Association of Children's Prosthetic-Orthotic Clinics

Professionals helping kids be Kids

2015 Annual Meeting

May 13-16

Clearwater Beach, Florida

Hilton Clearwater Beach Resort

"Professionals Helping Kids be Kids"

ABSTRACTS

THURSDAY, May 14

7:30–8:30 AM	**CONTINENTAL BREAKFAST** in Grand Ballroom Salons FG
7:00 AM–5:30 PM	**REGISTRATION** in Grand Ballroom Foyer
8:00 AM–5:15 PM	**SCIENTIFIC PROGRAM** in Grand Ballroom Salons DE
8:00–8:10 AM	**WELCOME** – ***David B. Rotter, CPO, President***
8:10–8:15 AM	**NEW INVESTIGATOR RESEARCH AWARD PRESENTATION –** ***David B. Rotter, CPO***
8:15–10:00 AM	**SESSION I – LOWER LIMB DEFICIENCIES – PART I** ***Moderator: David B. Rotter, CPO***
8:15–8:25 AM Paper 1	**Osteocartilaginous Transfer Of The Proximal Fibula For Treatment Of Bony Overgrowth In Children With Congenital And Acquired Tibial Amputations – Surgical Technique And Results** ***Graham Todd Fedorak, MD***; Hugh G. Watts, MD; Anna V. Cuomo, MD; Julian P. Ballesteros, MD; Richard E. Bowen, MD; Anthony A. Scaduto, MD
8:25–8:35 AM Paper 2	**A Retrospective Review: Care And Management Of The Lower Extremity Epiphyseodesis Surgery Patient** ***Maureen J. Maciel, MD***; Sandra B. Smith, PT; Natasha Casimir, PT, DPT
8:35–8:45 AM Paper 3	**Bracket Epiphysis Of The Tibia As Previously Unrecognized Phenotype Of Tibial Hemimelia – Report Of Two Cases** ***J. Ivan Krajbich, MD***; Benjamin Parkinson, MBBS, FRACS; Kelly Alexander, RN
8:45–9:00 AM	Discussion
9:00–10:00 AM Workshop 1	**Fibular And Tibial Hemimelia: Prosthetic Management And Gait Characteristics In The Growing Child** ***Kelly A. Jeans, MS***; ***Amanda Claire Brown, CPO, LPO***; Kirsten Tulchin-Francis, PhD; Lori A. Karol, MD
10:00–10:45 AM	***MEET & GREET VENDORS / POSTERS/ REFRESHMENT*** (in Exhibitor Hall)
10:45 AM–12:30 PM	**SESSION II – LOWER LIMB DEFICIENCIES – PART II** ***Moderator: Brian J. Giavedoni, MBA, CP, LP***
10:45–10:55 AM Paper 4	**Case Report Of Treatment Of A Patient With A PFFD Aiken A Left Hip, An Ipsilateral Congenitally Fused Knee Along With A Contralateral Fibular Hemimelia** ***Michael J. Forness, DO***
10:55–11:10 AM Challenging Case 1	**Popliteal Pterygium Syndrome Case Study: A Look At Pre- And Post-Amputation And Achieving The Best Ambulatory Outcome** ***Angela Swindell, CPO***; Lisa Schwarcz, PT, DPT, PCS; Julie Cagney, DPT; Stacy J. Suskauer, MD
11:10–11:25 AM Challenging Case 2	**Intervention To Provide Weight Bearing For A Young Child With Multiple Congenital Anomalies: A Challenging Case** ***Robert D. Lipschutz, CP;*** Vari McPherson, CPO; Shandy Rivera, CO; Natascha Mangan
11:25–11:35 AM Paper 5	**Oxygen Consumption In Patients With PFFD: A Comparison Of Prosthetic Level** ***Kelly A. Jeans, MS***; Amanda Claire Brown, CPO, LPO; Kirsten Tulchin-Francis, PhD; Lori A. Karol, MD
11:35–11:50 AM	Discussion
11:50 AM–12:00 PM Paper 6	**Biomechanical Comparison of Three Prosthetic Feet for One Transtibial Child** ***Guðfinna Halldórsdóttir, MSc***; Knut Karl Lechler, CPO
12:00–12:15 PM Paper 7	**Functional Outcomes Of A Child With Möbius Syndrome And Congenital Lower Limb Deficiencies After Rehabilitation: A Case Report** ***Natasha Casimir, PT, MS, DPT***; Nicole Bishop, PT, DPT
12:15–12:30 PM	Discussion

12:30–1:30 PM	**LUNCH** in Grand Ballroom Salons FG
1:30–2:30 PM	**HECTOR KAY GUEST SPEAKERS –** ***Eric P. Neufeld, CPO, FAAOP and David J. Krupa, CP*** **The ROMP Model: A Value Driven Method of Delivering Prosthetic Services in Resource Poor Countries**
2:30–3:30 PM	**SESSION III – PHYSICIAN'S GUIDED FORUM –** ***PART I*** ***Moderator: J. Ivan Krajbich, MD***
3:30–4:15 PM	***MEET & GREET VENDORS / POSTERS/ REFRESHMENT*** (in Exhibitor Hall)
4:15–5:15 PM	**SESSION IV – PHYSICIAN'S GUIDED FORUM –** ***PART II*** ***Moderator: Jorge A. Fabregas, MD***
5:15 PM	**Adjourn**

FRIDAY, May 15

7:00–8:00 AM	**CONTINENTAL BREAKFAST** in Grand Ballroom Salons FG
7:00 AM–6:00 PM	**REGISTRATION** in Grand Ballroom Foyer
7:30 AM–5:45 PM	**SCIENTIFIC PROGRAM** in Grand Ballroom Salons DE
7:30–9:30 AM	**SESSION V – GAIT & LOWER LIMB ORTHOTICS** ***Moderator: Hank White, PT, PhD***
7:30–8:30 AM Workshop 2	**The Development Of Gait: Back To The Beginning** ***Megan Smith, CO***
8:30–8:45 AM Challenging Case 3	**A Brace Design Comparison For The Pediatric Patient With Charcot Marie Tooth Disease** ***Sara B. Rubinstein, CO, LO, CTR***
8:45–8:55 AM Creative Solution 1	**Pediatric Partial Foot Prostheses: Utilizing A Custom Fit Dynamic Carbon Composite Prosthesis - A New Treatment Option?** Vincent DeCataldo, BOCO, BOCP; ***David C. Ruthsatz, CO, CPA, AT***
8:55–9:05 AM Paper 8	**Equinus Relapse After Ponseti Management Of Clubfoot: Correlation With Dorsiflexion Lag, And Management With Casting And Nighttime AFO** Alexander Tom Lerman; Anita Bagley, PhD; ***Joel A. Lerman, MD***
9:05–9:15 AM Paper 9	**How Important Is Brace Compliance In Ponseti-Treated Idiopathic Clubfeet?** ***Kevin Felton, CO, LO, FAAOP***; Donald D. Virostek, CPO; B. Stephens Richards, III, MD; Shawne Faulks, RN; Karl E. Rathjen, MD; Lori A. Karol, MD
9:15–9:30 AM	Discussion
9:30–10:55 AM	**SESSION VI – NEUROMUSCULAR** ***Moderator: Janet G. Marshall, CPO***
9:30–9:40 AM Paper 10	**Are There Gender Differences In Outcomes Following Hamstring Lengthenings In Children Diagnosed With Cerebral Palsy?** ***Hank White, PT, PhD***; Janet L. Walker, MD; Juanita Jean Wallace, MS; Samuel F. Augsburger, MS; Vishwas R. Talwalkar, MD; Ryan D. Muchow, MD; Henry J. Iwinski, MD
9:40–10:40 AM Workshop 3	**Prosthetic Management For Children With Cerebral Palsy And Spina Bifida** ***Phoebe R. Scott-Wyard, DO***; Natalie Wise-Aguilar, MPT, CCCE
10:40–10:55 AM	Discussion
10:55–11:40 AM	***MEET & GREET VENDORS / POSTERS/ REFRESHMENT*** (in Exhibitor Hall)
11:40 AM–12:45 PM	**SESSION VII – SPINE** ***Moderator: Todd C. DeWees, CPO***
11:40–11:50 AM Paper 11	**Anterior Only Approach To Spina Bifida (MM) Scoliosis** ***J. Ivan Krajbich, MD***

11:50 AM–12:05 PM Paper 12	**Malignant Peripheral Nerve Sheath Tumors (MPNST) In Pediatric Nf 1 Patients** ***J. Ivan Krajbich, MD***; Nadine L. Williams, MD
12:05–12:20 PM Challenging Case 4	**Infantile Scoliosis Treatment Utilizing EDF Casting And Scoliosis TLSO On A Two Year Old Patient With Arthrogryposis** ***Debra M. Auten, BS, LCPO***
12:20–12:30 PM Challenging Case 5	**Pediatric Positioning "Hey Wheelchair Man, How Small Can You Go?"** ***Craig A. Kraft, ATP/SMS***; Richard L. Besett, ATP
12:30–12:45 PM	Discussion
12:45–1:45 PM	**BUSINESS MEETING LUNCH (*Members Only*)** in Grand Ballroom Salons DE
1:45–2:45 PM	**PRESIDENTIAL GUEST SPEAKER – *Todd A. Kuiken, MD, PhD*** **The origins of TMR, why this approach is beneficial, and current implementation**
2:45–3:15 PM	**SESSION VIII – GLOBAL CONCERNS – *PART I*** ***Moderator: Anna V. Cuomo, MD***
2:45–3:05 PM Creative Solution 2	**Connecting Children With Limb Differences And Their Families: A Group-Based Multidisciplinary Therapy Program** ***Lisa Schwarcz, PT, DPT, PCS***; Jordan Sachse, OTD, OTR/L; Julie Cagney, PT, DPT
3:05–3:15 PM	Discussion
3:15–4:00 PM	***MEET & GREET VENDORS / POSTERS/ REFRESHMENT*** (in Exhibitor Hall)
4:00–5:45 PM	**SESSION IX – GLOBAL CONCERNS – *PART II*** ***Moderator: Wendy L. Hill, BSc, OT***
4:00–5:00 PM Workshop 4	**Overview Of A Limb Deficiency Registry And The Genetics Of Limb Deficiencies** ***Anna V. Cuomo, MD***; William R. Wilcox, MD, PhD; David B. Everman, MD
5:00–5:45 PM Workshop 5	**Childhood To Adolescence: A Review Of Relevant Emerging Technologies** ***Robert D. Lipschutz, CP; David B. Rotter, CPO***
5:45 PM	**Adjourn**

SATURDAY, May 16

7:30–8:30 AM	**CONTINENTAL BREAKFAST** in Grand Ballroom Salons FG
7:30 AM–1:00 PM	**REGISTRATION** in Grand Ballroom Foyer
8:00–11:55 AM	**SCIENTIFIC PROGRAM** in Grand Ballroom Salons DE
8:00–10:05 AM	**SESSION X – APPROACHES TO UPPER LIMB DIFFERENCES – *PART I*** ***Moderator: Phoebe R. Scott-Wyard, DO***
8:00–9:30 AM Workshop 6	**Limb Deficiencies Of The Upper Limb, Simple To Complex: The Challenges With Surgical, Prosthetic, Orthotic, And Therapeutic Interventions** ***Colleen P. Coulter, PT, PhD, DPT, PCS***; Allan E. Peljovich, MD, MPH; ***Bryce T. Gillespie, MD; William R. Wilcox, MD, PhD; Jorge A. Fabregas, MD; Brian Giavedoni, MBA, CP***
9:30–9:40 AM Creative Solution 3	**Cyborg Beast: An Open Source Low-Cost 3D-Printed Prosthetic Hand For Children With Upper-Limb Differences** ***Jorge M. Zuniga, PhD***; Jean M. Peck, OTL, CHT; Dimitrios Katsavelis, PhD
9:40–9:50 AM Paper 14	**Differences In Fitting Between Congenital And Acquired Amputees** ***Edmund N. Biden, D.Phil***; Wendy L. Hill, OT; Greg Bush, CP(c); Lilian K. Manor
9:50–10:05 AM	Discussion
10:05–10:35 AM	***REFRESHMENT BREAK / POSTERS*** (in Grand Ballroom Salons FG)

10:35–11:55 AM	**SESSION XI – APPROACHES TO UPPER LIMB DIFFERENCES – *PART II*** ***Moderator: Owen A. Larson, CP***
10:35–10:45 AM Paper 15	**Integration Of A V-C/V-O Prosthesis Simulator In Education Of Occupational Therapy Practitioners As Effective Clinical Team Members** ***Debra Ann Latour, Med, OTR/L***
10:45–10:55 AM Paper 16	**Engaging Students In A Multi-Disciplinary Clinic. Value For Time Committed?** ***Wendy L. Hill, OT***; Edmund N. Biden, D.Phil; Peter Kyberd, PhD
10:55–11:05 AM Creative Solution 4	**Use And Outcomes Impact Of A Prosthesis Simulator In Prosthetic Training With A Child And Caregiver(s)** ***Debra Ann Latour, MEd, OTR/L***; Laura Katzenberger, LP, CP
11:05–11:20 AM	Discussion
11:20–11:30 AM Creative Solution 5	**The Fantastic Fastener** ***Kate Nikolai, OTR/L***
11:30–11:40 AM Creative Solution 6	**Simple Solution: The Tab; Grasping Tool For Non-Prosthesis Users** ***Debra Ann Latour, Med, OTR/L***
11:40–11:55 AM	Discussion
11:55 AM	**CLOSING REMARKS – ADJOURN**

POSTERS

Poster #1	**Cyborg Beast: A Low-Cost 3D-Printed Prosthetic Hand For Children With Upper-Limb Reduction Deficiency** ***Jorge M. Zuniga, PhD***; Jean M. Peck OTL, CHT; Dimitrios Katsavelis, PhD; Keven Carney, OT; Cheryl Frickel, OT; John Stollberg, OT
Poster #2	**Prosthesis For A Patient With Proximal Femoral Focal Deficiency: A Case Report** ***Kristopher P. de Leon, MD***

The 2015 Annual Meeting evaluation is on-line ONLY. *Completion is required to obtain your Certificate of Attendance.* Access the survey at https://www.surveymonkey.com/s/ACPOCAM15 ***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 at by Friday, June 26, 2015.

