

Congenital lipomatous overgrowth (CLO), vascular malformation (V), epidermal nevi (E), scoliosis/spinal deformity (S), or CLOVES Syndrome is an extremely rare congenital disorder that affects approximately 150 people worldwide\(^1\). Individuals diagnosed with CLOVES Syndrome present with gross overgrowth and deformity of the upper and lower extremities and truncal region secondary to lipomatous overgrowth, dysregulated fat deposits, and vascular malformations\(^2,3\). These congenital differences often necessitate orthotic and prosthetic management to improve the individual’s biomechanics, prevent overuse injury, and increase quality of life. Because of its extremely convoluted presentation, orthotic and prosthetic management of CLOVES Syndrome is challenging and warrants a team approach to achieve optimal outcomes.

Recently, two children with CLOVES Syndrome were treated at Hanger Clinic, Houston, Texas. Each child had a unique presentation requiring individualized orthotic and prosthetic intervention.

**Patient One:** Three year old male that presented with lipomatous overgrowths and excessive soft tissue surrounding the gluteal region, quadriceps, hamstrings, lower legs, and foot. The patient underwent amputation surgery in 2013 to remove a grossly overgrown foot and ankle and currently ambulates with a right PTB prosthesis. The patient’s left leg presented with genu varum, excessive pronation of the foot and ankle, and excessive medial/lateral laxity at the knee. Furthermore, the patient complained of back pain while sitting due to an asymmetrical gluteal region.

Our treatment goals for this patient were to reduce angular deformities, prevent overuse injuries secondary to his deformities and to help him reach developmental milestones. Our orthotic and prosthetic interventions included a KAFO with extended medial trim lines to control pronation and posterior offset free motion knee joints to control excessive genu varum. The patient was also outfitted with a custom fabricated gluteal prosthesis to ameliorate back pain while seated.

The devices effectively controlled the patient’s lower limb laxity and reduced internal rotation of the knee, resulting in improved gait. Additionally, the gluteal prosthesis successfully improved the patient’s posture and sitting balance.

**Patient Two:** Three year old male that presented with bilateral lipomatous overgrowths and excessive soft tissue surrounding the upper and lower extremities, furrowed, spade shaped hands, and an asymmetrical face. Upon evaluation, the patient demonstrated excessive pronation and valgus of the feet and ankles during stance phase of gait. Joint laxity and deformity were noted at the feet, ankles, and knees. It was believed that the patient’s extreme hypotonicity led to these impairments.

Our treatment goals for this patient were to accommodate his existing deformities and prevent joint laxity from progressing. Our orthotic intervention included bilateral SMOs with a polyethylene anterior panel to control pronation and provide stability while weight bearing. While wearing the devices, the patient displayed a more symmetrical gait and a decreased valgus moment at the ankle.

In both cases, suspension and alignment to control and accommodate the patients’ unique anatomy were primary challenges. However, through a concrete understanding of biomechanical principles and material sciences, both patients are being successfully treated to maximize their quality of life.
References:


A KAFO Design For Marked Genu Valgum Related To CIPA
James M. Kallen, CPO(c)
Orthotic Services Ltd., Red Deer, AB, Canada

Patient: 15 Year Old Female

Condition: CIPA resulting in Charcot Arthropathy of Left Knee with non-Rettractable Excessive Genu Valgum.

This young lady presents with a marked genu valgum of which is not reducible to a neutral or favorable alignment. The genu valgum is present due to a Charcot Arthropathy related to C.I.P.A. (Congenital Insensitivity to Pain and Anhidrosis).

In the past, the patient mobility was assisted through wheelchair use only, as standing resulted in a further increase in genu valgum.

This presentation will show through the use of pictures, MRI, and x-rays, the severity of her condition and how a unique approach to brace design and fabrication has provided her with limited crutch based upright ambulation.

Due to the severity of her condition, with regards to CIPA and the Charcot Arthropathy, my local orthopedic surgeons have informed me that joint replacement or even amputation would be unsuccessful and thus have elected no further operative procedures.

It is hoped this presentation sparks conversation with regards to her treatment options including surgical.
Reconsidering The Role Of Spasticity In Deformity And Gait Pathology In Children With Diplegic CP

Beverly Cusick, PT, MS, NDT, COF
Progressive GaitWays, LLC, Telluride, CO

Course Description: Diffusion tensor imaging (DTI) tracks the flow of water along white matter tracts in the brain, and gives researchers a real-time look at brain function and dysfunction. In children born premature and those with diplegic cerebral palsy (CP), findings obtained with DTI have brought significant challenges to the definition of cerebral palsy as “a motor disorder caused by a static lesion to the upper motor neurons resulting in spasticity”, and so, to treatment strategies that target spasticity. In this course, the research on the effects of spasticity on deformity development and gait pathology are presented, and the participant is invited to consider the significance of deficits in postural control as a more relevant management target.

Objectives: Participants in this course are expected to be able to:

- Identify JW Lance’s definition of spasticity (1980) and discuss the proof of its validity.
- Define muscle tone and the contribution of the nervous system to it.
- Differentiate between hyperreflexia and muscle tone.
- Describe the properties of muscle and neighboring soft tissues under the condition of rapid elongation.
- Describe R₁ (L₁, L₀) end range on the passive length-tension curve and discuss its normalcy.
- Explain diffusion tensor imaging (DTI).
- Discuss the observations reported by researchers using DTI to assess brain function – and evidence of dysfunction - in children with diplegic cerebral palsy (CP). Relate those findings to the common definition of CP.
- Define an antigravity righting reaction and discuss its significance in daily life.
- List 4 somatosensory receptors that operate to produce an effective antigravity righting reaction.
- Explain the relationship between the stimulation of somatosensory receptors and antigravity righting reactions.
- Define a body center of mass and describe the ideal projection of the human body COM over the base of support in static standing in children of age 4 years and adults.
- Describe the normal progression of body COM projection onto the support base in typically developing toddlers.
- Describe the muscle recruitment strategy needed to remain upright in the presence of a chronically anterior displacement of the body COM in standing and in walking. Relate this strategy to development of common soft tissue contractures in children with diplegic CP.
- Explain the relevance of EMG data in gait as evidence of spasticity.
- Explain the rationale for building trunk and hip control of postural alignment and the body COM as a contracture prevention and management strategy.
Clinical Outcomes Of The Michigan Cranial Reshaping Orthosis: A Retrospective Review Of Outcomes Measured By Three-Dimensional Laser Scanning

Jeffrey P. Wensman, CPO¹; Ammanath Peethambaran, MS, CO, FAAOP¹; Alicia Foster, MS, CPO¹; Kevin Hickey, MSPO, CPO²; Rebecca Patterson, MSPO, CO²

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Key Words: Cranial, Reshaping, Helmet, Plagiocephaly, Brachycephaly

Introduction: Infants treated for positional cranial asymmetry involving plagiocephaly, brachycephaly, and scaphocephaly are often treated with cranial reshaping orthotic helmets to encourage symmetrical cranial growth. The Michigan Cranial Reshaping Orthosis is a bi-valve helmet that accommodates overall cranial growth during the therapy period while still directing cranial growth toward the desired areas. This design differs from standard one-piece helmets that allow limited volume for overall cranial growth. This study examines the efficacy and success rate of this low-profile design.

Materials and Methods: Visual inspection and manual measurements taken throughout the helmet therapy period, using a flexible tape measure and an AP-ML gauge, indicate significant cranial asymmetry correction. However, measurement inconsistencies due to soft tissue compression and clinician technique may limit the accuracy of outcome measures. Seventy subjects treated for plagiocephaly and/or brachycephaly with the Michigan Cranial Reshaping Orthosis were identified in this retrospective study. Data was compiled from Ohio Willow Wood’s Omega® Tracer® computer aided design clinical database of three-dimensional cranial scans taken before and after helmet therapy. Cranial helmet therapy treatment timeline was verified through the electronic medical record database. Cranial landmarks were defined on each three-dimensional image. Measurements between defined points were compared on the initial assessment scanned image and the final discharge scanned image for each patient.

Results: Comparison of initial and final three-dimensional scans showed improved symmetry in the relevant measures of cranial vault asymmetry index (CVAI) and cephalic ratio (CR) in 84.3% of subjects. Children in the plagiocephaly-only group showed 28.8% improvement in CVAI. Although sample size was low, children in the brachycephaly-only group showed 4.66% improvement in CR. Children in the combined plagiocephaly/brachycephaly group showed 41.4% improvement in CVAI and 2.60% improvement in CR. Overall, a 33.5% in CVAI and 2.10% improvement in CR were seen. These results are comparable to other studies of remolding helmet efficacy.

Conclusions: The data in the present study, therefore, support the use of the Michigan Cranial Reshaping Orthosis as a viable option in the treatment of plagiocephaly and/or brachycephaly when the primary method of treatment is utilization of a cranial remolding helmet.
Developing Clinical Practice Guidelines For The Orthotic Management Of Deformational Plagiocephaly

Curt A. Bertram, CPO, FAAOP
National Orthotics Specialist
Hanger Clinic, Hartland, WI

Clinical Practice Guidelines have become increasingly important in today’s health care environment. Derived from a systematic review of scientific evidence and further informed by clinical expertise and consensus, these statements can help formulate and define sound orthotic/prosthetic care. They can also avoid inefficiencies and optimize the utilization of health care dollars. Using this model, Clinical Practice Guidelines (CPGs) have recently been developed for cranial remolding orthoses in the management of deformational plagiocephaly. Additional guidelines are also being actively developed involving other diagnoses and technologies in O&P. The development process and outcomes of work done by the Clinical Standards Committee of Hanger Clinic over the past 2 years, will be discussed in this session, along with relevant treatment algorithms.
Surgical And Non-Surgical Management Of The Skeletally Immature Spine
Michael L. Schmitz, MD; Mark Holowka, MSPO; Jorge A. Fabregas, MD
Children's Healthcare of Atlanta, Atlanta, GA

Goals/Objectives:
1. Explain the unique challenges presented by the skeletally immature spine as it relates to early onset scoliosis: case studies will be provided.
2. Use an evidence based approach to discuss the surgical options available to the orthopedic team.
3. Explore the variety of non-surgical treatment options including EDF casting and orthotic intervention. Current literature and evidence regarding the non-surgical approaches will be highlighted. Case studies provided.

