1

What’s New in the Treatment of Children with Scoliosis

Dr. Amer Samadhi, MD

Short Bio of all Presenting Authors

After completing his fellowship, Amer Samdani, M.D., joined the staff at Shriners Children's Philadelphia in 2005. He specializes in the care of children with spine issues and is passionate about finding innovative ways to improve care. Fusionless strategies to treat children, such as vertebral body tethering, have been a major focus of his clinical work. He believes working at Shriners Children's is the ideal place to practice medicine as one gets to work with the best colleagues and patients without being hindered by a patient's ability to pay. Dr. Samdani says that the unique mission of Shriners Children's provides him a lot of job satisfaction and fulfillment.

Outside of clinical practice, Dr. Samdani is very active in research and education. He sits on the executive committee of the Harms Study Group and is a board member of the Pediatric Spine Study Group. He has published over 250 peer-reviewed articles and given over 100 invited lectures/Grand Rounds presentations.

Abstract

2

Complications and Outcomes of Challenging Spine Surgeries

Steven Hwang, MD

Short Bio of all Presenting Authors

Mentorship played a significant role in guiding Steven Hwang, M.D., along his career path. Working with certain residents fueled his interest in neurosurgery as a medical student and then in residency, and the diversity and resilience of children led him to pediatric neurosurgery. The combination of treating children with the variability in spinal pathology further inspired him to focus on pediatric spine surgery. Dr. Hwang enjoys the confluence of biomechanics and complexity of the spine with the care and impact surgeons can have on children.

As a dedicated member of Shriners Children's Philadelphia staff for many years, he has treated countless children and provided exceptional care and dedication to each patient. Recognized for his work and strong natural leadership to the surgical fellows, he has been appointed as chief of surgery at Shriners Children's Philadelphia. With this new title, Dr. Hwang will continue to provide remarkable care to patients in addition to leading the surgical team.

Abstract

3

Identifying Family Questions in Scoliosis Bracing: A Survey to Guide Patient-Centered Resources

Kelly Moton, MSPO, CPO, Kaitlin Riverest, MSPO, CPO, and James Wynne, CPO, FAAOP

Short Bio of all Presenting Authors

Kelly Moton, MSPO, CPO, is a Certified Prosthetist-Orthotist at OPSB of Boston Children's Hospital. She is dedicated to providing compassionate, family-centered treatment and is skilled in developing individualized orthotic and prosthetic solutions to support children's growth and function. Kelly is recognized for her collaborative approach with multidisciplinary teams and her commitment to improving patient outcomes through innovation and evidence-based practice.

Abstract

Introduction

A systematic review and meta-analysis estimated the global prevalence of scoliosis to be 3.1%, with variations based on gender, severity, and type (idiopathic or congenital). [1] Many patients pursue brace treatment as a non-surgical intervention. Concerns often arise about effectiveness, comfort, and appearance. Bracing can affect routines and self-image leading to increased stress for both patients and families. The evaluation can feel overwhelming as families a represented with an abundance of new information. Clear resources can empower patients and families to feel in control of their treatment.

Objectives

The purpose of this study is to identify frequently asked questions during idiopathic scoliosis bracing treatment and to create resources to ease the psychological impact of scoliosis bracing.

Methods

Participants included patients with a diagnosis of idiopathic scoliosis (and their caregivers) that were below the age of 18 years old at the time of brace fitting and were fit between January 1, 2022, and June 25, 2025. Surveys were created through Constant Contact and were sent out via email to parents with a valid email address on file. One initial email and two follow-up emails were sent containing the goal and importance of the study along withthe link to the survey. Figure I presents the survey topics and identifies the most frequently reported questions that families indicated they would have liked answered prior to initiating scoliosis treatment. A11 responses were exported from the survey platform and analyzed.