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: 10/01/2014; integra: Paid consultant
J Ivan Krajbich, MD: Submitted on: 10/02/2014; Association of Children's Prosthetic and Orthotic Clinics: Board or committee member; K2m: Paid presenter or speaker; Scoliosis Research Society: Board or committee member
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Kristine Kay Nolin, CPO: This individual reported nothing to disclose; Submitted on: 01/29/2015
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Hank White, PT, PhD: This individual reported nothing to disclose; Submitted on: 09/29/2014

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SESSION I – LOWER LIMB DEFICIENCIES – PART I

THURSDAY, May 14
8:15–8:25 AM
Paper 1

Osteocartilaginous Transfer Of The Proximal Fibula For Treatment Of Bony Overgrowth In Children With Congenital And Acquired Tibial Amputations – Surgical Technique And Results

Graham Todd Fedorak, MD; Hugh G. Watts, MD; Anna V. Cuomo, MD;
Julian P. Ballesteros, MD; Richard E. Bowen, MD; Anthony A. Scaduto, MD

Background: Bony overgrowth is a common problem in children after tibial transcortical amputation. The rarity of pediatric amputees, however, has resulted in small series of diverse approaches to this problem. We present the results of fifty children treated for tibial bony overgrowth with an autologous osteocartilaginous cap from the ipsilateral proximal fibula.

Methods: Records were reviewed of all amputation patients from a single pediatric hospital from 1990-2011. All patients with a minimum two years follow-up who underwent osteocartilaginous capping with the proximal fibula for established tibial overgrowth were included. Patients with acquired and congenital amputations were compared.

Results: Fifty tibiae in 47 patients met our inclusion criteria. There were 31 acquired amputations and 19 congenital. Mean age at surgery was 7.6 (2.1-15.6) years and mean follow-up was 7.2 years (2.2-15.4). Five tibiae (10%) in four patients developed recurrent overgrowth at a mean of 5.4 years (2.8-7.6). There was no significant difference between children with acquired or congenital amputations.

Conclusions: At a mean of 7.2 years 90% of limbs had not experienced recurrent overgrowth. Based on our results in 50 tibias treated for bony overgrowth with a consistent surgical technique we feel autologous osteocartilaginous capping using the proximal fibula is a safe and effective management of long bone overgrowth in both congenital and acquired pediatric amputees.
Level of Evidence: Case series, level IV

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THURSDAY, May 14
8:25-8:35 AM
Paper 2

A Retrospective Review: Care And Management Of The Lower Extremity Epiphyseodesis Surgery Patient

Maureen J. Maciel, MD; Sandra B. Smith, PT; Natasha Casimir, PT, DPT
Shriners Hospitals for Children, Tampa, FL

The management of leg length discrepancy and knee angulation deformity through temporary epiphysiodesis above and below the knee joint is a frequent orthopedic surgical procedure at the Tampa Shriners Hospitals for Children. The insertion of a plate that is secured above and below the physis is a more recent option and proposes to allow the patient to return previous activity levels within a short time after surgery.

Analysis from a retrospective chart review of 178 cases from the past five years of patients with an average age of 11 years and ranging from 2 to 17 years will be shared. The indications for this procedure included leg length discrepancy, genu varum, genu valgum and knee flexion contracture as a result of the patient's primary diagnoses. A standard preoperative teaching approach by the patient care team includes the teaching of a Physical Therapy home exercise program. However, even with postoperative reinforcement, variability in the rate of recovery towards meeting these preoperative therapy mobility goals has been observed.

Contributing factors including level of surgery, laterality, age, and co-morbidities will be related to the patient's mobility outcomes evaluated at the 2 week postoperative clinic visit. Analysis of the data will provide more predictive insight to help guide the team to develop a postoperative discharge plan of care with realistic expectations of recovery for the patient and family.

THURSDAY, May 14
8:35-8:45 AM
Paper 3

Bracket Epiphysis Of The Tibia As Previously Unrecognized Phenotype Of Tibial Hemimelia – Report Of Two Cases

J. Ivan Krajbich, MD; Benjamin Parkinson, MBBS, FRACS; Kelly Alexander, RN
Shriners Hospitals For Children, Portland, OR

Introduction

A unilateral longitudinal epiphyseal bracket of the tibia presenting as phenotypic tibial hemimelia has not previously been reported in the literature. We report on two cases of phenotypic tibial hemimelia which were found to have bracket epiphysis retarding the normal growth of the tibia resulting in very abnormal tibial segment on plain radiographs easily mistaken for Jones type II tibial hemimelia. Both patients also had finding of pre-axial polydactyly. Key to the diagnosis and treatment options available is reviewed.

Case reports

Patient #1: 26 month old male with right-sided tibial hemimelia like phenotype and pre-axial polydactyly. Otherwise a normal child.

Patient #2: 16 month old male born with multiple congenital abnormalities, right upper amelia, early onset scoliosis, right tibial hemimelia, phenotype and pre-axial polydactyly.

Both patients had an evaluation by plain radiographs and MRI. Studies demonstrated dysplastic tibia secondary to bracket epiphysis. Both underwent resection of the bracket with restoration of the tibial growth.

Conclusion

We present cases of two patients with previously unrecognized variant of congenital longitudinal deficiency of the tibia. MRI is needed to make definite diagnosis likely explaining the reason for delay in recognition of the pathophysiology. Implication for treatment is profound as early bracket excision can lead to growth restoration. We propose amendment of Jones classification to include this variant. Provided that these two cases were diagnosed in a single pediatric surgeon's practice in a span of three years, this subtype may not be rare and should be looked for, particularly in a child who also presents with preaxial polydactyly.

THURSDAY, May 14
9:00–10:00 AM
Workshop 1

Fibular And Tibial Hemimelia: Prosthetic Management And Gait Characteristics In The Growing Child

Kelly A. Jeans, MS; Amanda Claire Brown, CPO, LPO; Kirsten Tulchin-Francis, PhD;
Lori A. Karol, MD
Texas Scottish Rite Hospital for Children, Dallas, TX

Two common congenital deficiencies seen in the pediatric prosthetic clinic are fibular and tibial hemimelia. Fibular hemimelia is the most common skeletal deformity of the leg and can present as a partial or total absence of the fibula which can result in limb length inequality, valgus at the knee and ankle instability. Treatment options are usually guided by severity of the deficiency and range from shoe lifts, to limb lengthening, and to amputation. Tibial hemimelia is less common and is usually associated with other skeletal anomalies including DDH, knee flexion and instability, and an equinovarus foot. In patients with a functional knee joint and quadriceps, a Syme or below knee amputation would be considered. If the knee was not functional, a knee disarticulation would be required.

Children, who have undergone a Syme amputation for fibular or tibial hemimelia, require different considerations in their prosthetic management. Although the level of amputation is the same, a thorough understanding of the anatomical trends that are seen in these two patient populations can ease the challenges of prosthetic fittings. For example, in patients with fibular hemimelia, valgus at the knee is common because there is a lateral deficiency. In the patient with tibial hemimelia, the deficiency is medial, and can cause varus at the knee. An accurate prosthetic alignment is critical when working with these patients. Accommodating for anatomical triplanar differences within the prosthetic alignment will help to provide each patient with an optimal functional outcome. Gait analysis can be a useful tool to help illustrate the problems these patients have kinematically at the knee and hip joint while they walk. A large study conducted at our institution has invited children of all ages to help us better understand the challenges they face and that their clinicians face when trying to get the perfect prosthetic fit. Cases from both the fibular and the tibial hemimelia populations will be used as examples.

Objectives:

1. To review the pathology of patients with lower extremity hemimelia
2. To discuss prosthetic management and alignment in the growing child with fibular or tibial hemimelia
3. To present patients with the use of gait analysis as an outcome tool

Goals:

1. To gain a general background on the diagnoses of fibular and tibial hemimelia
2. To understand the considerations of prosthetic socket fit and alignment in these children
3. To gain a three dimensional perspective using data collected during gait analysis.

Reference

Tachdjian's Pediatric Orthopedics, 5th ed., 2014. Edited by John Anthony Herring and the staff at Texas Scottish Rite Hospital.

SESSION II – LOWER LIMB DEFICIENCIES – PART II

THURSDAY, May 14
10:45–10:55 AM
Paper 4

Case Report Of Treatment Of A Patient With A PFFD Aiken A Left Hip, An Ipsilateral Congenitally Fused Knee Along With A Contralateral Fibular Hemimelia

Michael J. Forness, DO
Director Limb Differences Clinic
Helen Devos Children's Hospital / Mary Free Bed Rehabilitation Hospital
Grand Rapids, MI

An in depth discussion of the treatment options available, both prosthetic and surgical, at each step of the treatment process is entertained. Review of the surgical options available in fibular hemimelia today and discussion of the pros and cons of same is undertaken. A review of the Paley super-hip protocol is carried out. Risks and benefits of that procedure are also reviewed in regards to increasing severity of pathology involved.

The right fibular hemimelia was initially treated with a Symes amputation. The patient was subsequently treated with a Paley superhip procedure on the left, with a simultaneous corrective osteotomy of the fused knee, to allow for weight bearing. Subsequent to the index procedure on the left, a lengthening of the 12 cm foreshortened femur was carried out. The patient was fully ambulatory with prostheses prior and subsequent to all procedures.

THURSDAY, May 14
10:55–11:10 AM
Challenging Case 1

Popliteal Pterygium Syndrome Case Study: A Look At Pre- And Post-Amputation And Achieving The Best Ambulatory Outcome

Angela Swindell, CPO; Lisa Schwarcz, PT, DPT, PCS; Julie Cagney, PT, DPT; Stacy Suskauer, MD
Kennedy Krieger Institute, Baltimore, MD

The Problem: How to Best Help a Child with Popliteal Pterygium Syndrome Achieve Functional and Efficient Ambulation

A 3 1/2 year old female with popliteal pterygium syndrome presents to the multidisciplinary limb deficiency clinic, accompanied by her parents. Consistent with this genetic disorder, she was born with webbing of the skin on the back of her legs across her knee joints as well as a cleft palate and minor syndactyly of the fingers and toes. Typically, she walks with her right foot and left knee on the floor around the house. She also has a reverse walker, which she uses to "waddle-walk" and bear weight through both feet able and to negotiate sidewalks and curbs around the community. This gait pattern is the result of a right knee flexion contracture of 90 degrees, left knee flexion contracture of 100 degrees, and bilateral hip flexion contractures of 20 degrees but has also resulted in mild left-sided weakness. Since birth, the goal had been to straighten her knees as much as possible with orthopedic surgeries: Z-plasty on the left followed by an external fixator at 3 months and bilateral femoral shortening at 2 years, splinting: dynasplints resulting skin breakdown, and physical therapy. While some children with popliteal pyterygium are able to gain full correction, she was at the limit of her potential for improvement. At the time of her clinic visit, she had recently been to four doctors, three of which recommended amputation, and only one recommended significant further shortening of her femurs. Her parents decided at this time to pursue bilateral knee disarticulation amputations.

Bilateral knee disarticulations were performed in February 2014. Following her amputations, the problem still remained: how to best help a child with popliteal pterygium syndrome achieve functional and efficient ambulation. What prosthetic devices would offer the best solution? How could physical therapy best address the problem? What is the right balance of challenging this child to optimize gait quality while also maximizing her daily function and encouraging self-confidence and peer acceptance?

The Solution: This presentation will look at three types of prosthetic devices tried in sequence: 1) plastic rigid removable dressings with posted distal ends, 2) bilateral above knee prostheses with polycentric knees with a manual locking feature and energy storing feet, and 3) bilateral above knee prostheses with carbon fiber running feet and no knees. A comparison of the three will be made in terms of gait factors, functionality, and patient preference.