Scoliosis, or lateral curvature of the spine, is often sub-categorized according to the age of onset. Familiar terms such as a congenital, juvenile, and adolescent have been common descriptors used to help both the clinician and researcher to group patients according to similar characteristics and treatment options. In the past 10 years, recent advances in both surgical techniques and the refinement of non-surgical treatment methods have expanded the decision making tree. More recently terms such as, “early onset scoliosis” and the “young spine,” have been used in greater frequency due to the overlapping nature of both the patient characteristics and treatment methods of these age based groups. Spinal fusion as a treatment method for scoliosis historically has been thought of as a last resort.

Surgical complications such as crankshaft phenomenon have been well documented leading clinicians to reserve surgical intervention until the spine has reached the majority of its length and closer to maturity. Technological advances in surgery have provided new alternatives for managing the spine at a younger age than ever before while minimizing the effect on quality of life. New constructs such as VBS, VEPTR, tethering, magnetic rods, etc. have provided an array of surgical interventions. However, before any discussion can begin about surgery it is important to understand the differences between the young spine and the more developed adolescent spine. The evaluation process must take into account the age/development, unique imaging, potential co-morbidities, and unique measurement techniques of the young patient with scoliosis. Only after a thorough evaluation process and team discussion can the clinician begin to weigh that information in the context of a potential surgical intervention. It is essential to understand the pros and cons of each of the surgical techniques and how they affect the quality of life of the patient who has a substantial amount of growth and change remaining in the years ahead. Not only have advances been made regarding the surgical treatment of the young spine but there are also a number of non-surgical treatment methods that must be part of any clinician’s treatment arsenal.

A number of centers around the country have been very successful treating the young spine by employing a number of non-surgical treatments. Recent evidence suggests EDF casting, traction, and bracing can be used both in unison and in alternating fashion to both delay surgical intervention and in certain instances correct the young spine. In similar fashion to surgical intervention it is important to collaboratively discuss the pros and cons of each method and understand the current evidence and literature associated with each treatment option.

The proposed symposia will involve a two part presentation. The first part will discuss the evaluation process, imaging techniques, and overall uniqueness of the young patient with scoliosis. This section will discuss the types of early surgical intervention and benefits/risks associated with each method. The second part of the symposia will discuss the non-surgical treatment options including inclusion/exclusion criteria, quality of life, and supporting evidence.
Hector Kay Memorial Lecture

THURSDAY, April 14
1:25–2:25 PM

From Baghdad to Beijing and Beyond
Melissa Stockwell, CP

I talk about my personal story from losing my leg in Iraq to competing at the highest level at the Paralympic Games. My story is about overcoming obstacles, believing in yourself and the realization that we all have the power to create our own story in life.
SESSION V – NON-SURGICAL OUTCOMES IN LOWER LIMB DEFICIENCIES AND AMPUTATIONS

FRIDAY, April 15
8:00–8:10 AM
Paper 4

Preliminary Data Assessing The Five Factor Model Of Personality Traits, PODCI, And OPUS Survey Results In Adolescents With Below Knee Amputations

Hank White, PT, PhD; Juanita Jean Wallace, MS; Samuel F. Augsburger, MS; Chris B. Burke, CP; Janet L. Walker, MD; Henry J. Iwinski, MD
Shriners Hospitals for Children, Lexington, KY
University of Kentucky, Dept. of Orthopaedic Surgery, Lexington, KY

Patient-centered care uses evidence-based medicine to defined outcomes that are meaningful and valuable to each individual patient [3]. The Orthotics and Prosthetics Users’ Survey (OPUS) is a clinical outcome survey for patients who wear orthotics or prosthetics [1]. As children and adolescents grow the fit of their prosthesis can change, and/or mal-alignments can occur. The satisfaction-with-device portion of the OPUS survey allows for assessment of the patients satisfaction with the fit of their prosthesis, and the lower extremity-functional-status portion of the OPUS survey assesses the patient’s functional mobility during activities of everyday life. In addition, the Pediatric Outcomes Data Collection Instrument (PODCI) can be used to measure the function abilities of children with disabilities [2].

A standardized assessment of a patient’s personality is not typically performed when individualizing care. However, a person’s personality type could affect their perceptions of their life and satisfaction with their prosthesis. The Inventory of Children's Individual Differences short form (ICID-S) is a standardized survey that assesses the personality traits utilizing the ‘five-factor model’ of personality for children and adolescents [4]. Vrijmoeth et al. (2012) reported that children with motor and cognitive impairments (cerebral palsy, spina bifida) demonstrated similar personality scores as able-bodied children [5].

This prospective study was approved by the local institutional review board. Children with unilateral below knee amputations over the age of 11 were recruited. All participants were able to walk independently without an assistive device. Results of the OPUS, PODCI and ICID-S surveys were completed by each participant.

Thirteen subjects (6 males; 7 females) whose age ranged from 12 to 20 years participated. Eight participants were identified as ill-fitting and required modifications or replacement of their current prosthesis. Nonparametric t-tests were used to compare appropriate and inappropriate fitting prosthesis groups.

Comparing appropriate fit to inappropriate fit, there was no statistical difference in ICID-S survey scores. Overall, despite having an amputation, the children’s personality profile scores were similar to values reported in the literature for children without disabilities. A trend of lower PODCI scores for participants with ill-fitting prosthesis was found for sports, pain, and global function; however, the differences were not statically significant. Both groups reported all tasks of the OPUS were easy or very easy to perform using their prostheses. Both groups reported similar satisfaction of prosthesis for weight, ease of putting on and durability. A larger percentage of participants with an inappropriate fitting prosthesis reported more dissatisfaction with prosthesis fit and comfort. Participants with inappropriate fitting prosthesis reported more pain/discomfort and dissatisfaction with their prosthesis and lower; but not statistically different abilities to perform activities of daily living.
References:
Comparison Of Ground Reaction Forces Between Correct Fitting And Incorrect Fitting Prosthesis For Children With Unilateral Below Knee Amputations

Hank White, PT, PhD; Juanita Jean Wallace, MS; Samuel F. Augsburger, MS; Chris B. Burke, CP; Janet L. Walker, MD; Henry J. Iwinski, MD

Shriners Hospitals for Children, Lexington, KY

University of Kentucky, Dept. of Orthopaedic Surgery, Lexington, KY

The goal of prosthetic gait for the unilateral amputee is to produce a symmetrical gait pattern [1]. An inappropriate fitting prosthesis can cause pain and result in a less efficient and a less symmetrical gait pattern. Self-report of discomfort or observational analysis of a patient walking determines if prosthesis is fitting appropriately. Differences in gait patterns and ground reaction forces have been reported between prosthetic limbs and intact limbs as well as between different levels of amputation [2].

Currently there is no objective measure routinely used to clinically identify an inappropriate fitting prosthesis. The objective of this study is to measures the ground reaction forces and temporal-spatial parameters in children with unilateral amputations to assess differences between appropriate fitting and inappropriate fitting prostheses.

This prospective study was approved by the local institutional review board. Children with unilateral below knee amputations between the ages of 4 and 21 were recruited. All participants were able to walk independently without an assistive device while wearing their prosthesis. Subjects were evaluated in the motion analysis laboratory prior to being assessed by a prosthetist or a physician; therefore, research personnel were blind to the prosthetic fit. Reflective markers were placed on the posterior heel, the dorsum of toe box of each shoe, and on the participant's sacrum. All participants were required to wear the same type of walking shoe. A Motion Analysis Corporation data collection system (12 Eagle cameras and four AMTI force plates) simultaneously collected motion and kinetic data at 1200 hertz. A minimum of three clean force plate strikes for each limb were collected. Data was normalized to the gait cycle and the participant’s body weight.

Seventeen subjects (10 males; 7 females) participated in the study. Participants ranged from 6 to 20 years old. Six subjects had acquired amputations and eleven had congenital amputations. Nine participants were identified as ill-fitting and required modifications or replacement of their current prosthesis. Nonparametric t-tests were used to compare appropriate and inappropriate fitting prosthesis groups.

An inappropriate fitting prosthesis resulted in delayed timing of propulsion force during late stance on the involved side and delayed timing of peak medial force on the uninvolved side during weight acceptance (p<0.05). There were no significant differences in the participant’s walking speeds. There were, however, decreases in the vertical forces during early stance and increases in vertical forces at mid-stance on the uninvolved side (p<0.05). The results of this study demonstrate that ground reaction forces are sensitive to the small changes seen in the gait of patients with an inappropriate fitting prosthesis.

References:
**Axial And Rotational Stiffness Of Pediatric Leg Prostheses**  
*Paolo Taboga, PhD; Alena M. Grabowski*  
University of Colorado, Boulder, CO

**Introduction:** Children with amputation are prescribed prosthetic feet based on contralateral foot length. However, such prostheses may cause excessive hip external rotation during walking, likely because the prosthetic foot is too stiff. Less stiff feet could improve biomechanics and symmetry during walking. Stiffness values for prosthetic feet are unknown. The ISO 10328 standard specifies maximum loads and torques that commercialized prosthetic feet must withstand, but stiffness values are not reported. Axial loading is specified for heel strike (-15 deg) and toe off (+20 deg), but rotational loading is only specified in the transverse plane (internal-external rotation). Ankle rotations during walking primarily occur in the sagittal plane. But, no standard procedure exists for sagittal plane rotational stiffness.

We measured prosthetic foot stiffness to inform prescription and walking biomechanics. We hypothesized that within each brand, axial and torsional stiffness would increase with foot length and for a given length, stiffness would not differ across brands.

**Methods:** We used ground reaction force data from four non-amputee toddlers during walking to estimate maximum heel-strike (200N), mid-stance (160N) and toe-off (150N) loads ($F_{max}$). Then we utilized a materials testing machine to measure force and displacement ($\Delta x_1$) and calculated axial stiffness ($k_A$) as $F_{max}/\Delta x_1$. We developed a testing procedure to simulate sagittal plane rotations by measuring the distance between the prosthetic ankle joint center and anterior toes ($L_1$), and applied a vertical force ($F$) at $2/3 \ L_1$ ($r$) (Fig. 1). We calculated torque ($T$) as $r \times F$ and dorsiflexion angle ($\alpha$) as $\arcsin(\Delta x_2/r)$. We then calculated torque and plantarflexion angle, where $L_2$ is the distance between the joint center and posterior heel. We applied vertical loads that elicited typical angles for walking ($\alpha=-15$deg plantarflexion and $\alpha=+20$deg dorsiflexion), and calculated torsional-stiffness ($k_T$) as $T/\alpha$. We tested 22 prosthetic feet twice per measurement and calculated average $k_A$ and $k_T$ (Table 1).