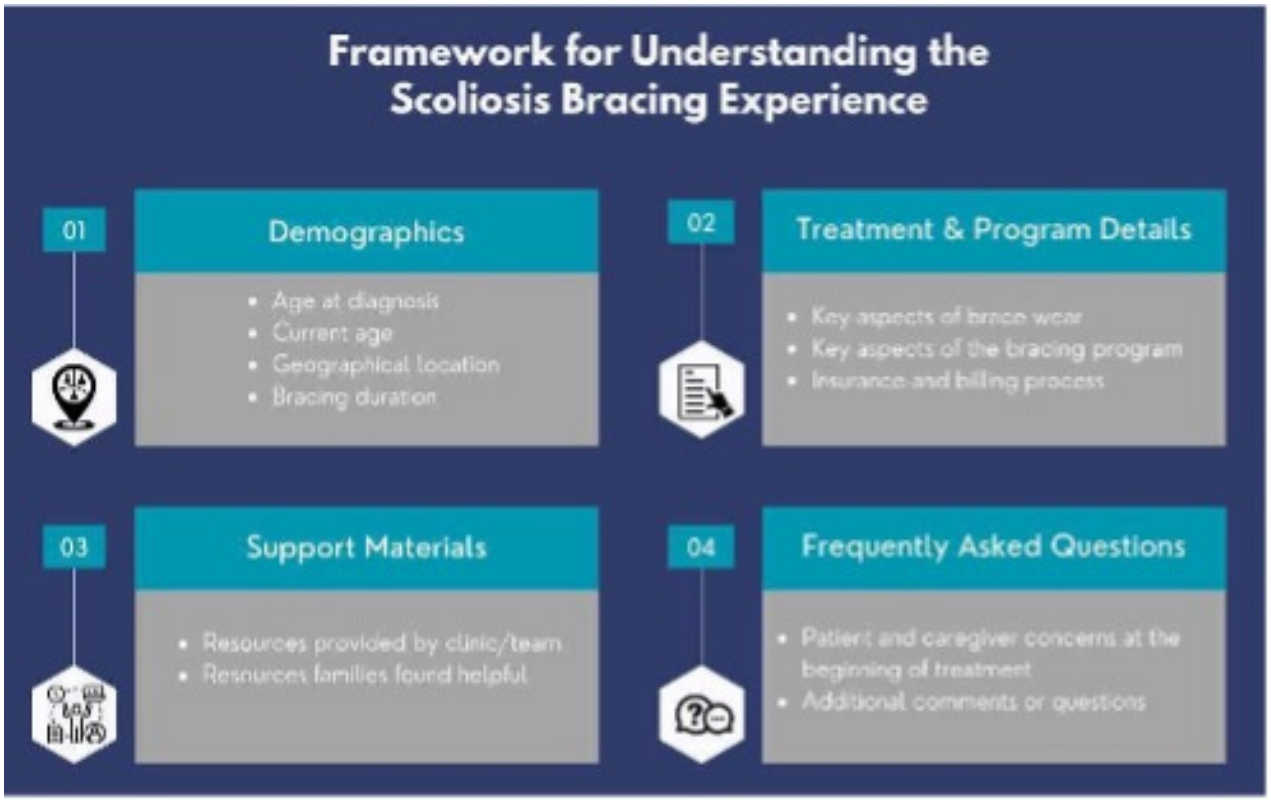

Figure 1: Survey topics and information collected regarding frequently asked questions about scoliosis bracing treatment.

Results

A total of 4,582 surveys were sent out with 213 being undeliverable. Ultimately, 643 participants completed the survey, which was open for a total of 42 days. 62.52% of participants are currently going through scoliosis bracing treatment. 75.43% of parents reported that their child began bracing over the age of 10 years old and were diagnosed with adolescent idiopathic scoliosis, 21.62% were between the ages of 4-9 years old and were diagnosed with juvenile idiopathic scoliosis, and 2.95% were three or younger and diagnosed with infantile idiopathic scoliosis.

Figure 2 shows the results for both brace wear and bracing program topics which families ranked from most important to least important.