Intervention To Provide Weight Bearing For A Young Child With Multiple Congenital Anomalies: A Challenging Case

Robert D. Lipschutz, CP[1]; Vari McPherson, CPO[2]; Shandy Rivera[2]; Natascha Mangan[2]
[1]Rehabilitation Institute of Chicago, Northwestern University
[2]Rehabilitation Institute of Chicago, IL

An 18 month old female, and her Spanish speaking parents, presented in our physiatrist's clinic for evaluation and determination of a possible intervention that might assist this young girl in weight-bearing and standing capabilities. She was referred to us from another local hospital with indication of multiple co-morbities including: mild hyrocephaly, agenesis of the corpus callosum, delayed head and neck control, cardiac abnormality necessitating surgery, asymmetrical chest, hernia, gastro-intestinal problems necessitating insertion of a soft g-tube, congenital scoliosis and a tethered cord, bilateral hip dysplasia with diagnosis of bilateral Proximal Femoral Focal Deficiency (PFFD), 60º left knee flexion contracture with slight pterygium, bilateral club feet which had been treated and Achilles tendon lengthenings.

With these multiple challenges, we were tasked with creating a device that would provide her with the capabilities of weight-bearing through her lower limbs. She does ambulate via modified crawling and has some ability to put weight through her right lower limb, although with the leg length discrepancy secondary to the posture of her left leg: hip flexion, abduction and external rotation, knee flexion, ankle plantar-flexion (consistent with the diagnoses of PFFD), she is unable to stand even with maximal assistance.

This case is being presented to gather thoughts from the attendees relative to intervention for this young child in addition to a possible diagnosis of her condition other than the PFFD of her legs. It is unclear to the authors whether or not she has PFFD and/or if she has another, non-identified syndrome. At the conclusion of the discussion; we will present what we have attempted to-date.

Oxygen Consumption In Patients With PFFD: A Comparison Of Prosthetic Level

Kelly A. Jeans, MS; Amanda Claire Brown, CPO, LPO; Kirsten Tulchin-Francis, PhD; Lori A. Karol, MD
Texas Scottish Rite Hospital for Children, Dallas, TX

Introduction

Proximal focal femoral deficiency (PFFD) is a congenital deficiency of the femur.[1] Severity of PFFD varies and different classification systems have been used to differentiate severity and are used in clinical decision making. Patients with no hip joint may be candidates for fusion of the femur to the pelvis, thereby making the knee joint function as the hip joint. Patients with a stable hip but very short femur might undergo a Syme amputation with the knee fused (having the limb function as a knee disarticulation) or the Van Nes rotationplasty might be considered if the ankle joint of the affected limb is normal and is capable of 60degrees of motion following rotation. Some children decline surgical management and use an equinus prosthesis to ambulate. The purpose of this study was to determine if there is a difference in metabolic cost between children with PFFD treated with a Syme amputation, Van Nes rotationplasty and those patients who walk using an equinus prosthesis.

Methods

Thirteen children with PFFD underwent oxygen consumption testing during overground walking, as part of this IRB approved study. There were 5 patients with a *Syme* amputation, 4 patients who underwent a *Van Nes* derotation and 4 patients who use an *Equinus* prosthesis. Testing included a 5min rest period followed by a 10min walk at self-selected speed. Variables analyzed included: oxygen rate (ml/kg/min, *VO_2 Rate*), heart rate (bmp, *HR*), velocity (m/min, *Velocity*) and oxygen cost (ml/kg/m, *VO_2 Cost*). A group of age/BMI matched controls were used in the comparison (n=20). Alpha was set to 0.05 for all statistical analyses.

Results

Patient demographic and oxygen consumption results (represented as a percent of age matched controls) can be found in Table 1. The results show no difference between PFFD patients walking with a Syme, Van Nes or Equinus prosthesis. When compared to age matched controls all groups had significantly greater oxygen cost than controls. (Figure 1) The Syme and Equinus groups maintained normal walking speed, by increasing their VO_2 rate. The Van Nes patients walked significantly slower but consumed the same amount of O_2 as the controls. Because VO_2 Cost is a measure of VO_2 Rate/ Velocity, the cost remained the same across groups.

Discussion

Although no significant differences were seen between the PFFD subgroups, in the comparison to controls, we see that all groups ambulate at a significantly greater oxygen cost than their able bodied piers. Previous work has reported that in the PFFD population, patients with a Van Nes tend to walk slower and at greater cost than patients with a Syme amputation, but significance was not reached due to small sample size (n=12).[2] Oxygen cost does not reach significant difference between patients with a Syme amputation, Van Nes rotation osteotomy or who are walking with an equinus prosthesis, within the PFFD population, however as in the previous study, small sample size is likely the primary limitation.

	Syme	Equinus	Van Nes	P
Age	14.3 (2.2)	14.6 (4.6)	12.8 (2.0)	0.6890
BMI	18.3 (1.7)	16.6 (2.4)	17.3 (1.7)	0.4272
HR	110 % (13%)	112% (21%)	117% (21%)	0.8578
VO_2 Rate	134 % (32%)	154% (28%)	119% (24%)	0.2611
Velocity	99% (12%)	95% (8%)	85% (12%)	0.2107
VO_2 Cost	138 % (36%)	162% (27%)	139% (13%)	0.3978

Table 1. Oxygen consumption data from patients with PFFD, reported as a percent of age matched controls.

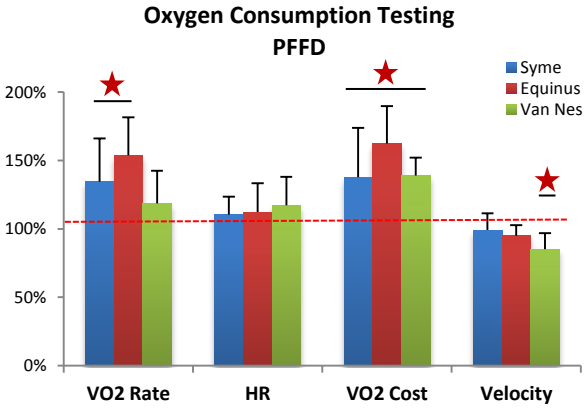

Figure 1. Group data represented as a percent of age matched controls. Compared to Controls:
★significantly different than Controls ($p<0.05$)

References

[1]Tachdjian's Pediatric Orthopedics, 5th ed., 2014
[2]Alman BA, et al. JBJS 1995

Biomechanical Comparison of Three Prosthetic Feet for One Transtibial Child

Guðfinna Halldórsdóttir; Knut Karl Lechler, CPO
Össur, R&D, Reykjavik, Iceland

INTRODUCTION

Shock absorption to reduce impact forces at the time of initial contact has been identified as one of the primary locomotor functions during normal walking 1,2. The range of motion (ROM) of an anatomical ankle is critical for progression and shock absorption during stance phase3. For children it is very important for their health to be active. In order for amputated children to be active their prosthesis must provide as much of the lost function as possible. This pilot study investigates and compares the function of three pediatric prosthetic feet.

METHODS

The aim of this study is to examine and compare functions of three different types of prosthetic feet for one 7 year old transtibial child. The feet are Flex-Foot Junior, Vari-Flex Junior and Cheetah Xplore Junior.

Ground reaction force data and high speed videos were collected while the user walked along a 10 meter walkway with embedded force plates. Markers were placed on foot, shank and thigh segments for motion analysis. Force data was collected from a force plate positioned in the end of a three step stair case.

RESULTS

The main differences during stance phase of level ground walking were noted in the peak horizontal propulsion force and ankle and knee range of motion. Cheetah Xplore Junior provided propulsion force of 17% of body weight (BW), compared to 13% (Vari-Flex Junior) and 10% (Flex-Foot Junior). Cheetah Xplore Junior and Vari-Flex Junior provided similar range of ankle motion (21° and 20°) while Flex-Foot Junior provided 10°. In terms of knee range of motion Cheetah Xplore Junior provided the largest range, 12° compared to 8° (Vari-Flex Junior) and 6° (Flex-Foot Junior).

During stair descent main differences were seen in peak horizontal braking force and peak vertical loading response. Cheetah Xplore Junior provided the lowest braking force, 23% of BW at 10% of stance phase, compared to 31% at 5% of stance phase (Vari-Flex Junior) and 41% at 3% of stance phase (Flex-Foot Junior). In terms of peak vertical loading response Vari-Flex Junior had the lowest peak value (200% of BW) compared to 217% for Cheetah Xplore Junior and 271% for the Flex-Foot Junior.

DISCUSSION

The results indicate that Cheetah Xplore Junior is the most energy returning of the three feet and provides the best shock absorption during high impacts like in stair descent. This reduces painful loads on stump in high impact situations like sports and other recreational activities. This foot also provided the largest range of ankle and knee motion. In this comparison Vari-Flex Junior does not score as high in terms impact and energy return as Cheetah Xplore Junior, however it provides close to natural range of motion. This foot also has other advantages that are not being measured in this study; it is light weight and can easily be cosmetically finished. The Flex-Foot Junior has the lowest build height of the three feet and it was therefore expected to be least functional of the three, however it is a good option for users with long residual limbs.

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Functional Outcomes Of A Child With Möbius Syndrome And Congenital Lower Limb Deficiencies After Rehabilitation: A Case Report

***Natasha Casimir, PT, MS, DPT*[1]**; Nicole Bishop, PT, DPT[2]
[1]Shriners Hospital for Children, Tampa, FL
[2]Shenandoah University, Winchester, VA

Background and Purpose: Möbius syndrome with congenital limb deficiencies is a rare condition that is infrequently encountered in physical therapy. Publications exist for functional outcomes in children with acquired limb deficiency but none address the outcomes observed after rehabilitation in a child also diagnosed with Möbius Syndrome. The purpose of this case study is to discuss the functional outcomes in a child with Möbius Syndrome and congenital lower limb deficiencies with rehabilitation after a change in prosthetic prescription.

Case Description: The patient was an 11 year old female with Möbius Syndrome, including a short transtibial limb deficiency and other congenital anomalies. The patient was referred for physical therapy after delivery of the prosthesis.

Outcomes: Improved ambulation quality, patient satisfaction and balance were obtained from the measurements.

Discussion: Rehabilitation incorporating developmental age appropriate interventions, focusing on impairments and functional limitations, may have resulted in improvements with gross motor skills and outcomes.

Table 1: *Patient Characteristic*

Age (y)	11
Sex	Female
Height (inches)	59
Weight (kg)	57.15 kg
Body Mass Index (kg/m2)	25.40

*Height and weight calculated with prosthetics

Table 2: *Outcome Measurements*

	Baseline		**Post Intervention**	
Manual Muscle Test (MMT)	**Right**	**Left**	**Right**	**Left**
Hip Extension	**3**	**3+**	**3+**	**3+**
Hip Flexion	**4**	**3+**	**4**	**4**
Hip Abduction	**3+**	**3+**	**4**	**3+**
Hip Adduction	**3**	**2+**	**3+**	**3+**
Knee Extension	**3+**	**4**	**4**	**5**
Knee Flexion	**3+**	**3**	**4**	**3+**
Passive Range of Motion	**Right**	**Left**		
Hip Extension	**10**	**5**		
Hip Flexion	**110**	**115**		
Hip Abduction	**28**	**35**		
Knee Extension	**0**	**0**		
Knee Flexion	**108**	**115**		

Table 3: *Intervention Protocol*

Phase 1 (Week 1-3)	Phase 2 (Week 4-8)	Phase 3 (Week 9-11)
• Dynamic alignment with prosthetist • Prosthetic training in parallel bars • Static standing balance with weight acceptance activity to R • Sit to stand from high mat with assistance • Open Chain Exercises: SLR, Terminal knee extension without resistance, SAQ, LAQ, marching and bridges. Each performed for 15 repetitions • Adaptive Tricycle • Recumbent stepper for 4 minutes 1.0 resistance • HEP consisting of open chain exercises listed above	• Gait training with PNF technique • Side stepping and reverse gait training in the parallel bars • Forward step up on 4inch step • Progression of gait training outside parallel bar on level surface • Kick ball alternating between LE • Mat exercise with progression of repetition to 20. Addition of side lying hip abduction and resisted knee flexion with theraband • Nintendo Wii-Fit (Soccer, Hula hoop, Penguin) • Adaptive Tricycle • Recumbent stepper for 5 minutes 1.5 resistance	• Gait training on uneven surface including grass and hills • 8 inch wide balance beam activity • Forward step up on 6 inch step • Stair negotiation activity • Progression of exercise including the addition of standing hip abduction and Standing TKE with theraband • Hip flexion and LAQ performed on therapy ball • Treadmill initiated at 3 minutes at 0.4 mph and increased gradually to 7 minutes at 0.6 mph, incline 1 • Recumbent stepper for 7 minutes at 1.5 resistance • Dynamic balance activity on balance board • Dynamic balance on Nintendo Wii-Fit • (Ski Slalom, Ski jump

Table 4: *Qualitative Results for Outcome Measures*

Measurement	Baseline	Post-Interventions
TUG ($\bar{x}$) seconds	29.14	22.89
AMPPRO	26	35
SF-36 Subscale		
Physical Functioning	35	65
Energy/fatigue	75	95
Emotional Well Being	96	88
Social functioning	50	75

a. TUG with average score from 3 trials in one session.
b. AMPPRO with a maximum score of 47 indicating optimal functional mobility
c. SF-36 with a possible maximum score of 100 representing high function or no functional limitation

Acknowledgements
I would like to express my sincere gratitude to the patient and her mother for agreeing to participate in the case study; my co-workers at Shriners Hospital for Children- Tampa Rehabilitation department for their words of encouragement during this process; Brian Sinnott, LPO, CPO for his input and knowledge regarding prosthetics; Pamela Versage, PT for her assistance with the case study and Dr. Nicole Bishop, DPT for her constructive feedback and mentoring throughout the writing process.