**Statistics:** We used three linear mixed models to test the effects of brand, length and condition (heel strike/foot flat/toe off) on $k_A$, and brand and length on $k_T$ for plantarflexion, and dorsiflexion ($p<0.001$).

**Results:** Across brands, $k_A$ was 35.2kN/m at heel-strike, stiffer at mid-stance (121.8kN/m) and less stiff at toe-off (11.8kN/m). $k_A$ was similar across brands with no effect of length, except TRS where $k_A$ was stiffer across conditions and for longer feet (Table 1). For every +1cm, $k_T$ decreased 0.16kN•m/rad in plantarflexion. For every +1cm, $k_T$ increased...
Discussion and conclusion: We partially reject our first hypothesis: axial-stiffness (k_A) was not affected by length, except for TRS feet that were stiffer for longer lengths. Foot length influenced torsional-stiffness, where k_T increased in magnitude with length for all brands. We reject our second hypothesis: k_A and k_T were not consistent across brands.

Prosthetists and pediatricians should consider both axial and torsional stiffness when prescribing walking feet for children and toddlers. While k_A values are not influenced by length, k_T can be reduced by selecting smaller feet, which could allow more favorable biomechanics during walking.

Acknowledgements: We would like to thank the Children's Hospital, Colorado, for their collaboration, Terry Noffsinger from Hanger Inc. and College Park Inc., Kingsley Mfg. Co., TRS Inc. and Trulife, for supplying prosthetic feet.

References:

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<td></td>
<td>13</td>
<td>49.5 ± 0.6</td>
<td>361.4 ± 8.0</td>
</tr>
<tr>
<td>College</td>
<td>16</td>
<td>28.4 ± 1.6</td>
<td>129.0 ± 4.5</td>
</tr>
<tr>
<td>Park Truper</td>
<td>17</td>
<td>29.3 ± 0.1</td>
<td>109.9 ± 1.5</td>
</tr>
<tr>
<td></td>
<td>19</td>
<td>29.7 ± 0.0</td>
<td>122.5 ± 3.7</td>
</tr>
<tr>
<td></td>
<td>21</td>
<td>28.4 ± 0.3</td>
<td>132.3 ± 2.9</td>
</tr>
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</table>

Table 1. Measured values for axial stiffness (k_A) and torsional stiffness (k_T) for different brands and foot lengths (all values expressed as: mean ± S.D.).
Factors Impacting Participation In Sports For Children With Amputations: A Pilot Study

Marena Lamy1; Batoul Sayed Ahmed1; Debra L. Cameron, OT, PhD1,2; Lisa Artero, MSc (OT), OT Reg. (Ont)3; Sandra Ramdial, CP(c)3; Matthew J. Leineweber4; Jan Andrysek, P.Eng4,5

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2University of Toronto, Rehabilitation Sciences Institute. Toronto, ON, Canada; Holland Bloorview Kids;
3Rehabilitation Hospital, Toronto, ON, Canada;
4Bloorview Research Institute, Holland Bloorview Kids Rehabilitation Hospital, Toronto, ON, Canada;
5Institute for Biomaterials and Biomedical Engineering, University of Toronto, Toronto, ON, Canada

Background: Individuals with amputations benefit physically and psychologically from participating in sports (Bragaru, Dekker, Geertzen, & Dijkstra, 2011). Despite these benefits, children with disabilities (including amputations) participate less in sports than children without disabilities (Wind, Schwend, & Larson, 2004). While it is known that barriers and facilitators exist that affect sport participation in the adult population, these have not been explored for children with amputations.

Research Question: What are the perceived factors impacting participation in sports according to children with amputations and their parents?

Methods: This pilot study uses a descriptive qualitative study design. Eleven participants consisting of children and their parents were recruited from an outpatient hospital clinic. Semi-structured interviews consisting of both open-ended and closed-ended questions were conducted either face to face or over the phone. These interviews were audio recorded, transcribed, coded and analyzed using the DEPICT model to facilitate the process from transcription to translation. The DEPICT model involved distributing the transcripts among team members, identifying codes and adding them to a codebook, presenting and discussing codes in team meetings, and narrowing and subdividing the codes into more concrete themes. Thematic analysis was guided by the International Classification of Function (ICF) framework, where the interaction between having an amputation and contextual factors (such as environmental and personal factors) was explored as it relates to sport participation for the study participants.

Results: Based on participant interviews, having a love for sports, understanding capabilities, functionality of their prosthesis, planning in advance, the investment involved, as well as stigma and the social environment were found to have an impact on sport participation for children with amputations. According to participants, perceived facilitators to sport participation include having supportive family, supportive friends, and supportive coaches, the use of specialized prosthesis and attachments, positive self-perception and self-talk, having a love for sports and sport culture, the physical and social benefits of sport participation, and external charitable organizations offering peer and financial support. Perceived barriers on the other hand include bullying, technical factors associated with prosthesis use in sports, the time, cost, and effort invested by families, distance of sport programs, the attitude and understanding of peers and coaches, and negative self-perception. Current literature on barriers and facilitators is focused on adult populations. In comparison, this pilot study identified that children present with different needs and experiences than adults, thus, results from adult populations cannot be generalized to pediatric populations. Similarities in both the adult and pediatric populations existed in areas surrounding prosthesis use, the social environment, and person factors associated with sport participation.

Conclusion: The findings from this pilot study have the potential to allow for the development and implementation of strategies to increase levels of participation in sports among children with amputations.

Relevance: Information collected from this pilot study provides new insights, and is essential for deepening the rehabilitation team’s understanding of factors that impact engagement in sports amongst children with amputations.
References:


**Pediatric Outcomes Data Collection Instrument In Pediatric Amputees: Parent And Adolescent- Reported Outcomes**

*Kelly A. Jeans, MS; Lori A. Karol, MD*
Texas Scottish Rite Hospital for Children, Dallas, TX

**Introduction:** Children with varying levels of amputation or limb deficiency face challenges in their general health and mobility. Clinically, our goal is to help these children navigate life as best they can with the use of a prosthesis and to achieve the goals they have for themselves. The application of prosthetic prescription in the case of a patient wanting to participate in track and field, is a different clinical approach than addressing the needs of a new bilateral amputee who is learning to walk for the first time. Gaging success and patient satisfaction is an important metric for clinical practitioners. The ability to have basic mobility, to be free of pain and the ability to participate in normal activity and higher level activities (sports) are essential components in satisfaction and happiness for both the child and the parent. The purpose of this study was to survey pediatric amputees and their parents (PODCI) to determine their general parent-reported function across amputation levels, and to determine if these reports differ between the adolescent and parent.

**Methods:** Patients using unilateral or bilateral lower extremity prosthesis/prostheses were invited to participate in this IRB approved study. The PODCI was distributed to the accompanying parent and to adolescents between 11-19yrs. The PODCI consists of the following subscales: Upper Extremity, Transfers/Basic Mobility, Sport/Physical functioning, Pain/Comfort, Global functioning (accumulative of first 4 scales) and Happiness/Satisfaction. Patients were grouped by amputation level: Below Knee (Syme and Trans-tibial), Above Knee (Knee Disarticulation and Trans-femoral), Hip Disarticulation, Bilateral and PFFD (including PFFD, equinus and Van Nes). Comparisons between amputation levels were made using the Parent-report with an ANOVA and post-hoc Tukey test. A matched student t-Test was used to compare within patient between the Parent and the Adolescent. Pearson’s correlation coefficient was run to assess relationships between significant PODCI variables. Alpha set to 0.05.

**Results:** PODCI data included 136 Parent-reported and 70 Adolescent-reported surveys. Comparisons of the Parent-reported surveys were made between unilateral amputees with BK (73), AK (20), HD (5) and PFFD (19). There were also 19 participants with Bilateral amputations surveyed. Group comparisons can be found in Table 1. The BK group reported significantly higher scores for Transfer/Basic Mobility and Sport/Physical function than both the AK and PFFD groups. The BK group reported greater Happiness than the AK group, while overall Global function was significantly better in patients with a BK amputation, than those patients with PFFD. There was a significant positive correlation between Transfer/Basic Mobility and Sport/Physical function (r=0.656; p<0.0001). Interestingly, the parents of patients with a HD report that their children have very little functional limitation, which is leading to the highest overall Global function score (93.6/100), however no significant differences were found. In a comparison between Bilateral and AK + PFFD patients, similar limitations were reported across subscales but no significant differences were found (p>0.05).
When we looked at the matched Parent verses Adolescent- reports, we found that the Adolescents scored themselves 5.1 points higher than their parents did on Sport/Physical function (p=0.001) and 5.9 points for Happiness (p=0.015).

**Conclusion:** The data clearly shows less function limitations being reported in the BK group compared to both the AK and PFFD groups. Surprisingly, in both the Parent and Adolescent-reports, the HD group reported very little functional limitation in Transfer/Basic Mobility and in Sport/Physical function. The number of patients in this group is small, but they are fairly consistent in their reporting, with the exception of Sport/Physical function (range 53-100) and Happiness (65-100). More data needs to be collected on this group in the future.

Even in the more involved patients, we see fairly high group averages ranging from 70.6-100.0. If parents report difficulty with their child’s ability to transfer and have basic mobility, they also tend to report limitations in Sport/Physical function. In a paired comparison, the Adolescents reported significantly higher in their abilities to participate in Sport/Physical function and in their overall happiness. It is reassuring to see that kids perceive themselves as higher functioning than even their parents.