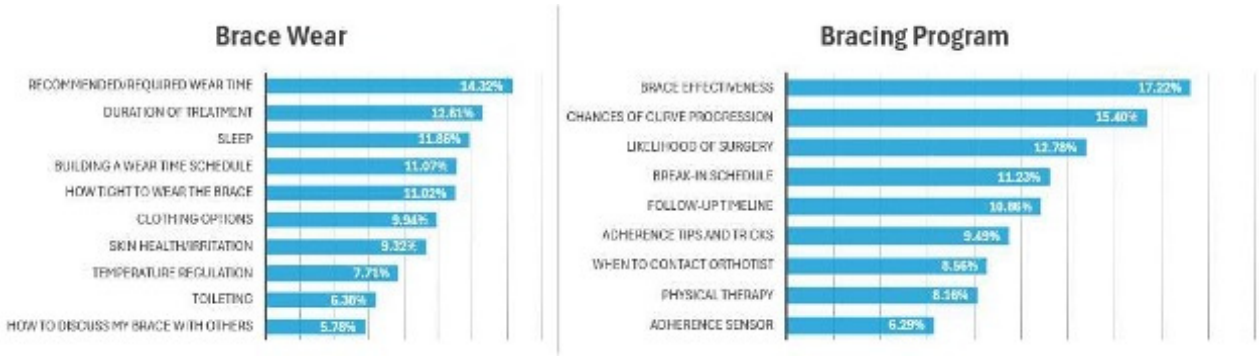

Figure 2: Ranking of topics by parents and patients from most important to least important relating to brace wear and the bracing program.

Discussion

Survey results indicate that families of children undergoing scoliosis bracing prioritize brace effectiveness and recommended wear time, while questions about sensors and discussing brace treatment with others ranked lower. Limitations include self-reported data, sampling only within OPSB clinics, and possible duplicate responses.

To address concerns, creators of this study will create a scoliosis bracing binder with a treatment timeline, wear and careguidance, exercises, psychology and sleep resources, communication and school strategies, plus

peer mentorship and support options.

Conclusion and Significance

A diagnosis of idiopathic scoliosis has been shown to have a negative psychological impact on patients and their caregivers.[2] The data gathered from this survey will allow members of the interdisciplinary team to provide moreinformation and resources on topics that families in bracing treatment are most concerned about, possibly decreasing the psychological impact of bracing.

4

I Do What I Want: Are Our Patients Adhering to Bracing Recommendations? A Prospective Cohort Study

Colby M. Freeman, BS, Grant Hogue, MD, Megan E. Johnson, MD, and G. Ying Li, MD

Short Bio of all Presenting Authors

Colby Freeman is a Medical Career Design Fellow at the Children's Hospital of Philadelphia.

Abstract

Introduction:

Bracing is the mainstay of treatment for growing adolescents affected by idiopathic scoliosis with curves between 25° and 45°. Previous randomized trials and prospective studies have indicated that duration of bracing is an important factor in preventing curve progression.

Objective:

Our study group seeks to further define this group in a multicenter fashion with focus on bracing compliance.

Methods:

Our multicenter group prospectively collected heat sensor data placed in a brace to assess for adherence to bracing recommendations. These patients were followed prospectively and had x-rays performed at regular 6-month intervals. We aimed to assess brace recommendations versus actual wear time and if any demographic or curve factors affected this relationship.

Results:

We identified 104 patients with minimum 6-month follow-up brace heat sensor data for analysis. All patients were within bracing range and were diagnosed with adolescent idiopathic scoliosis. The average brace prescription was 16.5 hours/day (±2.7; Range: 12-23 hours) and the wear time as indicated by heat sensor was 12.9 hours (±4.6). This constituted 3.6 less hours worn than prescribed (2.4-4.3; $p<0.001$). Age was not correlated with brace wear ($p=0.151$) nor was sex ($p=0.583$). However, thoracic curves had decreased brace wear versus target compared to thoracolumbar/lumbar (T/L) curves (4.2 less hours in thoracic versus 1.8 less in T/L; $p=0.007$). Curve magnitude was positively associated with total brace wear average over 6 months ($Rho=0.314$, $p<0.001$) but was not associated with adherence versus target brace wear ($p=0.080$). Logistic regression analysis showed that curve magnitude, age, curve location, and prescribed brace wear were independent predictors of brace wear greater than 12 hours.

Conclusion:

Brace adherence averages 3.6 hours less than prescribed or 78.2% of the original prescribed time. Patients with larger curves were prescribed longer brace wear but did not have better adherence versus target. Thoracic curves had less compliance compared to target compared to T/L curves. The only modifiable independent risk factor we were able to determine for greater brace wear was prescribed hours. This information can be used to counsel patients during bracing treatment. In our sample, prescription of longer than 16 hours did not result in a greater percentage of patients having wear times of 12 hours or more.