Footnote
This case report was completed by Dr. Casimir as a partial fulfillment of the requirements for the t-DPT degree at Shenandoah University.

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SESSION V – GAIT & LOWER LIMB ORTHOTICS

FRIDAY, May 15
7:30–8:30 AM
Workshop 2

The Development Of Gait: Back To The Beginning

Megan Smith, CO
SureStep, South Bend, IN

When discussing gait, we often describe it using common terminology including gait phases, joint angles, the 3 planes of movement, etc. While these terms are important and allow us to communicate effectively, especially when describing gait deviations, they do not give us the entire picture. We are not born walking. Children do not just "get up and go" on their first birthday. So, how do gait and postural control actually develop?

The development of gait and postural control starts in infancy. There are many contributing factors that affect development. These factors include bone ossification and modeling (Wolff's Law); muscle tone; biotensegrity; ligamentous structure; proprioception and motor control.

Skeletal modeling and ossification start in utero and are not completed until much later. Bones are modeled and shaped by forces acting upon them, such as gravity and muscle pull. Muscle tone can be described by a bell curve, from low to high. The stretch reflex and biotensegrity work to maintain tone and keep us upright. Patients who present with low or high tone present with a variety of proprioception and muscle control issues, which can lead to gait deviations. Joint relationships develop and change from birth through toddlerhood and into adulthood. Gross motor skill development and posture/positioning during those skills plays a part in the proper development of joints. Mechanoreceptors play a role in the gait and the development of postural control. There are many distinct phases in the development of postural control. The ability of a child to go through these phases is vital to proper gait biomechanics. As it relates to children with deficits, it is important to understand that if a child cannot or did not transition through these phases, we cannot look solely at their gait deviations and focus on skill development during therapy. Instead, we need to focus on motor control and come back to the basics. The pelvis is the center for stabilization during upright standing and walking and plays a major role in gait initiation. When we watch a patient with compensatory gait patterns ambulate, we often times are focused on the lower extremity. We cannot forget about the pelvis, trunk and upper extremities. The head, arms and trunk are not just passengers! Weight lines and center of mass also play a vital role in proper gait.

When we evaluate patients with gait abnormalities, it is important to decide where the child is lacking and what factors are affecting the gait pattern instead of focusing solely on and trying to treat the deviation. The deviations provide clues as to where the deficits are. This approach allows us to more effectively treat the root cause of the gait deviation.

This course will focus on the development of gait and postural control and the deviations we commonly see in our patients. We will discuss how these factors work independently as well as how they interact with one another to affect the development of gait and postural control. We will also discuss potential solutions, both orthotically and therapeutically.

Goals/Learning Objectives

- Define muscle tone
- Define proprioception
- Understand normal gait development
- Understand postural and motor control
- Understand abnormalities in gait and postural control development
- Learn how to evaluate and treat these abnormalities

A Brace Design Comparison For The Pediatric Patient With Charcot Marie Tooth Disease

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INTRODUCTION

Charcot Marie Tooth (CMT) is the most common hereditary neuropathy, with an estimated prevalence of 17-40 per 100,000 individuals.
The clinical presentation of individuals with CMT varies greatly, even within any of the 70 different types. Common symptoms include weakness, decreased muscle size, and sensory impairment. Distal weakness of the lower extremities can affect balance, endurance and effective clearance of the foot during swing phase. The muscle imbalance can cause rigid contractures of the foot and ankle leading to inefficient gait patterns, increased fatigue, (Hoellwarth JS et al; Yagerman 2012) and possibly pain. Existing literature on the efficacy for orthotic management for patients with CMT is limited within pediatrics. This requires orthotists to pay particular attention to the utilization of appropriate outcome measures to determine the effectiveness of orthotic management.

CASE DESCRPIPTION

A 3 year-old female presented with gross motor delay, abnormal gait pattern, and difficulty clearing the toes. The patient was seen at a multidisciplinary neuromuscular clinic by age four with a confirmed diagnosis of CMT type 2A. The patient demonstrated progressive foot and ankle mal-alignment, decreased balance and strength. Physical therapy and orthotic management were initiated.

MATERIALS AND METHODS

Two pairs of custom day-time orthoses were fabricated, as well as a pair of positional night-time orthoses to prevent further deformity and loss of range of motion. The first pair was a custom lightweight polymer PLS/SMO (PAFOs) design made by CascadeDafo™. The second pair was made with a carbon fiber shank thermoformed into a polymer SMO and proximal calf cuff (CFAFOs). Sagittal and frontal plane photographs were taken of her gait, and 6 minute walk tests were performed for both the PAFO and CFAFO conditions. The mother completed the Activities-specific Balance Confidence (ABC) Scale for the patient's performance in both orthoses. All tests were repeated barefoot.

RESULTS

Per the 6-minute walk test, the subject walked a longer distance using the CFAFOs compared to both the PAFOs and barefoot. Similar findings were observed in the ABC scores, where the subject was more confident that she would maintain balance wearing CFAFOs compared to PAFOs or barefoot. Finally, improved alignment was observed in the split frame photographs.

	ABC SCORE	**6 MINUTE WALK TEST**
Barefoot	49.375%	239 meters
PAFOs	61.25%	391 meters
CFAFOs	70.625%	412 meters

DISCUSSION

The CFAFOs proved to be the more appropriate and preferred design for this patient. The patient also preferred the CFAFOs because she believed that she could "run faster."

CONCLUSION

While the common treatment for patients with peripheral neuropathies like CMT is to use a lightweight carbon PLSAFO, it is important to control the progressive foot changes of the pediatric patient, while also giving assistance in clearance and possible energy return. A hybrid design appears to both control the tri-planar tendencies of the young patient's foot and increase walking distance, however greater investigation is required to determine how much energy return is occurring and its effects on longer walking distance.

CLINICAL APPLICATIONS

Clinicians have many options when treating patients with peripheral neuropathies. When evaluating the specific needs of the pediatric patient, clinicians should consider custom hybrid designs; benefits of these designs include customization and the lightweight properties of carbon.

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Pediatric Partial Foot Prostheses: Utilizing A Custom Fit Dynamic Carbon Composite Prosthesis - A New Treatment Option?

Vincent DeCataldo, BOCO, BOCP; ***David C. Ruthsatz, CO, CPA, AT***
Allard USA, Rockaway, NJ

INTRODUCTION

Documentation of pediatric partial foot amputation (PFA), prosthetic intervention and effectiveness of treatment is insufficient. However, recommendations regarding pediatric prosthetic intervention advise downsizing, sequenced complexity and a modular design that does not interfere with an increased activity level.[2] In the general population PFA is the most common amputation surgery with 2 per 1000 affected.[4] Transmetatarsal or mid-tarsal amputations account for approximately 24% of PFAs.[3] In the pediatric population 40% of amputations are attributed to trauma, with majority due to lawn mower and household accidents.[8] Current pediatric treatment options mimic those for adults with the extent of the intervention proportional to the extent of tissue lost.[3] Recently it has been recommended that any amputation including or proximal to the metatarsal heads requires a prosthetic intervention that extends proximal to the ankle.[6] A prosthesis utilizing a custom fit rigid dynamic carbon composite (DCC) ankle foot orthosis structure to aid in the restoration of gait has been proposed for the adult PFA patient.[7] By extending above the ankle the prosthesis aids in the progression of the center of pressure along the foot and restores the biomechanics of walking.[6]

METHODS

A prosthetic design for treating the pediatric partial foot amputee that restores gait function by addressing the biomechanical deficits is proposed. A new design custom fit rigid DCC with carbon anterior shell AFO customized with a toe-filler type socket with posting are the components of the proposed prosthesis. The AFO is custom fit design with a full carbon full length foot plate with a rocker, rigid lateral strut and carbon composite anterior shell. This design aids in restoring gait by allowing for a controlled plantarflexion moment at initial contact, a stable midstance and a controlled tibial advancement through terminal stance, while maintaining a 3rd rocker rollover and providing propulsion at terminal stance. The ability to customize the socket, dynamic properties, alignment and interface helps to protect the skin of the residuum while the dynamic function can be customized for functional needs.

DISCUSSION

This design is proposed based on reported outcomes of adult PFA patients. Gait studies utilizing the proposed PFA DCC design need to be conducted. Preliminary data regarding use of the DCC AFO in the pediatric population indicates that a dynamic response carbon AFO, similar to the rigid DCC design, provides improved function in running, jumping and walking performance while Gross Motor Function Measure was also improved.[1] Similar outcomes are expected with a PFA DCC prosthesis due to the similarity of the gross structure and function of the rigid DCC design.

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Equinus Relapse After Ponseti Management Of Clubfoot: Correlation With Dorsiflexion Lag, And Management With Casting And Nighttime AFO

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Introduction:

In managing idiopathic clubfoot using Ponseti's method, the relapse rate after discontinuing the foot abduction orthosis (FAO) ranges from 5-45%. Relapses can occur in varus and/or equinus, and while varus relapses in older children are typically treated with transfer of the tibialis anterior to the midfoot, equinus relapses have been variably reported and treated. Treatment of late equinus relapse in Ponseti treated clubfeet ranges from observation to recasting, orthotic use (frequently resumption of a FAO), and/or tendo-Achilles lengthening. We have recently treated equinus relapses non-operatively, with casting to obtain correction, followed by use of a nighttime solid ankle foot orthosis (AFO). One of our aims was to assess efficacy of the AFO in preventing subsequent relapse.

Relative weakness of the evertor and dorsiflexor muscles of the ankle frequently accompany idiopathic clubfeet. As frequently recommended, we strive to achieve at least 5 degrees of passive dorsiflexion in all patients after FAO discontinuation. However, some patients, even when adequate passive dorsiflexion at the ankle is achieved, cannot match that range of motion actively, demonstrating a functional dorsiflexion lag. We assessed whether patients with such a dorsiflexion lag are more likely to present with an equinus contracture than those with better active dorsiflexion.

Methods:

This study was a retrospective chart view of 122 children with idiopathic clubfeet treated with standard Ponseti technique. Children were at least 4 years of age by March 2014 with at least 1y follow-up after discontinuation of FAO. Data extracted from the medical records included: Degree of passive and active dorsiflexion after FAO, occurrence of equinus relapse after FAO, casting, surgery (tendo-Achilles lengthening or gastrocnemius recession), prescription of nighttime AFO, time with AFO, occurrence of equinus relapsing during AFO use.
Statistical analysis was performed using Chi-squared test.

Results:

Of the 122 children followed, 16 children (13%) had a varus relapse, 32 (26%) had varus and equinus, 32 (26%) had equinus only.
39/122 children studied were prescribed a nighttime AFO for an equinus relapse. 27/39 children had $\geq$1 year of recorded follow-up. 20/27 children did not have a subsequent equinus relapse. Of the 7 children who had an equinus relapse, 5 had not consistently worn their AFO.
42 affected feet (in 26 children) were recorded for active dorsiflexion. 30 feet achieved active dorsiflexion to at least neutral, and 12 feet did not, despite having at least 5 degrees of passive dorsiflexion. Of those who achieved active dorsiflexion to neutral, 16 (53%) had an equinus relapse. Of those who could not achieve active dorsiflexion to neutral, 12 (100%) had an equinus relapse (p=.003).

Discussion:

After discontinuation of FAO, when equinus relapse is defined of loss of ability to dorsiflex 5^{o} passively, the incidence is nontrivial, and can occur independently of varus. Casting followed by nighttime AFO use appeared effective in preventing further relapses in our follow-up period.
Despite the ability to passively dorsiflex these feet at least 5^{o}, many children lacked ability to actively reach neutral dorsiflexion (a "dorsiflexor lag"). These children appeared especially prone to equinus relapse.

How Important Is Brace Compliance In Ponseti-Treated Idiopathic Clubfeet?