**Table 1. Comparisons of Parent-reports between Amputee Level:  BK, AK, HD and PFFD.**

<table>
<thead>
<tr>
<th></th>
<th>BK 73</th>
<th>AK 20</th>
<th>HD 5</th>
<th>PFFD 19</th>
<th>Bilateral 19</th>
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<tbody>
<tr>
<td><strong>Mean</strong></td>
<td>Mean</td>
<td>Mean</td>
<td>Mean</td>
<td>Mean</td>
<td>Mean</td>
</tr>
<tr>
<td><strong>SD</strong></td>
<td>SD</td>
<td>SD</td>
<td>SD</td>
<td>SD</td>
<td>SD</td>
</tr>
<tr>
<td><strong>P</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upper Extremity</td>
<td>97.0</td>
<td>96.9</td>
<td>99.2</td>
<td>93.6</td>
<td>95.2</td>
</tr>
<tr>
<td>Transfer/Basic Mobi</td>
<td>98.1</td>
<td>93.7</td>
<td>96.7</td>
<td>92.0</td>
<td>92.0</td>
</tr>
<tr>
<td>Sport/Physical Fx</td>
<td>85.1</td>
<td>70.6</td>
<td>78.6</td>
<td>70.1</td>
<td>65.1</td>
</tr>
<tr>
<td>Pain/Comfort</td>
<td>88.1</td>
<td>87.6</td>
<td>100.0</td>
<td>88.3</td>
<td>86.5</td>
</tr>
<tr>
<td>Happiness</td>
<td>91.1</td>
<td>77.5</td>
<td>88.0</td>
<td>87.4</td>
<td>82.8</td>
</tr>
<tr>
<td>Global Fx</td>
<td>92.0</td>
<td>87.2</td>
<td>93.6</td>
<td>86.0</td>
<td>84.7</td>
</tr>
</tbody>
</table>

Significance set to p<0.05:  * BK > AK ; # BK > PFFD.  No differences between Bilateral and AK+PFFD.
The Problem: An 11 y/o female with a history of bilateral congenital longitudinal deficiency, fibular hemimelia type 2, and a congenitally dislocated right hip who presented with complaints of poor gait, fatigue, and pain after having undergone multiple surgical procedures directed at limb salvage during the first decade of life. These included multiple bone lengthenings and corrective osteotomies, soft tissue procedures on her feet, a gradual deformity correction with a Taylor Spatial frame, and a fusion attempt at the right ankle. These efforts directed at limb salvage were heavily driven by family preference at the time.
The Solution: The patient was evaluated by a multidisciplinary team consisting of an orthopedic surgeon, rehabilitation physician, physical therapist, occupational therapist, and prosthetists. The team discussed treatment options with patient, including further attempts at limb salvage vs. amputation. Patient played a large role in the decision making process and opted to undergo bilateral amputations as well as bilateral hip procedures over the following two years.

Patient is now pain free, able to household and community ambulate in her prostheses, and was very happy with her outcome when she was last seen for follow-up. Parents are pleased as well.

Details of the procedures performed once decision was made to proceed with amputation as well as concepts that drove the approach to patient’s deformity correction will be discussed.
13 years of age
Tibial - Fibular Bone Synostosis Permanent Solution In Pediatric Transtibial Amputations.
Case Review Of Two Bilateral Transtibial Amputees

Burhan Dhar, CPO; Zayed Al Zayed, MD
King Faisal Specialist Hosp & Res Ctr, Riyadh, Saudi Arabia

Appositional or terminal overgrowth of bone is common in children with an acquired or congenital amputation. This problem is seen primarily after amputation through the diaphysis of the tibia. Management of this condition requires frequent prosthetic adjustments or operative revision of the limb. (1)

Fusion of the distal tibia and fibula in transtibial amputations was first described in the early 20th century by Janos Ertl in Hungary. The concept was later popularized in the United States by Col. Philip A. Deffer in the 1960s and multiple modifications of the original technique have since been described. (2)

We concentrate on painless rounded functional residual limbs & end weight bearing capability. So, we use Tibial Fibular Synostosis procedure to evaluate the effect of this procedure on termination of overgrowth of bone in two children, one diagnosed as bilateral tibia hemimelia and the other as bilateral vascular insufficiency both underwent bilateral transtibial amputation following that technique.

After reviewing the literature regarding that technique, our hospital is first in applying the Tibial Fibular Synostosis procedure in pediatric patients who need bilateral transtibial amputation due to pathological limbs.

Key Words: Tibial fibular Bridge Synostosis, Transtibial Amputation, overgrowth.

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2. Distal tibiofibular bone bridging in transtibial amputation, jaymes d. granataa and terrence m. philbin.
Guided Growth Physeal Surgery in Bilateral Longitudinal Fibular Deficiency

Robin C. Crandall, MD; Gabriela Ferski, RN, MPH, MS
Shriners Hospitals for Children - Twin Cities, Fridley, MN

From 1987 to 2015 155 patients were identified at Twin Cities Shriners Hospital for Children who had fibular longitudinal deficiency. 28 patients had bilateral involvement. Of the 28 patients, 8 patients developed angular deformity severe enough to require physeal surgery in residual limbs. Techniques included stapling, plate and screw fixation, and simple physeal unilateral curettage. All patients had knee valgus, two patients had ankle and knee valgus, and two patients had knee valgus and knee flexion deformity. Unilateral Syme amputations were carried out on two patients, bilateral Syme amputations on two patients and four patients had retained partial foot amputations.

Conclusions: 20% of patients with bilateral fibular deficiency will require guided growth to correct deformity of residual limbs. 50% of those patients will need bilateral guided growth. Complications included “rebound” in three patients, four limbs, overcorrection of one limb, and metal failure in one limb. All patients will be presented.
How Does Energy Cost, Efficiency Of Movement, And Satisfaction With Mobility Change With Prosthetic Practice In A Patient With Arthrogryposis And Bilateral Knee Disarticulations?

Jesse L. Kowalski, PT, DPT; Kelly A. Jeans, MS
Texas Scottish Rite Hospital for Children, Dallas, TX

This patient is a 7 +7 year old male who originally presented to TSRHC at 2 months of age with a diagnosis of atypical arthrogryposis and a presentation of bilateral clubfeet, popliteal pterygium and significant knee flexion contractures, lacking 45 degrees from full extension bilaterally. He had initial Dimeglio scores of 5 on the right and 2 on the left. No upper extremity functional limitations are present. He had previously been treated with a Dennis Browne bar, serial casting, bilateral posterior releases with toe flexor tenotomies, and solid ankle AFOs. He had briefly utilized HKAFOs with a gait trainer but was not a functional ambulator. His knee flexion contractures became more significant as he aged, progressing to 70 degrees. He had no active quadriceps function. He primarily used a manual wheelchair for mobility, though he would also crawl and knee walk for household distances, with increased lumbar lordosis to overcome hip flexion contractures. He underwent bilateral knee disarticulations on 6/19/15 and had difficulty with closure and skin integrity and infections, requiring repeated I&Ds and eventually split thickness skin grafting.

Nearly 4 months postoperatively, he was casted and fit with stubbies and presented to PT for prosthetic training with 20 degree hip flexion contractures bilaterally, a 10 degree left hip abduction contracture, and significant muscular weakness of his hips and trunk averaging 3/5 to 3+/5. The patient participated in 5 days of 1 hour, twice daily physical therapy sessions focused on balance interventions, gait training, and functional mobility training in his stubbies. Standardized assessments including the AMPPRO, pedi Berg, pedi TUG, 1 minute walk test, and the Patient-Specific Functional Scale were administered on the first day of prosthetic training and again on the 5th day of prosthetic training. Oxygen consumption, kinematic data, and the PODCI were obtained on the fourth day of training. The patient will participate in ongoing outpatient PT services and these measures will all be repeated in 6 months to assess how his mobility, balance, and efficiency of movement as well as satisfaction and quality of life changes over time with prosthetic practice.

What kinds of prosthetic devices should we consider in the future for this patient? Is functional ambulation realistic, and if so, will he be at risk for development of back pain or other overuse injuries due to postural abnormalities and gait compensations?
Targeted Reinnervation: From Napkin Drawing to Standard of Care
Treatment of the Upper Extremity Amputee.

Gregory L. Dumanian, MD
Northwestern Medicine, Chicago, IL

Targeted Reinnervation (TR) represents the first of a number of dramatic improvements in prosthetic rehabilitation of the amputee. This presentation will include the development of TR by Drs. Kuiken and Dumanian, trace its path towards acceptance by the medical community, and introduce the use of TR in the treatment of chronic amputee pain. Advanced reconstructive strategies that combine TR with muscle flaps, direct skeletal attachment and implanted myoelectric sensory devices will be illustrated.
The Rotationplasty: An In-Depth Discussion Of The Surgical, Prosthetic And Rehabilitation Interventions: PART I – SURGICAL And PART II – PROSTHETIC and REHABILITATION

Brian J. Giavedoni, MBA, CP, LP¹; Colleen P. Coulter, DPT, PhD, PCS¹; J. Ivan Krajbich, MD²; David B. Rotter, CPO³

¹Children’s Healthcare of Atlanta, Atlanta, GA
²Shriners Hospital for Children, Portland, OR
³Scheck & Siress, UIC, Chicago, IL

The rotationplasty procedure was first described by Borrgreve in Germany in 1930. The procedure was later made popular for the child with Proximal Femoral Focal Deficient by Van Nes in the 1950’s. Saltzer and Kotz in Vienna modified the Van Nes procedure in the 1970’s to treat osteosarcoma of the distal third of the femur. The procedures, while in use since their respective introductions, remain sporadic and regional. Recently, whether due to increased use of social media and parent groups or increased interest by the surgeons, the number of procedures being performed is also increasing.

The goal of both procedures is to recreate a biologic knee joint from the patients’ ankle. When creating the prosthesis, alignment and design are unique to the relative procedures (PFFD or Sarcoma) for various anatomical and biomechanical reasons. Joint placement, type and clinical strategies will all be discussed, as well as surgical and therapeutic nuances within and between the two procedures. Audience participation will be strongly encouraged.