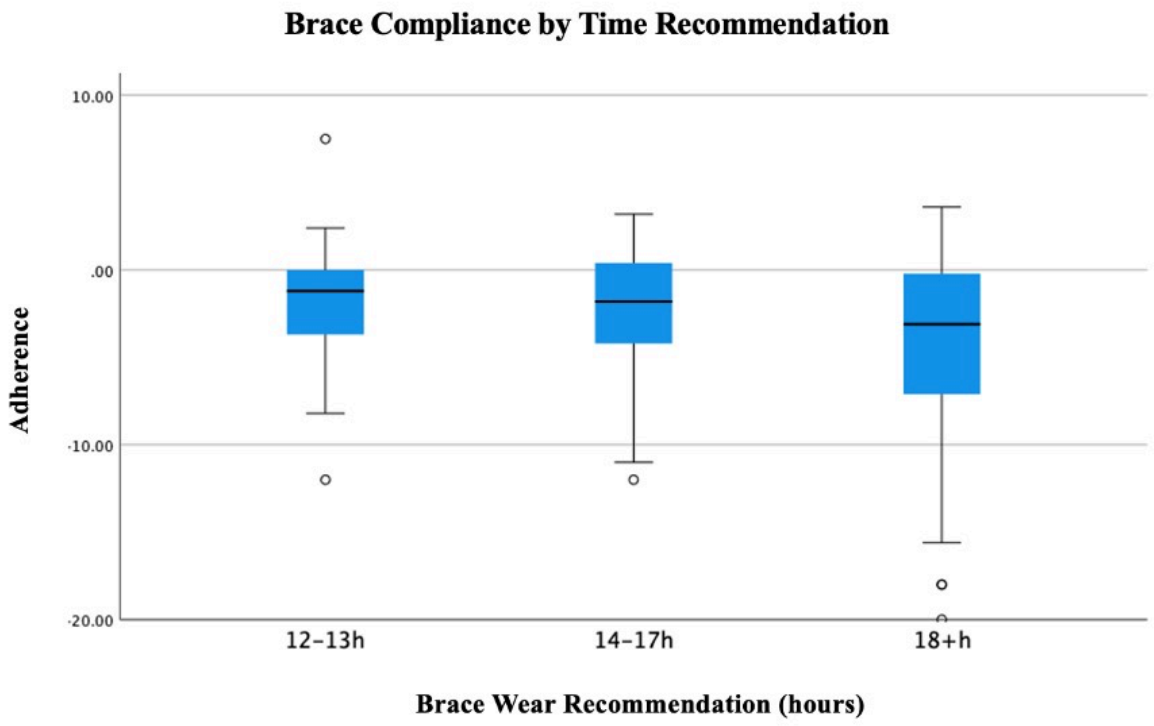

Figure 1: Simple boxplot of brace compliance by recommended bracing time

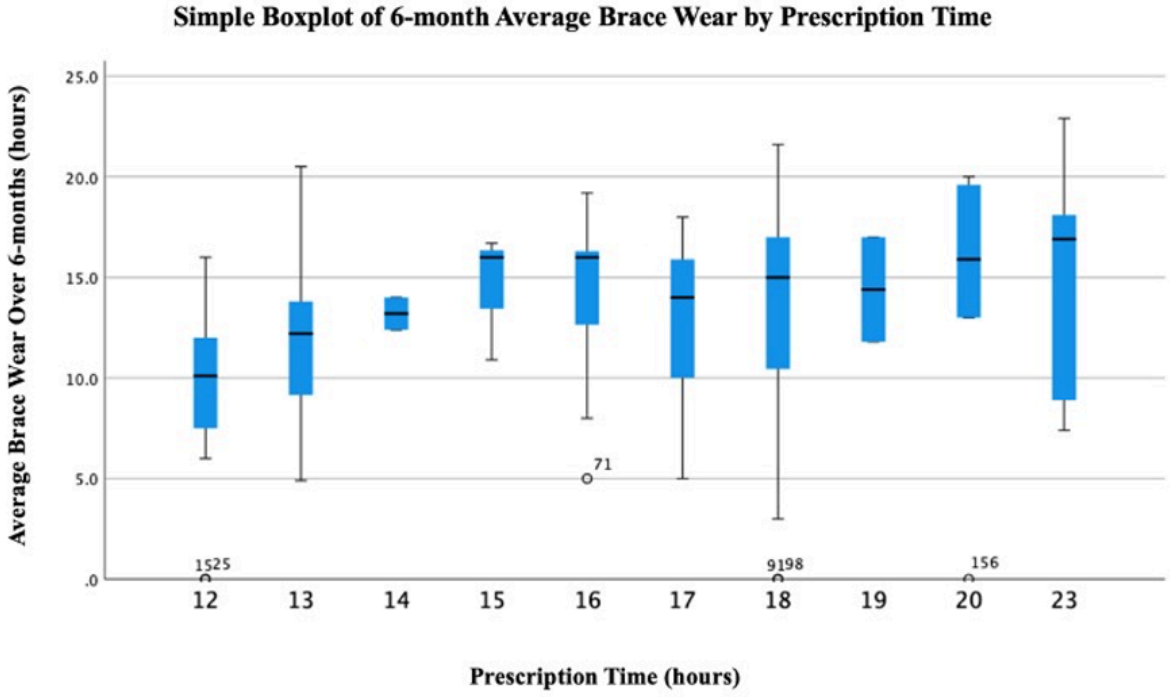

Figure 2: Simple boxplot of 6-month average brace wear by prescription time.

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The Role of Scoliosis Specific Exercises in the Non-Operative Treatment of Adolescent Idiopathic Scoliosis: A Prospective Matched Cohort Study

Megan E. Johnson, MD, G. Ying Li, MD, Grant Hogue, MD, and **Colby Freeman, BSShort Bio of all Presenting**

Authors

Colby Freeman is a Medical Career Design Fellow at the Children's Hospital of Philadelphia

Abstract

Introduction:

The role of bracing and observation in the treatment of adolescent idiopathic scoliosis (AIS) is well documented. The role of physical therapy for decreasing the size of the curve or preventing progression remains controversial. Schroth therapy is the most commonly prescribed form of scoliosis specific exercise (SSE). A recent meta-analysis failed to show a clinically significant effect of SSE on curve magnitudes. Many studies on SSE fail to account for skeletal maturity and curve size, which are known predictors of curve progression.

Objective:

Our goal was to use a prospective multicenter database to match patients who received SSE with those who did not and assess curve progression while controlling for initial curve magnitude and skeletal maturity.

Methods:

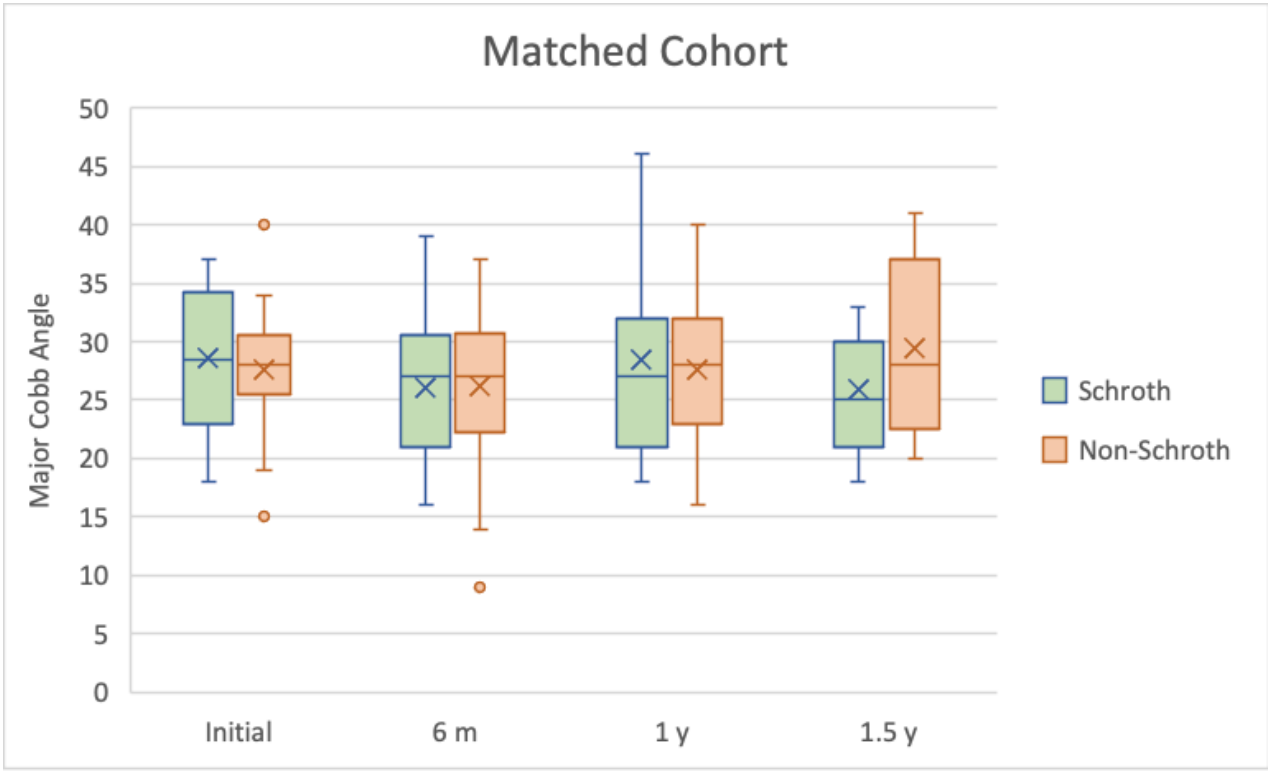
We utilized a multicenter database from several tertiary referral institutions to collect data on patients treated non-operatively for AIS. We identified 18 patients who were treated with SSE and matched them 1:1 with patients who did not receive SSE. Patients were matched by initial curve size as measured by the Cobb method and initial skeletal maturity as measured by the Sanders method. Patients were prospectively followed every 6 months until they required surgery or reached Sanders stage 7B of skeletal maturity. We compared patients at 6-month intervals to detect differences between patients who received SSE and those who did not. A difference in >/= 5 degrees was considered clinically significant.

Results:

There were no significant differences in age, skeletal maturity, or initial curve sizes detected between groups, indicating that the groups were well-matched. We found no significant differences between groups at 6 months, 1 year, or 1.5 years in terms of curve size (all p >0.05). Only 28% of patients initially prescribed SSE were practicing those exercises at 1 year. Average brace wear was 14.2 hours for the SSE group for those who were prescribed braces (n=13) and 13.8 hours for the non-Schroth group (n=13). Brace wear was not significantly different between the two groups (p >0.05).

Conclusion:

Although SSE are frequently prescribed for AIS, their role remains unclear. Our study failed to demonstrate any differences for SSE in altering the natural history of progression or improving compliance with bracing modalities. The majority of patients in our study no longer practice SSE at one year.


Matched Cohort
Major Cobb Angle
50
45
40
35
30
25
20
15
10
5
0
Initial
6 m
1 y
1.5 y
Schroth
Non-Schroth

6

Bad Tumor, Good Planning and Limb Salvage Alternatives

Alexandre Arkader, MD

Short Bio of all Presenting Authors

Alexandre Arkader, MD, is a board-certified attending surgeon who specializes in treating children with bone tumors. He works with the Orthopedic Center and the Cancer Center at Children's Hospital of Philadelphia.

Dr. Arkader is one of a handful of surgeons in the country with formal training in both pediatric orthopedics and orthopedic oncology. Additionally, he has a special interest in treating complex limb deformities, expertise in external fixation methods and other minimally invasive techniques for limb preservation and correction.

"The minute I started my orthopedic residency, I knew I'd go into peds ortho; I just love caring for children," Dr. Arkader says. "The thought about taking care of oncology patients only came to me during my fellowship at CHOP Orthopedics. The combination of both subspecialties – orthopedics and orthopedic oncology – lead to my desire to treat children with benign and malignant bone and soft tissue tumors, as well as perform limb salvage and reconstruction procedures for children with congenital and acquired conditions."
"The ability to create such a positive impact in the care of these children, the possibility of combining all the principles in pediatric orthopedic care and oncological principles to achieve the best outcome possible for the affected child is both challenging and inspiring," Dr. Arkader adds.