Kevin Felton, CO, LO, FAAOP[1]; Donald D. Virostek, CPO; B. Stephens Richards, III, MD; Shawne Faulks, RN; Karl E. Rathjen, MD; Lori A. Karol, MD
Texas Scottish Rite Hospital for Children, Dallas, TX

Purpose: With Ponseti -treated clubfeet, strict adherence to bracing is considered essential for successful outcomes. The purpose is to determine the treatment outcomes relative to the amount of time bracing was actually utilized.

Methods: Infants with idiopathic clubfeet were braced with foot abduction orthoses with a temperature data logger imbedded in a shoe. Parents were not told that compliance was being monitored. The orthoses were prescribed 22 hours per day for the first 3 months followed by 12 hours per night until 2 years of age.
Compliance was monitored for time intervals: 1) 0-3 months, 2) 4-6 months, 3) 7-12 months, and 4) 13-18 months. Parents rarely returned with shoes to allow assessment of the 19-24 month interval. Compliance was defined as wear >80% of prescribed time.
The outcomes were assessed as *good* (plantigrade foot +/-TAL only), *fair* (limited procedure), or *poor* (full PMR).

Results: 53 patients with 78 clubfeet averaged 2.5 years follow-up (range 1.8-4.3 years). All feet had a Dimeglio score 0 or 1 when bracing was initiated. 36% of patients were compliant with the bracing protocol the entire time while 64% were found to be noncompliant during one or more of the time intervals. Compliance decreased over time as seen in the intervals: 1) 83%, 2) 78%, 3)64%, and 4) 50%.

75 of the 78 feet (96%) were rated *good* when bracing was discontinued. However, during these two years of bracing, 9 feet (seven patients) relapsed. Of these 9 feet, 6 feet (5 patients) were successfully treated with recasting and TAL. Four (of these six) feet were in three compliant patients when relapse occurred while two were in noncompliant patients. The remaining 3 of the 9 relapsed feet required surgery (2 feet in a noncompliant patient had posterior releases and 1 noncompliant patient had PMR).Two more feet in brace-compliant patients that were rated good when bracing was completed required surgery at ages 3 and 4 years.

Conclusion: No clear patterns were established between objectively-measured brace compliance and outcome. Compliance decreases over time. Most patients will wear the brace <80% recommended time during some periods of the bracing protocol. Nevertheless, achieving a *good* outcome can be expected. Some will require recasting for relapses whether or not they are compliant with brace use.

Significance: Only one-third of patients will remain fully compliant with brace wear following Ponseti cast treatment. Despite this, most will complete their time of bracing with *good* outcomes.

SESSION VI – NEUROMUSCULAR

FRIDAY, May 15
9:30–9:40 AM
Paper 10

Are There Gender Differences In Outcomes Following Hamstring Lengthenings In Children Diagnosed With Cerebral Palsy?

Hank White, PT, PhD[a]; Janet L. Walker, MD[a,b]; Juanita Jean Wallace, MS[a]; Samuel F. Augsburger, MS[a]; Vishwas R. Talwalkar, MD[a,b]; Ryan D. Muchow, MD[a,b]; Henry J. Iwinski, MD[a,b]

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Gender differences in biology, tissue and disease may affect the results of orthopaedic surgeries.[1] For young children, college age adults and elderly adults, females have been reported to have more hamstring flexibility than males.[2-5] Children diagnosed with cerebral palsy (CP) demonstrate reduced hamstring lengths compared to able-bodied children.[6] Lastly, males with CP demonstrate declines in gait while females gait were unchanged ten years after single event multilevel surgeries.[7]

The purpose of this study was to assess if there were gender differences in the short term outcomes for children/adolescent following medial/lateral hamstring lengthenings in isolation or as part of single event multilevel surgery. Outcome measures were: Gross Motor Function Measure (GMFM) scores, walking velocity, cadence, stride lengths, walking kinematic data of the trunk, pelvis, hips, knees and ankles.

An IRB approved study, performing a retrospective review of our motion laboratory's database for children with spastic diplegia who had a motion analysis study before and after medial and lateral hamstring lengthenings was performed. Data for 121 participants was analyzed. Statistical analysis was performed using SPSS 22. General linear model repeated measures analysis of variance (ANOVA) was performed to assess mean changes over time for all participants and between gender, with a p-value of <0.05 indicating statistical significance. Independent sample t-tests were used to assess pre-operative variables, with a p-value of <0.05 indicating statistical significance.

There was no significant difference between groups for age, height, or length of time between evaluations. The mean age at surgery was 12 years for both genders. Mean time from surgery to the postoperative gait study was 1.4 years (range of 0.6 years to 4 years). Eighty subjects were male and 41 were female. Based on GMFCS levels, subjects demonstrated similar levels of involvement (Level 1 males 16%/females 12%, Level 2 males 33 %/females 37%, Level 3 males 51%/females 51%). Preoperatively, there was no significant difference between male and female subjects for all measures: GMFM scores, temporal-spatial data and all kinematic data ($p>0.05$).

Postoperatively, on average, males demonstrated an increase and females demonstrated a decrease in subset E (Walking, Running and Jumping) of the GMFM when using their orthosis and walking aid($p<0.01$). Male subjects demonstrating knee hyperextended post-operatively demonstrated decrease in GMFM score while males without hyperextension demonstrated an increase in scores. Females demonstrated decrease in GMFM scores, regardless of knee hyperextension.

Both genders demonstrate non-significant increase in walking speed, decrease in cadence and increase in stride length ($p>0.05$). On average, both genders demonstrate significantly less anterior pelvic tilt, and a significant decrease in hip flexion during stance($p<0.001$). On average, both genders demonstrated significant decrease in stance phase knee flexion ($p<0.001$). On average, females demonstrated a larger decrease in knee flexion throughout the gait cycle compared to males ($p<0.05$). This larger decrease resulted in a higher incidence of knee hyperextension following medial/lateral hamstring lengthenings (22 % females versus 10 % males). Therefore, while both genders with CP spastic diplegia benefit from medial/lateral hamstring lengthenings, more judicious use in females is warranted.

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FRIDAY, May 15
9:40–10:40 AM
Workshop 3

Prosthetic Management For Children With Cerebral Palsy And Spina Bifida

Phoebe R. Scott-Wyard, DO; Natalie Wise-Aguilar, MPT, CCCE
Shriners Hospitals for Children, Los Angeles, CA

There is a complete lack of evidence available regarding prosthetic management of children with amputations as a result of chronic diseases such as spina bifida and cerebral palsy. This lecture will discuss major comorbidities that must be considered in these patients, such as seizures, spasticity, learning disability, insensate skin, obesity, contractures, neurogenic bowel, and neurogenic bladder. Important clinical considerations when fitting these children with prostheses will be reviewed, including type of prosthesis and aspects of care when gait training with a new prosthesis. A case series will be presented for discussion.

Objectives:
The practitioner will be familiar with major comorbidities associated with cerebral palsy and spina bifida.
The practitioner will be comfortable with incorporating complex medical issues into prosthetic management/prescription for children with amputations and cerebral palsy or spina bifida.
The practitioner will become familiar with principles of gait training in children with amputations and cerebral palsy or spina bifida.

SESSION VII – SPINE

FRIDAY, May 15
11:40–11:50 AM
Paper 11

Anterior Only Approach To Spina Bifida (MM) Scoliosis

J. Ivan Krajbich, MD
Shriners Hospitals for Children, Portland, OR

Introductions:
Significant, spinal deformity is a common occurrence in children born with MM. The literature review, show consistently high infection and pseudarthosis rates in the surgical correction involving the usual posterior approach. This is not surprising as the posterior approach involves operating through compromised soft tissue and boney elements. To avoid these complications anterior only approach has been suggested. Our study examines out experience with anterior only approach to the MM scoliosis together with the review of the literature on the subject.

Methods:
Study consists of retrospective review of MM scoliosis patients treated by a single surgeon over the 20 year period. Patients treated with posterior only or anterior-posterior approach were excluded. Pre-operative, perioperative and postoperative data were extracted and analyzed with emphasis on postoperative short and long term complications. Ovid MEDLINE ® search was conducted for articles presenting results for anterior approach to treatment of MM patients with scoliosis. Final analysis of our data and literature was conducted and conclusions and recommendations arrived at.

Results:
Eleven patients fulfilled the criteria for the study. There were no cases of wound infection, pseudarthrosis or vascular injury. There was one neurological complication. No patient changed ambulatory status post operatively.

Average preoperative deformity was 69° and pelvic obliquity of 17°. Instrumented levels ranged from five to ten. The average postoperative correction was 65% of scoliosis and 66% of pelvic obliquity. Four patients had add-on proximal deformity and one, a distal one. Three of these required additional more proximal procedures.

There were eight studies detailing infection rates for MM patients and anterior fusions, for an infection rate of 1.0%.

Conclusions:
Our experience and literature review supports the view that anterior only approach in MM scoliosis patients can significantly decrease the risk of major complications of deep infection and pseudarthrosis. The complication of proximal add on deformity is not a surprising feature of the anterior only approach. Many of these patients are, a) young skeletally immature when in need of surgical correction thoracolumbar deformity, b) already have a mild deformity in the mid-to upper thoracic spine. The goal of the anterior only approach is to avoid the posterior abnormal tissues of the lumbar area and the potential devastating complication of a deep infection, yet allow for continuous growth of the upper and mid-thoracic spine.

The data support consideration of anterior only approach for this patient population.

FRIDAY, May 15
11:50 AM–12:05 PM
Paper 12

Malignant Peripheral Nerve Sheath Tumors (MPNST) In Pediatric Nf 1 Patients

J. Ivan Krajbich, MD; Nadine L. Williams, MD
Shriners Hospitals for Children, Portland, OR

Introductions:
MPNST is not a rare diagnosis in children with NF1. It usually arises in the pre-existing plexiform neurofibroma site. The lesion in chemotherapy and radiation therapy resistant and complete surgical excision is the only known effective treatment. Very high mortality of this condition reported in the literature led us to review our experience with MPNST and formulate recommendations for management based on the results.

Methods:
Retrospective review of all pediatric patients diagnosed with MPNST in the senior authors practice was undertaken. Location, size, pre-existing lesions, potential delay in diagnosis, treatment afforded and outcome were recorded.

Results:
Seven patients fulfilled inclusion criteria. All lesions arose in pre-existing neurofibromas. Four were in the pelvis, one in each cervical thoracic area, popliteal area and forearm. Three out of pelvic lesions and the neck had a delay in diagnosis and all these died of their disease. One pelvic patient and the two limb-site patients had complete wide resections and are long term survivors. In all patients MRI demonstrated suspected malignant changes in the pre-existing neurofibromas, in one of the pelvic patients even several months prior to the diagnosis.

Conclusions:
Early diagnosis before metastatic spread and ability to perform wide, clean margin surgical resection was the only criterium preventing fatal outcome. We recommend aggressive investigation of any enlarging lesion in the NF1 patients and regular screening by MRI of known pelvic and brachial plexus neurofibromas.

FRIDAY, May 15
12:05–12:20 PM
Challenging Case 4

Infantile Scoliosis Treatment Utilizing EDF Casting And Scoliosis TLSO On A Two Year Old Patient With Arthrogryposis

Debra M. Auten, BS, LCPO
Cook Children's Medical Center, Fort Worth, TX

Elongation, derotation & flexion casting has been used widely in the past to treat infantile scoliosis. A Noel casting frame is used to position the patient under anesthesia. A two part cast is applied while a derotation force is applied to the patients trunk as the patient is held in traction (elongation and flexion) (picture 1). A radiograph is viewed in the surgical suite in order to apply the forces (by hand) to the proper spinal segments (radiograph 1).

The patient that challenges us currently is a two year old male with the primary diagnosis of Arthrogryposis. He has progressive infantile scoliosis. We realize that this young child will require surgical intervention some point in the near future (radiograph 2). I would like to walk you through the discovery of the onset of the problem through the treatment plan as of date. Our primary goal at this point is to delay surgical correction to obtain additional spinal growth while obtaining maximal thoracic scoliosis curve reduction.

The series of radiographs I will show next, will take us through the progression of treatment over the last 12 months. I come today seeking additional resources in reducing the patients curve utilizing methods consisting of casting, orthosis management and physical therapy techniques. We have many tools available to us such as but not limited to: physical therapy, Noel casting frame, digital scanner and a Rodin carver in our facilities
Radiograph 1: P/A spine from an outside facility showing the curve magnitude before treatment
Radiograph 2: A/p spine after the first EDF cast was applied (post op)
Radiograph 3: 1st cast removed due to medical complications and cast tightness
** It was decided to put the patient into a custom, corrective TLSO with- in 2 days of cast removal
The patient was scanned, a scanned image was modified then a mold was carved, a TLSO was fabricated from the modified scanned file.
Radiograph 4: In brace x-ray, Boston style, Rodin scanned TLSO fabricated at our facility
Orthosis was becoming tight & compliance was in question at this point
Radiograph 5: Out of brace, pre- EDF cast #2
Radiograph 6: post-op in EDF cast #2

SOLUTION: (additional diagnosis & medical metrics will be provided here) (2 min's worth of time). We are wondering if there is something more we can do for this young patient. We are trying to get some additional curve reduction before surgical intervention and a bit more of additional spinal growth.