Objectives:
1. To identify the surgical differences between rotationplasty for the PFFD and for the Sarcoma patient
2. To identify common surgical and prosthetic challenges from physician, prosthettist, and physical therapist perspective
3. To identify differences in prosthetic design and alignment for the prostheses
4. To identify various treatment considerations based on severity and resection levels
5. To challenge practitioners current convention

Goals:
1. Gain knowledge in the surgical nuances of the procedures
2. Understand the effects of component selection and joint placement and alignment of the prosthesis
3. Discuss the effectiveness and outcomes of the surgical, prosthetic, and therapeutic options
Proximal Focal Femoral Dysplasia: Creative Solution Of Prosthetic Fitting To Incorporate Native Knee Flexion, A Case Series

Phoebe R. Scott-Wyard, DO; Jack Mark, CPO

1Child Amputee Prosthetics Project, Shriners Hospital for Children - Los Angeles, CA
2Shriners Hospital for Children - Los Angeles and Pediatric Orthotic and Prosthetic Services, Los Angeles, CA

Patients with proximal focal femoral dysplasia (PFFD) that are not appropriate candidates for leg lengthening typically undergo surgical intervention in order to improve prosthetic fit and functional outcomes. They may have a knee fusion with foot ablation surgery, or, when appropriate, undergo rotationplasty such that their ankle is turned around and can function as a knee. However, there are patients that do not undergo such surgical intervention, perhaps due to lack of access to experienced orthopedic care, due to personal reasons, or out of necessity. These patients may choose to ambulate with crutches or be fit with a nontraditional extension-type prosthesis that includes their entire lower extremity, accommodating the foot in a plantarflexed position inside the prosthesis. These can be heavy and typically are fit without any knee unit that would enable flexion in gait or when seated. We present a case series of two patients with PFFD who have not undergone surgical intervention, however who have some knee function, albeit with abnormal joint mechanics and at a level much more proximal than the ipsilateral knee. We chose to fit both patients with an atypical prosthesis that allowed them the use of their unstable anatomical knee: a PFFD exoskeletal, transtibial extension prosthesis with side joints and thigh lacer. We will present both cases, with gait videos and photos. We hope to add to the discussion of creative solutions to this complicated clinical problem.
Rethinking Proximal Brim Design Of PFFD Sockets
Rebecca A. Hernandez, CPO/LPO
Children's Healthcare of Atlanta, Atlanta, GA

The Problem: It is the experience of this clinician and other members of this clinic, that when fitting and aligning sockets for those with PFFD, the orientation of the socket becomes internally rotated with respect to the knee. When completed, the socket is internally rotated to the point that the high lateral wall is now anterior. It is the intent of this Challenging Case study to examine possible explanations for this alignment to include weak hip flexors, ease of lateral shift of the trunk and other biomechanical considerations. The purpose of this talk is to elicit feedback and generate discussion from the conference attendees.

The Solution: At this clinic, the clinicians have been designing PFFD sockets with higher anterior trimlines for several years, with success and greater comfortable as reported by patients.
Health-Related Quality Of Life Among Patients That Underwent Lower Limb Rotationplasty Reconstruction Versus Limb Salvage For Treatment Of Malignant Tumors
Corey Beebe, MS¹; Ryan A. Mooney, PA-C²; Shelley Dell’Orfano, CPNP, RN, MS²; Travis C. Heare, MD²; Nathan Donaldson, DO²
¹Musculoskeletal Research Center, Children’s Hospital Colorado, Aurora, CO
²Department of Orthopedics, University of Colorado, Anschutz Medical Campus, Denver, CO

Introduction: Improvements in orthopedic oncologic management practices have enhanced the prognosis for patients diagnosed with musculoskeletal tumors. This improvement in life expectancy has mandated the need for evaluation of quality of life measurements for these individuals. However, health-related quality of life (QOL) among pediatric patients affected by lower limb musculoskeletal sarcomas is underreported in current literature. The purpose of this study was to evaluate the QOL following surgical treatment of sarcomas of the lower extremity.

Methods: The SF-36v2 and Toronto Extremity Salvage Score (TESS) instruments were administered to individuals that were undergoing follow-up care for the surgical treatment of lower limb musculoskeletal sarcomas at our institution. Independent sample t-tests were used to evaluate the relationship of various subsets of QOL as compared to the type of surgical intervention performed. These subsets included physical functioning, social functioning, mental health, physical role, physical component summary scores (PCS), and mental component summary scores (MCS).

Results: Data was collected from 34 patients (58.8% male) at an average of 3.33 ± 3.22 years after the initial surgical treatment. Bony sarcomas (91.2%) were more common than soft-tissue sarcomas (8.8%) in this study population. Limb salvage (N=25) was more frequent than amputation with rotationplasty reconstruction (N=9). All subsets of QOL were reported higher for individuals that had undergone rotationplasty reconstruction, though not significant (Figure 1). PCS and TESS scores were significantly higher for rotationplasty reconstruction (p=0.049 and p=0.032, respectively).

Discussion/Conclusions: Physical component summary scores were, on average, 7.06 points greater for individuals having undergone rotationplasty reconstruction when compared to limb salvage. Our study shows that individuals that have undergone rotationplasty reconstruction have higher perceptions of physical functioning when compared to limb salvage. These results highlight the importance of considering quality of life measurements when comparing various surgical interventions for individuals affected by lower extremity musculoskeletal tumors.
Overground Walking Following A Unilateral Van Ness Rotationplasty: A Biomechanical Comparison

Susan Kanai, PT, OCS, CSCS; Travis C. Heare, MD1,3; Anne K. Silverman, PhD4; Corey Beebe, MS2,5; Nathan Donaldson, DO1,3
1Department of Orthopedic Surgery; 2Musculoskeletal Research Center; 3The University of Colorado, Anschutz Medical Campus, Denver, CO; 4Department of Mechanical Engineering, Colorado School of Mines, Golden, CO; 5Children's Hospital Colorado, Aurora, CO

Introduction: Van Ness Rotationplasty is a limb-sparing surgical treatment utilized in the treatment of sarcomas of the lower extremity. This procedure provides an option to preserve healthy anatomic tissue and segment length to maximize functional outcomes. However, there is little quantitative evidence regarding the biomechanical changes that occur in these patients following the completion of a rotationplasty procedure. A greater understanding of the kinematics, kinetics, and electromyographic (EMG) firing patterns of both limbs may lead to improved rehabilitation methods following this procedure.

Case Description/Background: This case report evaluates a then 6-year-old male who presented to the orthopedic clinic with non-traumatic onset of left knee pain. This consultation resulted in a diagnosis of osteoblastic osteosarcoma. Treatment consisted of chemotherapy, resection of the tumor, and completion of a left leg Van Ness rotationplasty. At the time of data collection, this individual was 16 years old and functioning independently with all activities of daily living. The goal of this project was to gain a greater understanding of the biomechanics of both limbs following rotationplasty during overground walking.

Discussion/Conclusions: Quantified kinematic and kinetic differences between the non-surgical limb and age-matched normative data were found during overground walking. Specifically, there were kinematic differences at the pelvis, knee, and ankle. This individual had an elevated (5°) and protracted (10-15°) non-surgical hemipelvis over the full gait cycle. Peak knee flexion (47°) during swing in the non-surgical limb was lower than age-matched norms (50-65°) and the surgical limb (68-71°). During stance phase of walking, ankle dorsiflexion in the non-surgical limb was not present through stance phase; the ankle instead maintained a near neutral position. In addition, there was a greater ankle plantarflexion moment in early to mid-stance compared to age-matched norms. In mid-stance the non-surgical ankle plantarflexed to a greater extent than age-matched norms, potentially to assist with foot clearance of his surgical/prosthetic side. In the surgical limb, measurable differences were observed at the ankle functioning as the new knee, primarily the lack of “knee flexion” at the loading response in early to mid-stance when compared to age-matched normative data. There was also a lack of knee power absorption during this phase of gait.

While surface EMG signals displayed differences in both limbs when compared to normative data of muscle activity during overground walking, we seek to understand the timing of activity of the surgically altered musculature through further analysis. With this preliminary information, we hope to gain greater insight into the biomechanical function of the limb after rotationplasty reconstruction. In addition, we aim to gain further understanding of muscle adaptations during overground walking and other functional tasks. This information may have implications into more targeted and effective surgical and rehabilitation strategies resulting in functional improvements for these patients.
Can A Person With Van Ness Rotationplasty Walk Symmetrically?

Madhurima M. Baliga, BSE¹; Travis C. Heare, MD²; Nathan Donaldson, DO²; Susan Kanai, PT, OCS, CSCS³; Anne K. Silverman, PhD⁴

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²Department of Orthopedic Surgery, The University of Colorado Anschutz Medical Campus, Aurora, CO
³Department of Physical Therapy, Children’s Hospital Colorado, Aurora, CO
⁴Department of Mechanical Engineering, Colorado School of Mines, Golden, CO

Introduction: Van Ness Rotationplasty is a surgical procedure performed on patients who have a sarcoma near the knee. The knee joint is resected, and the lower limb is rotated 180° and reattached, allowing the ankle joint to newly function as a “knee” joint. The lower leg muscles remain, but are reattached to thigh muscles. A goal of rehabilitation is often maximizing mobility and achieving a symmetric walking pattern relative to able-bodied individuals. However, it is unknown if achieving symmetric walking is possible given that the musculoskeletal system in rotationplasty is asymmetric. Thus, the goal of this study was to use a computational framework to determine if it is theoretically possible for a rotationplasty patient to walk symmetrically, and identify the muscle forces that symmetric walking requires.

Methods: Previously, OpenSim 3.1 was used to create a rotationplasty model from a nominal, non-amputee model. The right shank and knee joint were removed and the ankle joint was redefined between the femur and the calcaneus. The “new knee” joint was assigned a range of 60° of plantar flexion (knee extension) to 20° of dorsiflexion (knee flexion). Ankle plantarflexor and dorsiflexor muscles were attached to the thigh muscles by maintaining the origin of the thigh muscles and insertion of the ankle muscles while creating one continuous muscle path. The final model had 19 degrees of freedom (DOFs) and 82 musculotendon actuators. Once the model was created, a simulation of symmetric walking was generated using a Computed Muscle Control (CMC) algorithm. The symmetric walking motion from a healthy adult was provided as example data with OpenSim 3.1 (“subject01”). Muscle forces from the simulation of the rotationplasty model were compared with muscle forces from a simulation of a healthy adult model.

Results and Discussion: The simulation reproduced the symmetric experimental walking motion with average residual forces and moments of 0.90%BW and 2.76%BW-m over a gait cycle. Overall, the hybrid muscles in rotationplasty required much greater force generation to replicate the motion of a non-amputee individual. For example, the root mean squared error between the force generated by the lateral gastrocnemius/medial vastus hybrid muscle in rotationplasty and the force generated by the medial vastus in able-bodied walking was 846.0 N. The force produced by the hybrid muscles was greatest from 70 to 90% of the gait cycle (approaching the right foot strike, see Fig. 1) and the kinematics produced by CMC in this portion of the gait cycle deviated from the motion capture kinematics. The simulation walking motion deviated from experimental motion in multiple DOFs, but the largest difference was in pelvis list (maximum of 9°).
Conclusions: This study investigated if it is theoretically possible for a rotationplasty patient to walk symmetrically. A symmetric simulation was generated, but required very large muscle forces. These large muscle forces suggest that it may not be possible for a rotationplasty patient to walk symmetrically. Future work will simulate the gait of a rotationplasty patient to provide insight into muscle functional roles and optimal design of prosthetic components.