FRIDAY, May 15
12:20–12:30 PM
Challenging Case 5

Pediatric Positioning "Hey Wheelchair Man, How Small Can You Go?"

Craig A. Kraft, ATP/SMS; Richard L. Besett, ATP
Shriners Hospital for Children, Tampa, FL

This case study involves an infant boy with a genetic disorder and is an example of one of the many challenges we encounter on a daily basis dealing with children that have complex positional and mobility needs. The orthopedist goals are to correct, prevent, or support structural deformities while at the same time preventing skin breakdown and maximizing the child's functional ability to achieve independent mobility. Wheelchair positioning is essential when children are unable to ambulate.

This fourteen month old child was referred by his physical therapist to our orthopedic clinic due to decreased range of motion in his hips and upper extremities. The therapist was also concerned with the child's poor positioning in his positional stroller. On completion of the evaluation by the medical team the child is found to have a 30 degree measurable spinal scoliosis, a rare diagnosis, and is using a stroller that is far too large to provide anything but supine positioning. The orthopedist wants spinal correction with upright seated positioning on a mobility base.

The task begins but doesn't end with a project to position a 15 month old child with a 4 ½ inch seat depth and an 8 ½ inch shoulder height in sitting. Researching commercial options and weighing cost factors while meeting the orthopedist, therapist, family home and transportation needs are some of the factors necessary for a good outcome.

This case study takes you through the process considering the medical condition, commercial and custom equipment alternatives, and final delivery to provide a product that meets all stakeholders' needs.

FRIDAY, May 15
1:45–2:45 PM

PRESIDENTIAL GUEST SPEAKER

Building Bionic

Todd Kuiken, MD, PhD
Center for Bionic Medicine, Rehabilitation Institute of Chicago, IL
Northwestern University, Evanston, IL

In this presentation, Dr. Kuiken will first review the challenges of controlling modern powered upper limb prostheses. We will then present the concept of Targeted Muscle Reinnervation and Targeted Sensory Reinnervation. This section will wrap up with the data to-date. In the second part of the talk, he will present pattern recognition control concepts. This will be followed by a number of examples of how it has been applied to amputees. Next Dr. Kuiken will describe the RIC arm development that has been led by Dr. Jon Sensinger. This is a unique arm system design to be able to fit smaller adults and even the average 12 year old child. Finally, he will present the work of Dr. Levi Hargrove and his team on control of powered leg prostheses.

SESSION VIII – GLOBAL CONCERNS – *PART I*

FRIDAY, May 15
2:45–3:05 PM
Creative Solution 2

Connecting Children With Limb Differences And Their Families: A Group-Based Multidisciplinary Therapy Program

Lisa Schwarcz, PT, DPT, PCS; Jordan Sachse, OTD, OTR/L; Julie Cagney, PT, DPT
Kennedy Krieger Institute, Baltimore, MD

PROBLEM: Children with limb differences and their families have few opportunities to interact with peers who have similar body types, prosthetic devices and medical needs.

CREATIVE SOLUTION: Develop a monthly therapy group for children with limb differences and support program for their families.

Therapy group participants include children with upper and lower extremity congenital limb deficiency and acquired amputations. Group occupational and physical therapy uses functional activities, therapeutic games and offers diagnosis education with age appropriate materials. The concurrent family support program provides training and education sessions, encourages sharing of experiences and offers support to caregivers. The design, combining a therapy group and support program, offers unique benefits to children and their families that compliment individual therapy.

SOMEONE LIKE ME: A GROUP-BASED MULTIDISCIPLINARY PROGRAM FOR CHILDREN WITH LIMB DIFFERENCES

PURPOSE: Children with limb differences have fewer opportunities to interact with peers who have similar body types, prosthetic devices and equipment. The purpose of this group-based therapy program for children with limb differences and their families was to provide an opportunity to share experiences and problems, to address goals that cannot be addressed in individual therapy and provide diagnosis-related education in a supportive environment with peers.

DESCRIPTION: A group-based therapy program for children with limb differences was developed and implemented jointly by physical and occupational therapists at a pediatric rehabilitation hospital. The monthly group was held in the early evening to allow for children and their parents to attend. The program included themed activities such as crafts, adapted sports and diagnosis education with age appropriate materials. Group participants included children with upper and lower extremity congenital limb deficiency and acquired amputations. The group included boys (n=3) and girls (n=4), upper extremity differences (n=1) and lower extremity differences (n=6) aged between 1 to 8 years. Parents attended educational trainings with speakers on relevant topics (e.g. ADA law, adapted sports, prosthetics, and bullying). The impact of the program was evaluated longitudinally with data collected in 3-month intervals from entry into the program, using standardized measures, qualitative surveys and clinical evaluations.

SUMMARY OF USE: This group provided an opportunity for children with rare medical conditions to engage in age appropriate physical activities with peers that have similar diagnoses. Children worked on goals identified as important to them and their families. Group therapy offered opportunities to work on goals that could not be adequately addressed in individual therapy, such as walking in a line or participating in team sports and offered the benefit of similar peer modeling. The group provided early exposure and practice of new skills in a comfortable environment that could be applied to community settings to increase participation. The family training and education sessions provided support of caregivers, encouraged sharing of information, and offered resources the families identified as necessary

in supporting their children. The group provided the opportunity for patients to consult monthly with therapists that specialize in limb differences.

IMPORTANCE TO MEMBERS: A group-based program brought together children with rare disabilities who often have few existing opportunities for meeting and learning from each other. New skills and activities can be practiced in a comfortable setting before returning to a community environment with improved performance. Families of children with rare diagnoses benefit from the support of other parents whose children have similar diagnoses and education to promote resource sharing and advocacy. For therapists, therapy groups can build expertise with a rare diagnosis and provide an opportunity to treat as a multidisciplinary team.

SESSION IX – GLOBAL CONCERNS – *PART II*

FRIDAY, May 15
4:05–5:05 PM
Workshop 4

Overview Of A Limb Deficiency Registry And The Genetics Of Limb Deficiencies

Anna V. Cuomo, MD[4]; William R. Wilcox, MD, PhD[1]; David B. Everman, MD[3]
[1]The Department of Human Genetics, Emory University School of Medicine, Atlanta, GA; [2]Division of Birth Defects and Developmental Disabilities, Centers for Disease Control and Prevention's National Center of Birth Defects and Developmental Disabilities, Atlanta, GA; [3]Greenwood Genetic Center, Greenwood, SC; [4]The Department of Orthopedics, University of North Carolina School of Medicine, Chapel Hill, NC

Goals:
1. Introduce a limb deficiency registry
2. Encourage participation in the registry

Learning objectives:
1. Understand how a registry is set up and managed
2. Understand how a registry can be used for research
2. Become familiar with some of the basic genetics and inheritance of limb deficiencies

This symposium will introduce a registry model for studying limb deficiencies that is based on the successful International Skeletal Dysplasia Registry (ISDR). The ISDR was established in 1970 to assist in the diagnosis, management, and etiology of skeletal dysplasias. It was supported by a grant from the National Institutes of Health (NIH). The database is now supported through University of California – Los Angeles and is comprised of a collection of materials from families with one or more members diagnosed with a skeletal dysplasia including: radiographs, medical records, clinical photographs, cultured cells (including fibroblasts, chondrocytes, lymphoblastoid cells, and amniocytes), DNA, fetal specimens, frozen tissue, histology and electron microscopy materials, blocks and slides, and prenatal ultrasound images.

The ISDR has the capability to be expanded to include patients with limb deficiencies. Using the ISDR model, Dr. William Wilcox will explain what types of scientific questions regarding limb deficiencies can be explored with the registry, as well as the inner workings of starting and maintaining an active database. He will also discuss what is currently known about the genetics of limb deficiencies. Since limb deficiencies can result from environmental exposures and are often associated with other anomalies, the Centers for Disease Control and Prevention (CDC) is interested in tracking cases and identifying risk factors. Dr. Richard Olney will discuss the current and future role of the CDC and the materials that could be available for research. We will then focus the symposium with two clinical examples. Dr. David Everman will provide an update on the clinical, genetic, and molecular aspects of split-hand/foot malformations. Dr. Anna Cuomo will provide a brief overview of tibial deficiencies and introduce a study population with an unusually high incidence of tibial deficiencies. Finally, we will conclude the symposium with our future directions of the registry and a panel question and answer period.

FRIDAY, May 15
5:05–5:45 PM
Workshop 5

Childhood To Adolescence: A Review Of Relevant Emerging Technologies

Robert D. Lipschutz, CP[1]; David B. Rotter, CPO[2]
[1]Rehabilitation Institute of Chicago, Northwestern University
[2]Scheck & Siress, Chicago, IL

Many of the members of the Association of Children's Prosthetic-Orthotic Clinics (ACPOC) have practices that primarily treat children. Because of this, many of these team members have limited experience with the components that are available for the young adult and adult populations. As the children mature through adolescence and into young adulthood; they may benefit from technologies that are not prevalent in the pediatric setting. Additionally, the popularity of athletic endeavors for adolescents and young adults has increased. Some of these activities require specific sporting devices to be fit or adapted for these young adults; in order for them to successfully participate.

The presenters of this symposium hope to educate the members of ACPOC on some of the latest technological advancements in powered and non-powered prosthetic components. Discussion will include: a review of Micro-Processor Knees (past , present and future), look at adaptive ankles (with and without external power), update on Pattern Recognition technology, highlight new Body Powered and Externally Powered components, along with a review of sporting prostheses and their application in the adolescent and young adult populations.

SESSION X – APPROACHES TO UPPER LIMB DIFFERENCES – *PART I*

SATURDAY, May 16
8:00–9:30 AM
Workshop 6

Limb Deficiencies Of The Upper Limb, Simple To Complex: The Challenges With Surgical, Prosthetic, Orthotic, And Therapeutic Interventions

Colleen P. Coulter, PT, PhD, DPT, PCS; Alan Peljovich, MD, MPH; ***Bryce T. Gillespie, MD; William R. Wilcox, MD, PhD; Jorge A. Fabregas, MD; Brian Giavedoni, MBA, CP***
Hand and Upper Extremity Treatment Center of Georgia, and Children's Healthcare of Atlanta, Emory University, Children's Orthopedics of Atlanta, Children's Healthcare of Atlanta, Atlanta, GA

One to two percent of newborns are born with congenital defects, and 10% of them have congenital differences of the upper extremity. Children who are born with upper extremity limb deficiencies pose challenges for their families and the team of medical professionals. Frequently there is no clear-cut answer for the best surgical, prosthetic, orthotic and therapeutic intervention. There may be several options.

Making an accurate diagnosis that includes relevant family history is the first step towards determining the appropriate intervention.
This purpose of this symposium is to provide an overview of congenital upper limb deficiencies, present a system for classifying the deficiency, describe the association with lower limb deficiencies, discuss genetic implications of radial deficiencies, and introduce possible surgical, prosthetic, orthotic, and therapeutic interventions.

Outline:

- Identifying deficiencies of the upper limb
    - Symbrachdactyly
    - Syndactyly
    - Ulnar deficiencies
    - Radial deficiencies
    - EEC ectrodactyly-ectodermal dysplasia-clefting
    - Humeral deficiencies
    - Phocomelias
    - Amelias
    - Transverse deficiencies

- Association with lower limb deficiencies
  Defining the lower limb deficiencies associated with the upper limb

- Genetic causes and differential diagnoses, and genetic counseling for radial ray defect

- Interventions- Goals of intervention
    - Preserve function
    - Surgical management upper limb
    - Prosthetic and Orthotic management
    - Therapeutic management
    - Education and counseling to the parent and families

Goals:

1. Review the broad variety of deficiencies of the upper limb
2. Present a proposed classification system to describe upper limb deficiencies
3. Understand the role of the geneticist in the evaluation of a limb deficiency
4. Review the surgical, prosthetic, and orthotic management of upper limb deficiencies

Objectives: The participants will:

1. Gain an understanding of the complexities of congenital upper extremity limb deficiencies
2. Appropriately classify the upper limb deficiency
3. Identify surgical, prosthetic, orthotic, and therapeutic appropriate for the level of upper limb deficiency with and without associated anomalies.
4. Know when to refer a family for a genetics evaluation
5. Learn the other anomalies that can be associated with a radial ray deficiency

SATURDAY, May 16
9:30–9:40 AM
Creative Solution 3

Cyborg Beast: An Open Source Low-Cost 3D-Printed Prosthetic Hand For Children With Upper-Limb Differences

Jorge M. Zuniga, PhD[1]; Jean Peck, OTL, CHT[2]; Dimitrios Katsavelis, PhD[1]

1. Department of Exercise Science, Creighton University, Omaha, NE
2. Creighton University Medical Center, Department of Occupational Therapy, Omaha, NE
3. Department of Occupational Therapy, Creighton University, Omaha, NE

Purpose: The aim of this preliminary investigation was to describe a low-cost three-dimensional (3D)-printed prosthetic hand for children with upper-limb reductions (Figure 1) and propose a prosthetic fitting methodology that can be performed at a distance (Figure 2). We hypothesized that anthropometric measurement of the upper limbs taken from photographs and processed by image editing software would not differ from anthropometric measurements taken directly on upper limbs.

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 low-cost 3D printed prosthetic hand. Seven separate two-way repeated measures ANOVAs [2 x 2; hand (affected versus non-affected) x fitting procedures (direct versus photographs)] were performed to analyze the data. A p-value of ≤0.05 was considered statistically significant for all comparisons. The results of the two-way repeated measures ANOVAs showed no significant mean difference between the anthropometric measures taken directly on the subject's upper limbs and those taken from the photographs. There were no significant two-way interactions for repeated measures ANOVAs performed for hand x fitting procedures. There was a significant main effect, however, for hand (affected versus non-affected), with no significant main effect for fitting procedures (direct versus photographs).

Discussion: This investigation describes a low-cost 3D-printed prosthetic hand for children and proposes a distance fitting procedure. The Cyborg Beast prosthetic hand and the proposed distance-fitting procedures represent a low-cost alternative for children in developing countries and those who have no access to health care providers. Further studies should examine the functionality, durability, benefits, and rejection rate of this type of low-cost 3D-printed prosthetic device.

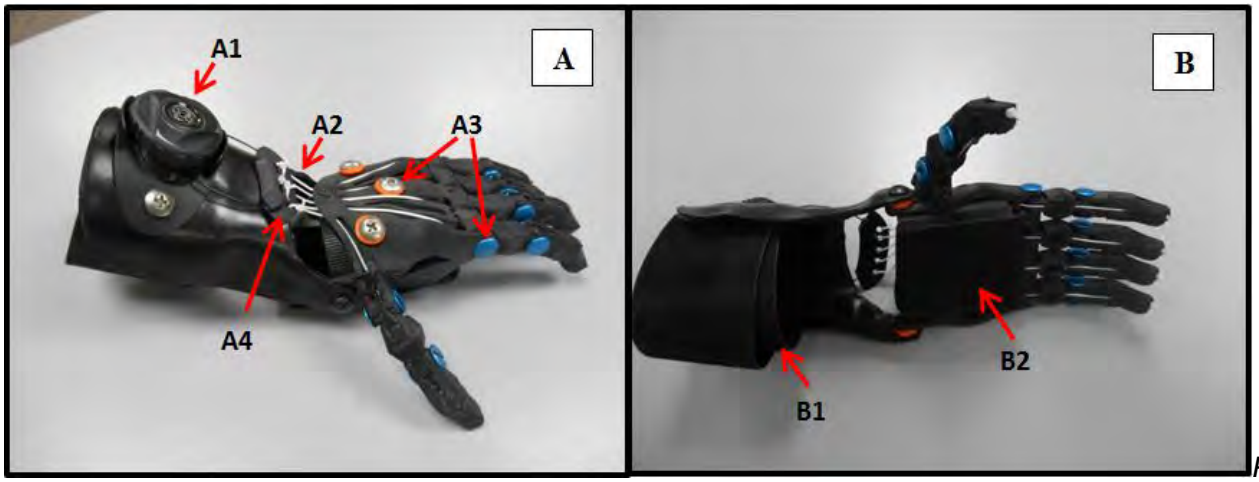

Figure 1. Prosthetic Hand (Cyborg Beast). A: Top view (A1: Tensioner dial, A2: Lift nylon cords, A3: Chicago screws, A4: Tension balance system) and B: Bottom view (B1: Forearm adjustable Velcro strap, B2: Hand adjustable Velcro strap).

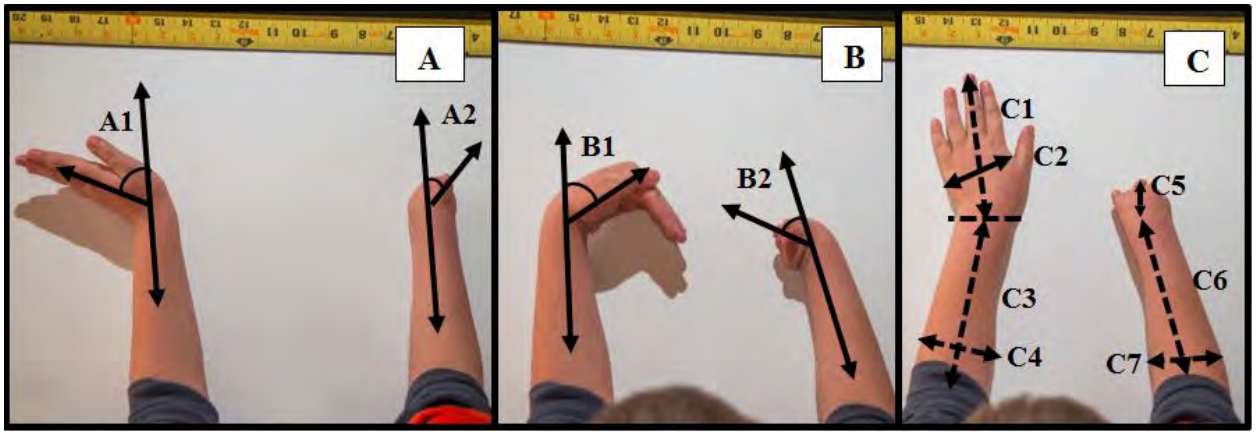

Figure 2. Three photographs of upper limbs. A: wrist extension (A1: non-affected, A2 affected), B: wrist flexion (B1: non-affected, B2: affected), and C: Top view (C1: Non-affected hand length, C2: Non-affected hand width, C3: Non-affected forearm length, C4: Non-affected forearm width, C5: Affected hand length, C6: Affected forearm length, and C7: Affected forearm width).

SATURDAY, May 16
9:40–9:50 AM
Paper 14

Differences In Fitting Between Congenital And Acquired Amputees

Edmund N. Biden, D.Phil; Wendy Hill, OT; Greg Bush, CP(c); Lilian K. Manor
Atlantic Clinic for Upper Limb Prosthetics, Institute of Biomedical Engineering, UNB, Fredericton, NB, Canada

Hypothesis: Patients who have congenital limb loss are generally treated from birth and have a different pattern of prosthetic usage than those who have acquired amputations. We hypothesize that these differences in preferences and treatment practice disappear over time.

Background: Our Clinic has been in operation for over 30 years fitting primarily upper limb, externally powered prostheses. There is no age limit on the patients who are seen, and as a result there are individuals who have been seen in the clinic from the beginning.

The clinic exists in an academic setting but is not affiliated with a medical school.

Electronic records for the full life of the clinic are maintained and form the basis for this presentation.

Patient groups: Our clinic has seen 212 individuals over its life. These are 64% male and 36% female. 122 of these are currently active of whom 47% are congenital and 53% are acquired. Males represent 46% of the current patients but only 30% of the males have congenital limb loss.

Among the group with congenital limb loss, 19% have losses at the partial hand or wrist level; 61% are trans radial and the balance, 19% are at higher levels. For the acquired group, 31% have losses at the partial hand or wrist level, 32% are trans radial and the 27% remaining are at higher levels.

Most of the individuals with congenital limb loss are seen from when they are infants and the median time to first fitting is 12 months. This reflects our clinic practice of fitting early. By contrast, the median age at first fitting for an acquired amputee is 32 years indicative of the fact that very few children are referred to us with acquired amputations and most of the limb loss occurs in a working age population.

The pattern of fittings reflects these age differences. At the time of first fitting 71% of the acquired amputees are fitted with an externally powered device although 25% will also have a non-powered prosthesis as well. The remaining 29% have either a body powered, passive or other sort of work limb. Over time, an increasing proportion of these individuals will try externally powered devices with that number reaching 83%. For most recent fittings, the proportions seem to settle at 71% with externally powered devices and again about a quarter of these patients will also have non powered devices as well.

The pattern for those with congenital limb loss is quite different. Initially, likely because we are fitting young children, only about 38% are in externally powered devices. This rises to near 90% over time and then settles so that at the most recent visit, 78% of the congenital limb loss group had an externally powered limb although half of these patients also had a passive or leisure device as well.

Over time the choices of the people with congenital limb loss begin to converge with those of the acquired limb loss group.

SESSION XI – APPROACHES TO UPPER LIMB DIFFERENCES – *PART II*

SATURDAY, May 16
10:35–10:45 AM
Paper 15

Integration Of A V-C/V-O Prosthesis Simulator In Education Of Occupational Therapy Practitioners As Effective Clinical Team Members

Debra Ann Latour, MEd, OTR/L
Single-Handed Solutions, LLC, Springfield, MA

Evidence has been published regarding the beneficial impact of prosthesis-simulator. Bittermann (1968) cites use of such simulators with the non-amputee. This concept has been utilized for decades to impart empathy and to facilitate understanding for the strategic motor planning required to operate the body-powered technology. Companies such as Otto Bock and TouchBionics use simulators to assess myo-sites and to develop controls skills during pre-prosthetic training. Weeks et al (2003) discusses the use of a simulator with uninvolved upper limb to successful transfer skill of prosthesis use to the involved upper limb. Little has been discussed regarding the use of such simulators in the academic preparation of occupational therapy practitioners. How do students of occupational therapy develop an understanding of the nuances of the diverse prosthetic technology, attributes and mechanisms involved in skills development, control and then transfer of skills to actual functional skills including social integration?

Mitchell et al (2014) have recently reported on prosthetic education of occupational therapy students. Their findings indicate that of 167 occupational therapy programs surveyed, 85% of program directors thought that training in orthotics/prosthetics was important or very important. However, only 32% of the programs had a required lecture of this content, and that only a few hours of the total OT curriculum is devoted to training in prosthetics.

Recently, a prosthetic simulator has been developed that allows interface of both voluntary-opening as well as voluntary-closing terminal devices for comparative experience of the user. Such experience is vital to understanding the mechanism of the technology, the relation to load on the user's anatomy, potential for overuse and need to strategically vs intuitively motor plan during use. Also of importance is understanding these aspects in terms of training, particularly in the presence of potential co-morbidities that may include learning disabilities, poor endurance, other skeletal asymmetries. This tool has been made available to students of occupational therapy who are pursuing specialty coursework in upper limb prosthetic technology and training. Students utilize this technology to better understand the requirements, benefits of and problems associated with the voluntary-opening and the voluntary-closing systems, to complete task analyses utilizing the technologies and to strategize developmental skill acquisition. The impact of the occupational therapy practitioner's opportunity to utilize a multi-faceted prosthesis-simulator and how it relates to and beneficially affects care of the pediatric patient is discussed in this paper.

SATURDAY, May 16
10:45–10:55 AM
Paper 16

Engaging Students In A Multi-Disciplinary Clinic. Value For Time Committed?

Wendy L. Hill, OT; Edmund N. Biden, D.Phil; Peter Kyberd, PhD
Atlantic Clinic for Upper Limb Prosthetics, Institute of Biomedical Engineering
Fredericton, NB, Canada

Objective: We present an overview of student training activities in our clinic and assess the value of such training both to the students and also to the clinic members.
Background: Our Clinic is located in an academic research environment which includes engineering, kinesiology and other disciplines but no medical school. We are located close to the regional tertiary rehabilitation centre and a large regional hospital which provide access to, physiatry, orthopaedics, psychology, social work, physiotherapy and other specialties. A regional medical student training program has recently become part of the mix. Our clinic specializes in externally powered upper limb prosthetics with a prosthetist and technicians, an occupational therapist and administrative support. The clinic also has the ability to draw on engineering and other expertise from the academic programs.

Value to Students: Our clinic draws students from a variety of sources: Engineering students at the undergraduate, masters and PhD levels; Kinesiology students at the undergraduate and masters level; OT students from regional OT programs, and Medical Students from a program which has recently been established in the region. The projects these students undertake are frequently integrated into the programs they are following.

These students value the opportunity for interactions with the clinic and patients and the interactions have lead many students into prosthetics or biomedical related careers. Working with patients makes research more relevant to students when they can see the potential benefit as they are conducting a study. The students also value the opportunity to interact with a wide range of professionals and benefit from the multi-disciplinary environment. Students also benefit from working on projects which have very tangible applications which is less common in undergraduate projects. Students are also exposed to people with disabilities and so are introduced to the idea that principles of universal design are important, at an earlier stage than is typical. They will take into any area of engineering or other professional practice when they graduate.