Figure 1: Forces produced over the gait cycle by the semimembranosus-tibialis anterior hybrid muscle.
One of the most requested presentation topics by ACPOC members are retrospective views of patients that were first treated as children and have continued use of a prosthesis in to adult life. The purpose of this presentation is to gain insight into the challenges facing hip disarticulation patients as they age. The experience of six long term prosthetic users, the longest being 45 years, will be presented. It is hoped that our community of specialists can gain insight into potential future challenges to better inform current patients being treated in pediatric clinics.
7 year old female amputee with Caudal regression syndrome. Presents with an anatomically and functionally sound right limb. Left side lower extremity has longitudinal deficiency with complete absence of the left pelvis, femur, fibula, and incomplete foot. Her old prosthesis was fit as a bucket style hip disarticulation prosthesis, with an obturator for her left limb to escape the socket. It has a traditional style prosthetic hip joint mounted medial to the obturator.

This current prosthesis is becoming too small. Due to growth, the obturator required for her left side limb needs to be increased, this is encroaching on our ability to mount a prosthetic hip joint, and also decreases the surface area in the distal end of the socket to distribute forces. The child’s mass is increasing, and more forces are being borne through the socket on a decreasing amount of surface area.

We are currently trying to create a new socket for her. The new socket will include a spinal style body jacket to accept most of the weight bearing with a second laminated section over her residual limb to help control sagittal plane hip motions. There will be a trans-femoral style hip joint mounted laterally on the body jacket.

Our concerns for the new design include the ability to appropriately distribute forces for single limb stance phase on the prosthetic side. The ability of the residual limb to control the flexion and extension of the prosthesis. The ability of the prosthetic hip joint to function as required in both stance and swing phase, as well as sitting comfort, and patient acceptance. The family is not interested in amputation of the residual limb at this time.

We are interested discussing with colleagues who have worked with similar presentation. What has worked? What is the prognosis for this child with and without amputation of the left side congenitally short limb?
Quadramembral Amputee Secondary To Purpura Fulminans
Greg M. Bush, BA, CP(c); Wendy L. Hill, BSc, OT; Edmund N. Biden, D.Phil; Monique Taillon, MD
Atlantic Clinic for Upper Limb Prosthetics, Institute of Biomedical Engineering, UNB,
Fredericton, NB, Canada and The Stan Cassidy Centre for Rehabilitation

Problem: AS is a 10 y.o. female residing in a rural area who contracted strep A infection resulting in Purpura Fulminant. She was transported to the regional childrens’ hospital where she underwent amputations of all four limbs leaving her with bilateral transradial amputations, a right hip disarticulation and a left transtibial amputation. She was also treated for hepatic failure, renal failure (requiring temporary hemodialysis) and necrosis of some bowel segments.

In addition, she had a full thickness sacral lesion and involvement of most of the skin on her left lower extremity. In particular, the left lower extremity had skin grafting to the patellar region and distal residual limb while the remainder healed by secondary intention. Unfortunately, she developed keloid in this extensive scar. Because of the extent of her medical problems prosthetic fitting was delayed. She spent approximately 6 months in the children’s hospital after which she was transferred to the tertiary rehab centre in her home province and enrolled in our amputee clinic program. Prior to the amputations AS had been right dominant but her right side is a short transradial.

AS has a pre-existing cognitive disability which leaves her functioning at approximately a 5 y.o. level. She also had pre-existing hearing loss, which is addressed by bilateral hearing aids, and she wears glasses.

AS has a complex family situation. Prior to her illness she was living with her mother and older sister in an inaccessible house. Her father lived nearby, also in an inaccessible house. Prior to her illness, AS was in Grade 3 with a special education plan and an educational assistant.

Solution so far: AS has powered mobility. She quickly became adept at driving her wheelchair and operating the controls for tilt which allow her to keep changing the loads on her compromised skin. The family has a wheelchair accessible van. Community fund raisers have generated a substantial fund to assist with her care.

AS spent approximately 3 months as an inpatient in the tertiary rehab centre after transfer from the children’s hospital. During that time she was seen regularly in our clinic.

AS was fitted with shrinkers for her arms which improved her skin condition. She has been fitted bilaterally with Otto Bock pediatric hands with dual site controls. She adapted very quickly to the use of the prostheses. Her left side was fitted in a pre-flexed manner to allow her to reach her mouth. She spends quite a lot of time with her iPad. The touch screen on the iPad requires capacitive coupling to the user in order to work which meant that simply holding a stylus in her prosthesis didn’t function. The solution was to provide a wired connection between the stylus and an electrode placed in her prosthesis.

The scar on AS’ left side (transtibial amputation) is gradually resolving with use of a shrinker. She and her mother are very keen for her to walk, although they have accepted that this will not be a short term goal.

AS has moved back to her community. The community is refurbishing a house for the family but it is not complete at this time requiring her to be carried in and out and limiting the inside use of her powered chair. She is back in elementary school. AS is, and will be, a complex case for the rest of her life.
Prosthetic Planning and Decisions with Multiple Co-Morbidities: A Case Study of Team Intervention for a 3 Year Old Male with Four Limb Involvement

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Problem: The patient is a 3 year old boy who was adopted from an orphanage in China in April of 2015. At the time of adoption it was known that he had Tetralogy of Fallot (TOF) and Double Outlet Right Ventricle (DORV), with poor endurance and mobility impairments. Within 2 weeks of arrival to the United States, he underwent complex cardiac repair at outside hospital. Extensive intraoperative bleeding and complications arose during surgery. On post op day 1 he had a code event requiring 11 minutes of CPR resuscitation, reintubation, and placement of chest tube for pneumothorax. A subdural hematoma occurred after the arrest. The referring hospital noted an exaggerated inflammatory response and hemodynamic instability leading to multisystem organ failure. By post-op day 3, he had developed a purpuric rash involving arms and legs, progressing to necrosis of his hands and feet. Steroids and plasmapheresis were initiated. He was transferred to the treating hospital on 07/14/15. Bilateral upper and lower extremity amputations were completed on 08/06/15 secondary to necrosis, after bone scan and demarcation was verified clinically. The result was bilateral transtibial amputations and bilateral long transradial amputations.

This child is a very complex case due his medical course and his social history of being recently adopted from abroad. The patient’s attachment to his adoptive mother was emerging during his initial hospital stay. He was very anxious with all novel situations and transitions. All of these factors were significant in leading prosthetic planning discussions. Our team discussion included Rehab medicine, Orthopedics, prosthetists, occupational therapy, physical therapy, the patient, and his parents.

Prosthetic and rehabilitation planning questions were numerous but always focused on 2 primary questions: “What will make this child the most functional?” And “what will this child tolerate now?” We considered various upper extremity options including unilateral vs bilateral prosthetic intervention, body powered vs myoelectric prosthetics, 3D printed hands vs traditional prosthetics, and even lower extremity training before upper extremity training. Safe and functional mobility was of highest priority for both the family and our team.

Solutions: With a large and dynamic multidisciplinary team we chose to take a holistic approach to this child’s needs. Solutions included the following:

- Early on patient would ask for “robot hands” but became upset with any mention of prosthetic legs – so we started with upper extremities.
- Wound healing was most rapid in his right upper extremity – so we started there.
- Initiated manual voluntary opening hand with figure 8 harness.
- Initiated training on bilateral lower extremity prostheses with walker modification
- Prioritized feeding skills to remove NG tube prior to discharge.
- Scheduled fitting for custom wheelchair – likely with Smart Drive power assist.
- Initiated contact with Creighton’s 3D printing group to create Left upper extremity prosthesis
- Submitted application for GoBabyGo car for increased power mobility and social interaction

Only this child will be able to tell us what path is right for him, but we will provide him with every opportunity to find that path to independence and happiness.
Upper Extremity Anomalies Associated With Femoral And Fibular Deficiency

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Purpose: Defects occurring in the so-called Femoral-Fibular-Ulnar developmental field are believed to cause of the cluster of anomalies seen in children with femoral, fibular and ulnar limb deficiencies. Upper limb function is an important consideration in the management of the lower limb deficiencies. The purpose of this study is to determine the frequency and type of upper extremity anomalies found in children with femoral or fibular deficiency and to determine their relevance in their lower extremity management.

Methods: An IRB approved retrospective study was performed of consecutive patients seen at our center with the diagnosis of femoral and/or fibular deficiency. Medical records and existing radiographs were reviewed and 327 patients were identified. Chi-square analysis was used to compare characteristics of those with and without upper extremity anomalies.

Results: Upper extremity anomalies were identified in 56 patients (17%). Thirty-six were male and 18 females. Male predominance in upper limb deficiency was not different from the total population (p=0.50). Thirty patients had fibular deficiency only (54%), 4 had femoral deficiency only (7%), and 22 had both (39%). This was similar to the entire population (p=0.13). Thirty-two patients (54%) had bilateral lower extremity deficiencies compared to 91 (28%) for the whole group. This was significant with upper limb anomalies more common among those with bilateral compared to unilateral lower extremity deficiencies (p<0.0001).

Seventy-five upper limbs were involved with 50 ulnar deficiencies, 9 congenital trans-humeral deficiencies, 4 congenital shoulder disarticulations, 7 cleft hands, 2 radial head dislocations, and one each- radial deficiency, syndactyly, and capitate-lunate coalition. Two patients with bilateral anomalies had ulnar deficiency on one side and a congenital amputation on the other, one trans-humeral and one shoulder disarticulation. Four patients had bilateral loss of prehension that could preclude amputation in the lower extremities.

Conclusions:
1. Upper extremity anomalies are found in 17% of children with femoral and/or fibular deficiency and are more common in those with bilateral lower extremity deficiencies.
2. Ulnar deficiency is the most commonly associated upper extremity anomaly, consistent with the prevailing developmental field concept. However, the frequent finding of congenital transverse deficiencies with femoral and/or fibular deficiencies and the identification of patients with concomitant ulnar deficiency and congenital amputation suggests there may also be a common embryological path with trans-humeral and shoulder disarticulation level deficiencies.
3. Concern for bilateral loss of prehension effecting lower extremity management occurred in 1.2% of patients with femoral and/or fibular deficiency.
Problem Solving Lower Body Dressing for Children with Multiple Limb Involvement
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A variety of challenges emerge when working with children with multiple limb involvement. Their physical abilities, age-appropriateness, behavior/motivation, conceptualization/cognition, and support by their guardians all need to be considered when assisting with adaptive strategies or incorporating devices. All families are different and there is not one universal device/strategy that can conquer all challenges. At the Child Amputee Prosthetics Project the collaboration of the child, family, occupational therapist, prosthetists, and technicians were all involved in the problem solving process. Two cases will be reviewed.