Value to the Clinic: Education is a professional obligation which is even more prominent in an academic setting. Involvement in educational activities represents a cost to the clinic in terms of staff time and some disruption of schedules. However, the costs are offset by the fact that the students are able to carry out research that the clinicians may not have time to do. Often the clinicians have ideas for research or questions arising from clinical practice but have limited resources to pursue them. Students often can fill that gap as well as providing a link to high level expertise from academic departments. This benefits both the clinic and the academic units since it opens new communications channels. Surveys conducted of academic departments which are considered as sources of potential employees in rehabilitation settings found that in many cases the knowledge of the rehab industry was lacking. Our experience has also shown us that many of the academic units are very happy to have research project ideas presented to them that have clinical value.

SATURDAY, May 16
10:55–11:05 AM
Creative Solution 4

Use And Outcomes Impact Of A Prosthesis Simulator In Prosthetic Training With A Child And Caregiver(s)

Debra Ann Latour, Med, OTR/L[1]; Laura Katzenberger, CP[2]
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[2]Handspring, Middletown, NY

Evidence has been published regarding the beneficial impact of prosthesis-simulators. Bittermann (1968) cites use of such simulators with the non-amputee. This concept has been utilized for decades to impart empathy and to facilitate understanding operation of the body-powered technology. Companies such as Otto Bock and Touch Bionics use simulators to assess myo-sites and to develop controls skills during pre-prosthetic training. Weeks et al (2003) discusses the use of a simulator with uninvolved upper limb to successfully transfer skill of prosthesis use to the involved upper limb. Teaching children to become adept with their prosthesis, its use and integration of it into acquisition of developmental milestones, activities of daily living and play can be challenging. As any practitioner of pediatric services knows, one is rarely working solely with the child, as it is integral for beneficial outcomes that caregivers and other family members be involved in the process. Carry-over of recommendations for all aspects of wear schedule of the prosthesis, skills-drills activities and adaptive strategies and techniques is essential for the successful outcomes of functional independence and positive perceived quality of life. Although parents, family members and other caregivers may be present during the prescriptive and therapeutic phases of the prosthetic program, they often lack first-hand experience of wearing and utilizing an actual prosthesis. Simulators of limited technology, such as a voluntary-opening device may be available to provide this experience on a limited basis, but not readily accessible on an ongoing basis. This technology is typically used to provide a forecast to the parent of what to expect, and even to project empathy for what the child may be experiencing. Such simulators have also been used with peer groups to advocate empathy and respect for individuals with upper limb differences and to enhance understanding of what is involved to strategically utilize body-powered prosthetic technology.

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 video-taped 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 child 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 parent and other family members 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. Report of outcomes measures will be included in final results and discussion at the time of this presentation.

SATURDAY, May 16
11:20–11:30 AM
Creative Solution 5

The Fantastic Fastener

Kate Nikolai, OTR/L
Shriners Hospital for Children, Chicago, IL

Individuals affected by bilateral upper extremity amelia or upper extremity limb deficiencies are many times dependent on others to complete their everyday tasks such as dressing. Anna, who has bilateral upper extremity amelia has adapted and was able to dress herself, however, she was limited in the type of pants she was able to wear to be independent in dressing. She was only able to dress herself if she wore soft stretchable pants. Like most young, 20-year-old women, Anna had a desire to be able to wear tight fitting jeans or pants that button and zip, and are fashionable for her age group. However, she still wanted to be able to don, fasten and unfasten these pants independently. There were no fastening devices commercially available to Anna that would help her complete this task. The *Fantastic Fastener* was designed and developed together with a group of Northwestern University School of Engineering students, myself, and Anna, to allow her to independently dress and undress at home and be able to use a public restroom. This tool is a portable, lightweight device that fits into Anna's purse and she is able to use it at home and take it with her when out in the community. It allows her to wear pants that are form fitting with a zipper and buttons and she is able to use a public restroom independently. The *Fantastic Fastener* is lightweight, latex-free, safe, height adjustable, durable and easy to use. The device is secured to the wall via suction cups, which Anna is capable of doing on her own. With the help of the *Fantastic Fastener*, Anna can independently fasten and unfasten her pants and now has the unbelievable freedom to be out in the community and use a public restroom independently while wearing pants in which she feels fashionable.

The following materials to build the device cost less than $100 and included:

- Plastic cutting board
- Rubber suction cups
- Ball bearing pulleys
- Mouth stick
- Mirror
- Steel wire
- Metal strips
- Springs
- Cord
- Nuts
- Bolts
- Washers

The *Fantastic Fastener* consists of a plastic platform with buttoner, un-buttoner, belt loop hooks, mirror, mouth-stick with holder, and suction cups. This device has improved the quality of life for Anna by giving her complete independence in getting dressed and undressed in whatever she wants to wear.

SATURDAY, May 16
11:30–11:40 AM
Creative Solution 6

Simple Solution: The Tab; Grasping Tool For Non-Prosthesis Users

Debra Ann Latour, Med, OTR/L
Single-Handed Solutions, LLC, Springfield, MA

Individuals with upper limb deficiency may choose to wear and to use prosthetic technology. Typical reasons include comfort, function, appearance and integration to body concept. Likewise, there are many different reasons why these individuals might not utilize such technology: choice, tolerance, efficiency, and accessibility. They may not choose or prefer the prosthesis provided. They may experience discomfort or difficulty to tolerate the socket or the weight, length or suspension of the technology. They may perceive the prosthesis to be inefficient. Or they may not have the opportunity to acquire a prosthesis. In these instances, the individual will complete manipulative tasks with varying levels of ability and difficulty.

Individuals with congenital upper limb deficiency may present with nubbins, which are typically described as fleshy buttons that protrude from the distal volar aspect of the residual limb. They are not usually articulated nor do they tend to possess bony anatomy. Although nubbins do not offer volitional movement, the underlying structures of soft tissue may include muscle or fascia and may allow for the appearance of movement. Those individuals with retained nubbins may derive functional benefit by using this anatomy to stabilize, or to grasp objects. This can be particularly helpful during bimanual manipulative tasks such as to stabilize paper while cutting with scissors, to cut food with fork and knife, to tie shoes, even to make a ponytail.

At one time, nubbins were not perceived to enhance function and were thought to be detrimental. Their presence might interfere with good ability to fit the residual limb to the socket or they might inadvertently tear or detach from the limb due to trauma. Because of this, the nubbins were often surgically removed. Not all individuals with congenital limb difference possess nubbins. Individuals with acquired limb deficiency do not have nubbins as described. These individuals lack the anatomical advantage that presence of the nubbins may offer.

The Temporary Appendage Base, or TAB (patent-pending) mimics the appearance and potential function of the nubbins. It is a simple technology consisting of a base with a flap that can be adhered strategically to the remnant limb and used to stabilize, grasp or snare objects and to complete bimanual manipulative tasks. The TAB flattens for easy fit should the individual choose to wear/use a prosthesis. This presentation uses case studies and offers a simple but compelling solution to enhance functional performance of the residual limb without nubbin anatomy.

Poster 1

Cyborg Beast: A Low-Cost 3D-Printed Prosthetic Hand For Children With Upper-Limb Reduction Deficiency

Jorge M. Zuniga, PhD[1]; Jean Peck OTL, CHT[2]; Dimitrios Katsavelis PhD[1]; Keven Carney, OT[3]; Cheryl Frickel, OT[3]; John Stollberg, OT[3]

1. Department of Exercise Science, Creighton University, Omaha, NE
2. Creighton University Medical Center, Department of Occupational Therapy, Omaha, NE
3. Department of Occupational Therapy, Creighton University, Omaha, NE

INTRODUCTION: There are increasing numbers of children with traumatic and congenital hand amputations or reductions. Children's prosthetic needs are complex due to their small size, constant growth, and psychosocial development. 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 prosthetic hands, they are not accessible to children from low income, uninsured families, or to children from developing countries. Advancements in computer-aided design (CAD) programs and additive manufacturing offer the possibility of designing and printing prosthetic hands at a very low cost.

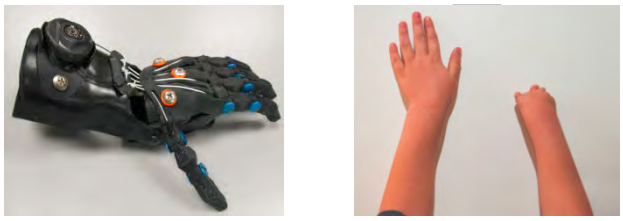

Figure 1. A) Cyborg Beast. B) Unilateral upper-limb reduction Deficiency

PURPOSE: The purpose of the present investigation was to examine improvement in perceived changes in quality of life, daily usage, and activities performed with our low-cost prosthetic hand named Cyborg Beast (Figure 1A).

METHODS: Nine children (two girls and seven boys, 3 to 16 years of age) with upper-limb reductions (Figure 1B, one traumatic and eight congenital) were fitted with our low-cost 3D printed prosthetic hand and were asked to complete a survey. Inclusion criteria included boys and girls from 3 to 17 years of age with unilateral carpus upper-limb reductions, missing some or all fingers, and wrist range of motion of the affected wrist greater than 20°. Exclusion criteria included upper extremity injury within the past month and any medical conditions that would be contraindicated with the use of our prosthetic hand prototype, 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 prosthetic hand 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 hand 1 to 2 hours a day, 3 reported using the prosthetic hand longer than 2 hours and 1 reported using the hand only when needed. Furthermore, children reported using our prosthetic hand for activities at home (9), just for fun (10), to play (6), for school activities (4), and to perform sports (2).

CONCLUSIONS: The main finding of our survey was that our prosthetic device has a great potential in positively impact quality of life, daily usage, and can be incorporated in several activities at home and in school.

Poster 2

Prosthesis For A Patient With Proximal Femoral Focal Deficiency: A Case Report

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College of Medicine and Philippine General Hospital, University of the Philippines, Manila, Philippines

Proximal femoral focal deficiency is a rare birth defect that affects the hip bone and the proximal femur. The incidence is one case per 50,000 to 200,000 population. The disorder may be unilateral or bilateral, with the hip being deformed and the leg shortened. The goal of treatment is to provide optimal function during standing and ambulation. A 15-year-old male with height of 170 cm presented with a 38 cm leg length discrepancy with the left hip in a slightly flexed and externally rotated position, atrophy of the muscles of the left posterior pelvis with no active range of motion (ROM) at the left hip and knee. There was full and pain-free passive ROM at the left hip and no appreciated motion at the knee joint. Normal ROM in all planes was noted at the left ankle with motor grade of 4/5. The left foot was at a level just below the right knee when the patient in standing. The patient was independent in transfer activities and ambulatory with bilateral axilllary crutches. A combination of orthosis and prosthesis (henceforth "prosthosis") was designed with a mechanical hinge joint to equalize the leg length and to improve lower extremity function during standing and ambulation. The thermoplastic solid hip-ankle-foot orthosis was used to accommodate and provide stability to the shortened left leg. The orthosis also served as the proximal attachment for the standard transtibial (below-knee) endoskeletal prosthesis designed with a mechanical hinge joint and a manual locking mechanism using a cable attached to the lateral proximal part of the thigh shell. The mechanical hinge acts as the "knee" that allows the device to flex when the patient sits. However, cosmesis remains a problem: protrusion of the patient's anatomical foot during sitting. The mechanical hinge joint is locked in extension during ambulation; gait deviation including absence of mechanical hinge "knee" joint flexion during the swing phase of the prosthetic leg and listing of the trunk toward the prosthetic side during the stance phase was unavoidable. The Prosthesis Evaluation Questionnaire (PEQ) was administered and the patient rated "extremely satisfied" with his ambulation, appearance and utility of the prosthosis, perceived response of strangers, and functional outcome changes in his quality of life. Upon discharge, the patient was independent in donning and doffing the prosthosis, ambulatory using the prosthosis without gait aid with minimal listing during the stance phase on the prosthesis side. During the patient's two-year follow-up, adjustment of the prosthesis was done to accommodate growth; checking of the prosthesis for mechanical breakdown and anticipatory management of potential musculoskeletal complications and psychosocial concerns on the use of the prosthesis were also done.

Although the prescribed "prosthosis" did not correct the structural deformity, the device enabled the patient to compensate for his functional deficits in transfers and ambulation and reduced his instability during standing and independent ambulation. Consequently, prosthesis use improved the patient's self-confidence and allowed him to engage in basketball as an avocational pursuit. The prescribed device is a cost-effective, non-surgical alternative for patients with PFFD.

Key words: Proximal femoral focal deficiency, leg length discrepancy, prosthesis, "prosthosis"

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 17.75 ***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 – 6.75, Friday – 7.75, Saturday – 3.25.

ABC Credits
The ACPOC Annual Meeting has been approved for a maximum of 22.75 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 – 4.25, Thursday – 7.25, Friday – 7.75, 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 20 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 afternoon Technical Workshops – 4, Thursday – 6, Friday – 6, Saturday – 4

NOTE: There are separate sign-in sheets for ABC and OPC for each workshop and general session.

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.

NOTES

Association of Children's Prosthetic-Orthotic Clinics

Professionals helping kids be Kids

Save the Date!

2016 Annual Meeting

April 13-16, 2016

Omni Interlocken Resort

Broomfield, Colorado

(Denver area)