One case involved a four year old girl with congenital anomalies of bilateral upper and lower extremities, including complete amelia of the left upper extremity, right transhumeral deficiency with a single digit, bilateral femoral deficiency with fibular deficiency and four-toed feet. She was very motivated and wanted to complete lower body dressing. The traditional suction cup hook or dressing stick were not useful. Her hips were wide to manage as well. Various attempts with different kinds of hooks were tried. Ultimately a dressing platform with 3 hooks and a modified arm rest to assist with balance was fabricated. She began with loose shorts and successful with minimal assist to “wiggle” into and out of the shorts, however unsure how successful it was in the home setting. After fabrication was completed and family was instructed to trial at home, the family did not return for follow up visits.

Another case involved a fourteen year old boy with amyoplasia with all four limbs involved. He recently underwent bilateral above knee amputations due to bilateral knee extension contractures and equinovarus deformities, which hindered him from participating in daily activities. Bilateral upper extremities had very limited shoulder and elbow strength and range of motion, bilateral forearms are fixed, bilateral wrist flexion contractures, and little to no grip of bilateral hands. Multiple attempts trialed with more traditional adaptive equipment, dressing stick, suction cup wall hook however limitations in bilateral upper extremities and bilateral lower extremity range of motion lead to fabricating a device we observed on Youtube and modified for the individual. It was made of light weight PVC pipe to “prop” the shorts while the child “crawled” into his shorts supine. Two dressing sticks placed in the PVC pipe assisted with doffing the shorts.

The input from each individual of the team especially the family is important while trialing and problem solving various ideas before discovering what is ideal for the child with multiple limb differences. One device at a certain time of development will likely not be appropriate always and modifications and adjustments will need to continue throughout the life span.
Challenges Of Treating Children Diagnosed With Cornelia De Lange Syndrome

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Over the past year, 3 infants diagnosed with Cornelia de Lange Syndrome each with significant multi-system involvement have been referred to Children’s Healthcare of Atlanta Limb Deficiency Program. As clinicians caring for these infants, the degree and severity of their impairments can present challenges requiring a cohesive multidisciplinary team to assist the families in their surgical/medical care, rehabilitation, and psychosocial development.

The purpose of this symposium is to introduce the participants to the diagnosis of Cornelia de Lange Syndrome, discuss the etiology and genetic supporting the diagnosis, and identify the musculoskeletal, neurological, and cognitive characteristics of the disorder. Medical, surgical, and rehabilitation interventions will be presented.

- Introduction
- Etiology and associated anomalies
- Interventions: goals for intervention
  - Musculoskeletal impairments: upper and lower extremity
  - Rehabilitation
- Discussion

Goals:
1. Identify the characteristic features of Cornelia de Lange Syndrome including associated anomalies and genetic etiology
2. Review the musculoskeletal, neurological, and cognitive characteristics of Cornelia de Lange Syndrome
3. Discuss the surgical, prosthetic, orthotic, and therapeutic management

Objectives: The participants will:
1. Gain an understanding of the complexities of diagnosing and treating children with Cornelia de Lange Syndrome
2. Identify appropriate surgical, prosthetic, orthotic, and therapeutic interventions
3. Know when to refer a family for a genetics evaluation
4. Learn the other anomalies that can be associated with Cornelia de Lange Syndrome
Management Of Terminal Bony Overgrowth Of The Humerus With Osteocartilaginous Grafts
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Purpose: Bony overgrowth is a common complication in children after humeral transcortical amputation. Previous studies group children with humeral overgrowth with those who have developed overgrowth in other locations. Capping tibial overgrowth with the proximal fibula has been shown to be the most effective treatment. This is not clear for the humerus. We present eighteen humeri treated surgically for humeral osseous overgrowth with simple resection or autologous osteocartilaginous graft.

Methods: Records were reviewed of amputation patients from a single pediatric hospital from 1987-2011. Patients with two years follow-up who underwent surgical treatment for established humeral overgrowth were included. One requiring revision surgery before two years was included. Patients initially managed with simple resection were compared to those managed with autologous osteocartilaginous grafts. All patients who underwent autologous osteocartilaginous grafting, either as index or subsequent procedure were examined.

Results: Eighteen humeri in sixteen patients met inclusion criteria, including ten acquired amputations and eight congenital. Mean age at initial surgery was 8 (2.6-13.3) years and mean follow-up was 6.6 (1.4-10.3) years. Thirteen humeri underwent simple resection, with recurrent overgrowth in nine, and revision surgery in eight at a mean 2.6 years. Five humeri were primarily managed with autologous osteocartilaginous grafts. Two developed non-overgrowth related complications at 1 and 42 months. Including revision procedures after simple resection, 10 humeri were managed with autologous osteocartilaginous grafts. Thirty percent (3/10) required revision surgery, however, there were no cases of recurrent overgrowth.

Conclusion: At a mean of 5.4 years, seven of ten humeri treated with autologous osteocartilaginous grafts, either primarily or as a secondary procedure, had not required revision surgery. In contrast, only five of thirteen humeri treated with simple resection did not require further surgery with eight undergoing revision at a mean 2.6 years. Despite this difference in outcomes, the heterogeneity of surgical techniques in humeral osteocartilaginous capping demonstrates that an ideal technique has yet to be established. Furthermore, outcomes are not as consistent as when the technique is applied to overgrowth of the tibia.

Significance: This study provides guidance for a problem, which deceptively appears to have a simple solution. The ease of performing simple resection is belied by the fact that the surgeon who chooses this strategy will likely be back in the operating room within a few years. However, issues with fixation and hardware prominence can complicate osteocartilaginous grafting of the humerus.
Use Of A Foerarm Prosthosis For Activity Specific Adaptions For Children With Long Transverse Or Longitudinal Deficit

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The participation in age appropriate activities is critical for the development of self-esteem, social skills, peer interaction skills, upper extremity strength and coordination. The use of a prosthesis with activity specific terminal devices, allows children with long transverse amputations or longitudinal deficits to more easily and equally participate in bilateral and bimanual activities.

Children with a long transverse amputation such a wrist disarticulation or transcarpal/metacarpal amputation have frequently not been fitted with a traditional socket and terminal device. This is secondary to the added length to the residual arm, loss of the considerable function these children have without a prosthesis, loss of sensation, etc. Likewise, children who have longitudinal deficits such as ulnar or radial deficiencies, absent ulnar or radial digits, have not had devices available to them that increase their ability to participate in a variety of age appropriate activities requiring bilateral or bimanual skills.

This presentation will explore the use of a forearm prosthesis adapted to children, which allows the use of activity specific devices to facilitate and enhance participation in age appropriate activities that require bilateral or bimanual skills. This allows these children to more equally participate in activities such as baseball/Little League, riding bikes, catching balls of different sizes, gymnastics, fishing, etc. This prosthetic-orthotic solution gives children a more equal opportunity to actively participate in their lives.
As healthcare professionals and providers, it is incumbent upon us to provide client-centered care. The consumer demands it, the healthcare industry requires and our professional ethics mandates it. Patient satisfaction has long been a buzzword and in the prosthetic industry, it includes satisfaction with service delivery as well as with technology. Existing surveys and feedback forms often appear inadequate; and the information is often provided late in the process, hampering functional outcomes and at times does not allow the clinician with the opportunity to rectify dissatisfaction.

At Handspring, we have partnered with our adult and pediatric clients to create a feedback loop which speaks to all phases of the prescriptive prosthetic process. We initiate use of the feedback document during the pre-prosthetic phase and extend it through follow-up after delivery of the definitive technology. Items on the form are relevant to comfort, aesthetics, ease of donning/doffing, tolerance to weight, length, socket and harness as appropriate; control systems, and functionality of the technologies. The user grades each item using a color-coded system. By actively engaging the client, as well as input from the family and/or case manager, the prosthesis users is able to offer feedback immediately. This information contributes to user acceptance of the device, and ultimately to beneficial functional outcomes.
Development Of Low Cost 3D Printed Transitional Prostheses

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Introduction: There are increasing numbers of children with traumatic and congenital amputations or reductions. Children's prosthetic needs are complex due to their small size, constant growth, and psychosocial development (Krebs et al., 1991 and Zuniga et al. 2015). Families' financial resources play a crucial role in the prescription of prosthetics for their children, especially when private insurance and public funding are insufficient. Electric-powered (i.e., myoelectric) and body-powered (i.e., mechanical) devices have been developed to accommodate children's needs, but the cost of maintenance and replacement represent an obstacle for many families. Due to the complexity and high cost of these prostheses, they are not accessible to children from low income, uninsured families, or to children from developing countries (Krebs et al., 1991 and Zuniga et al. 2015). Advancements in computer-aided design (CAD) programs and additive manufacturing offer the possibility of designing and printing prostheses at a very low cost (Zuniga et al. 2015). The purpose of the present investigation was to demonstrate the manufacturing methodology of 3D printed transitional prostheses, examine improvement in perceived changes in quality of life, daily usage, and activities performed with these types of devices.

Methods: Nine children (two girls and seven boys, 3 to 16 years of age) with upper-limb reductions (one traumatic and eight congenital) were fitted with our 3D printed transitional prostheses and were asked to complete a survey. Inclusion criteria included boys and girls from 3 to 17 years of age with unilateral upper-limb reductions. Exclusion criteria included upper extremity injury within the past month and any medical conditions that would be contraindicated with the use of our 3D printed prostheses prototypes, such as skin abrasions and musculoskeletal injuries. The study was approved by the Creighton University Institutional Review Board and all the subjects completed a medical history questionnaire. All parents and children were informed about the study and parents signed a parental permission. For children 6 to 17, an assent was explained by the principal investigator and signed by the children and their parents. The survey was developed to estimate the impact of our prosthetic device including items related to quality of life, daily usage, and type of activities performed.

Results: After approximately 1 to 3 months of using our 3D printed prostheses 11 children and their parents reported some increases in quality of life (4 indicated that was significant and 7 indicated a small increase), while 1 indicated no change. Nine children reported using the device 1 to 2 hours a day, 3 reported using it longer than 2 hours and 1 reported using it only when needed. Furthermore, children reported using our 3D printed prostheses for activities at home (9), just for fun (10), to play (6), for school activities (4), and to perform sports (2). Four children reported malfunctioning and/or breaking of the 3D printed prosthetic device.

Figure 1. Shows some of the 3D printed transitional prostheses prototypes developed by our research team. A: Hand prosthesis (Cyborg Beast); B: Below Elbow Device; C: Prosthetic Shoulder.
**Discussion:** The main finding of our survey was that our 3D printed transitional prostheses have a great potential in positively impact quality of life, daily usage, and can be incorporated in several activities at home and in school. However, 36% of our research participants reported durability issues and/or malfunctioning of these devices. There is a need to develop medical grade 3D printed prosthetic devices to solve the durability constrains.

**Conclusion:** Although, durability and environment are factors to consider when using 3D printed prostheses, the practicality and cost effectiveness represents a promising new option for clinicians and their patients. 3D printing technology for the development of prosthetic devices is at a very early stage. The supervision of a certified prosthetist is crucial for the proper development and use of 3D printed prostheses.

**Clinical Applications:** 3D printed transitional prostheses have a great potential in positively impact quality of life, daily usage, and can be incorporated in several activities at home and in school. The supervision of a certified prosthetist is crucial for the proper development and use of 3D printed prostheses.

**References:**
Poster 2

**Use Of Bilateral Upper Limb Prosthesis Simulators In Preparatory Training Prior To Delivery**  
*Debra Ann Latour, MEd., OTR/L*  
Single-Handed Solutions, LLC, Middletown, NY

It appears that the concept of utilizing simulators is underutilized. The body-powered prosthesis simulator described accesses both voluntary-opening and voluntary-closing terminal devices. As described in this presentation of reflective case studies, the prosthesis simulator can be used in multiple stages of prosthetic training. During the initial evaluation, the simulator can be used to compare function and access of the technologies for successful prescription and actual client trial. This evidence can be videotaped and photographed to provide compelling evidence justifying medical necessity to the funding stakeholder(s). In addition, the caregiver can experience the diverse technologies in order to better understand the requirements of use and application to functional and bimanual manipulative tasks. During the preparatory phase, the user can adjust to the demands of suspension and practice pre-prosthetic skills-drills and activities. Upon delivery of the definitive prosthesis, the simulator can be utilized to educate the family members and caregivers to various strategies in order to complete bimanual tasks. These opportunities with the simulator appear to enhance carry-over of strategies to facilitate skill acquisition and appropriation of prosthetic satisfaction. Case study of clients with bilateral UL limb loss and a report of outcomes measures will be included in final results and discussion at the time of this presentation.
Potential RSI Risks In One Handed Texting

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Background: We have reported previously on survey data we have collected for working age amputees and normally limbed individuals. We found that the amputee population had a substantially higher incidence of reported wrist and hand pain and that the pain levels were higher than in the normally limbed group. The factor which seemed to be most closely linked to wrist and hand pain was “texting”. Amputees tend to text one handed which results in heavy use of the hand and potentially awkward postures. One handed texting is reported for up to 40% of the general population so this issue goes well beyond simply amputees.

Approach: We have recently completed a study of one handed texting in a group of normally limbed individuals and will eventually extend this work to our amputee clinic population. Individuals were asked to text one handed using an iPhone 4. They were asked to text a sequence of numbers and letters which included keys close to the thumb, ones which involved reaching the full width of the keyboard and ones which were in the middle of the phones virtual keyboard. People did a long pattern which required 13 key strokes, and a short pattern with 5 (essentially the corners and the middle of the keyboard). Right and left handed patterns were created so as to be symmetrical in reach and general thumb orientation. Forces were measured by attaching a Tekscan™ force sensing resistor to the thumb using double sided tape. The person then did each sequence of keystrokes five times so that there was enough data that trials which were difficult to interpret or incomplete could be discarded. Data were collected using a digital data acquisition system and transferred to a computer for analysis.

Results:

- The women who completed the study generally applied higher forces to the keypad than did the males. For “near” keys these forces exceeded recommended touchscreen design forces about half the time.
- The time taken to do the sequence of keystrokes was generally longer for the women.
- Generally people applied larger forces to “near” or low reach keys than when they press keys where they need to reach across the keyboard.
- People with larger hands tended to apply smaller forces.

The study suggests that one handed texting produces forces and postures which put people at risk for RSI’s. These risks may be reduced by redesign of keyboards to reduce the extremes of reach.
This presentation is related to the population of children that have birth related brachial plexus lesions. It is well known that children with a brachial plexus lesion are at risk for developing internal rotation contractures around the shoulder joint. This can lead to not only functional impairments but also can cause shoulder joint abnormalities.

Traditional management mainly uses therapy interventions to try and maintain ROM in these children. We present using an adjuvant protocol of botulinum toxin injections in combination with orthotic interventions to improve range of motion at the shoulder joint. We will present a case series of children who were treated using this protocol.

The data will include:
Lesion level including Naraku's Classification
Pre-injection exam including ROM
Injection Procedure
Post-injection splinting protocol
Post injections ROM

Below is an example of the data that will be presented: The data shows how over time some children begin to lose motion mainly in external rotation in adducted position. With treatment intervention the ROM is dramatically improved.
**A New Prosthetic Model For Management Of Pediatric Partial Foot Amputations**
*Robert Meier, CO, BOCO; Vincent DeCataldo, BOCO, BOCP*
Allard USA, Rockaway, NJ

**Introduction:** Data show that partial foot amputations in the pediatric population are continuing at a consistent rate with 60% being congenital and 40% as a result of trauma. The suggested prosthetic solutions presented in literature for these amputations are as varied as the causes leading to amputation. A review of the fundamental function of the foot was conducted leading to a model for the prosthetic management of these amputations that both protects the residuum and restores propulsion.

**Methods and results:** The patient was a bilateral congenital partial foot amputee with gait challenges that got worse as she got bigger. Previous solutions lead to callus formation and skin breakdown with resultant non-compliance. The solution was to use prefab carbon composite AFOs together with custom partial foot prostheses to increase the length of the foot lever arm. Outcomes show that this intervention protects the foot from further breakdown and helps restore propulsion while providing enhanced proximal stability.

This technique works with both congenital and traumatic forefoot amputations.
Goals
The goal of the annual meeting is to provide a forum for the sharing of knowledge regarding the newest developments in research, equipment, observations, and treatments for children and adolescents with limb deficiencies. The meeting will also encourage and promote investigative endeavors and augment the education of personnel engaged in scientific endeavors related to the field of limb deficient patients.

Objectives
1. To provide a format that presents the best available knowledge in the care and treatment of children and adolescents with limb deficiencies and transition into Adulthood.
2. To examine the indications, techniques and results of various surgical procedures; and describe the management of children’s orthopaedic problems.
3. To examine the latest prosthetic-orthotic equipment.
4. To present the latest in physical and occupational therapy, rehabilitation, adaptive equipment, and techniques.

Target Audience
New and established orthopaedic surgeons, pediatricians, rehabilitation physicians, nurses, orthotists, prosthetists, physical and occupational therapists, other health professionals who care for children with orthopaedic or related disabilities, and educators from within the US and Canada, or in practice outside the US and Canada.

Continuing Education Credits
This activity has been planned and implemented in accordance with the accreditation requirements and policies of the Accreditation Council for Continuing Medical Education (ACCME) through the joint providership of the American Academy of Orthopaedic Surgeons and Association of Children’s Prosthetic-Orthotic Clinics. The American Academy of Orthopaedic Surgeons is accredited by the ACCME to provide continuing medical education for physicians.

The American Academy of Orthopaedic Surgeons designates this live activity for a maximum of 16.5 AMA PRA Category 1 Credits™. Physicians should claim only the credit commensurate with the extent of their participation in the activity. Credits are allocated as follows: Thursday – 6.5, Friday – 6.5, Saturday – 3.5.

AAPA accepts certificates of participation for educational activities certified for AMAPRA Category 1 Credit™ from organizations accredited by ACCME or a recognized state medical society. Physician assistants and registered nurses may receive a maximum of 16.5 hour of Category I credit for completing this program. NEW sign in sheets for Physician Assistants and Registered Nurses outside meeting room.

ABC Credits
The ACPOC Annual Meeting has been approved for a maximum of 23.5 credits through the American Board for Certification in Orthotics and Prosthetics (ABC), Inc. Full participation in this program is required to be eligible for the full amount of credits. Credits are allocated as follows: Wednesday Technical Workshops – 5.5, Thursday – 7.5, Friday – 6.5, Saturday – 3.5. Sign-in Sheets will be available at each session. An additional credit will be given to those who fill out the Category II Application Form for Exhibit Hall Attendance.

OPC Credits
The ACPOC Annual Meeting has been approved for a maximum of 22 MCE credits through the Orthotics Prosthetics Canada (OPC). Full participation in this program is required to be eligible for the full amount of credits. Credits are allocated as follows: Wednesday Technical Workshops – 6, Thursday – 6, Friday – 6, Saturday – 4.
NOTE: There are separate daily AM and PM session sign-in sheets for ABC for each workshop and general sessions. NEW revised OPC sign in sheets require attendees to complete their contact information once and initial daily the AM and PM sessions they attended.

Registrants of other disciplines must submit their request for continuing education credits to their local groups. Certificate of Attendance forms are available at the registration desk.

The 2016 Annual Meeting evaluation is on-line ONLY. Completion is required to obtain your Certificate of Attendance. Access the survey at https://www.surveymonkey.com/r/ACPOCAM16. Directions on completing the survey: Once you have accessed the evaluation, you can go back to previous pages in the survey and update existing responses until the survey is finished or until you have exited. If you do not complete the survey before exiting, your responses will be captured however, you will not see your previous answers, when you subsequently access the survey form. Your IP address is stored in the survey results to verify that you have completed the survey. Once you have answered all the questions, you will be directed to the certificate of attendance. Feedback is important and is considered in planning future educational events.

Please complete the online survey by Tuesday, May 31, 2016.
Save the Date!

2017 Annual Meeting
March 22-25
Omni Houston Hotel
Houston, Texas