Dr. Arkader joined CHOP after eight years at the Children's Hospital of Los Angeles (CHLA) and Keck School of Medicine of USC. At CHLA, Dr. Arkader served as the Director of the Bone and Soft Tissue Tumor program, the Orthopedic Trauma Program, and the International Fellowship at the Children's Orthopedic Center at CHLA.
Dr. Arkader earned his medical degree from F.T.E. Souza Marques in Rio de Janeiro, Brazil. He completed an internship in international medicine at the Hospital Santa Casa de Misericordia, and a residency in orthopedic surgery at the Hospital de Traumatologia-Ortopedia in Rio de Janeiro, Brazil.

In 2003, Dr. Arkader came to the United States to further his professional training. He completed a fellowship in pediatric orthopedics at Children's Hospital of Philadelphia, and a second fellowship in musculoskeletal oncology at Memorial Sloan-Kettering Cancer Center in New York, NY.

Along with his clinical work, Dr. Arkader is also an active researcher. He's published more than 80 peer-reviewed articles, many of which focused on musculoskeletal oncology and benign bone tumors, an area in which CHOP is a national leader in both experience and volume of patients successfully treated.

"We are 100% focused on pediatric care," Dr. Arkader says. "I'm proud to work here with a team that is fully dedicated to achieving the best outcomes possible for all of our patients."

Dr. Arkader has served as a national authority for numerous textbook chapters on pediatric musculoskeletal tumors. He has lectured in innumerous national and international meetings, and leads a biannual pediatric orthopedic course in South America. He participates in several study groups focused on research related to trauma and musculoskeletal infections and is an active reviewer for several medical journals. In addition, Dr. Arkader is a member of several national and international professional organizations including the Pediatric Orthopedic Society of North America, the American Academy of Orthopaedic Surgeons, the Musculoskeletal Tumor Society and the Children's Oncology Group.

Abstract

7

Incidence and Risk Factors for Amputation Overgrowth in Pediatric

Colby Freeman, BS, Stone R. Streeter, BS, Caroline Kim, BS, Keith Baldwin, David A. Spiegal, Alexandre Arkader, MD and B. David Horn, MD

Short Bio of all Presenting Authors

Colby Freeman is a Medical Career Design Fellow at the Children's Hospital of Philadelphia

Abstract

Introduction:

Bony overgrowth following lower extremity amputation in skeletally immature patients can lead to increased pain, skin breakdown, and higher rates of revision surgery. Several novel surgical techniques have been implemented to reduce the incidence of bony overgrowth. However, risk factors for its development are not well described, which has limited the effectiveness of interventions. The primary aim of this study was to determine the demographic and surgical factors associated with a greater risk of bony overgrowth after lower extremity amputation in the pediatric population.

Methods:

This was a retrospective review of all patients <18 years old who underwent lower extremity amputation (below-the-knee (BKA) and above-the knee (AKA)) at a large single-center tertiary hospital from 2010-2025. Patients with congenital or intrauterine amputations or <6 months of follow-up were excluded. Demographic and clinical information was collected. Indications for amputation were separated into the following categories: tumor, trauma, infection, and vascular. Patients with bony overgrowth requiring revision surgery were considered the end point for analysis. Bivariate analyses such as Chi-square/Fishers exact test and Mann-Whitney U test were conducted due to the variable distribution of the data.

Results:

In total, 37 patients were included (mean age 10.2±5.2, 64.9% male). Of these, 29.7% (n=11) underwent revision surgery for bony overgrowth. The average duration between initial and revisional surgery was 2.45 ± 1.90 years. Patients requiring revision surgery were significantly younger at initial amputation (6.3 vs 11.9 years, p=0.0037), with only one patient >11 years old at the time of initial amputation going on to need revision surgery for bony overgrowth. The primary indication for amputation, level of initial amputation (BKA vs AKA), and amputation surgical technique did not affect the rate of revision surgery due to bony overgrowth (p>0.05).

Conclusions:

Younger patients undergoing lower extremity amputation are at the greatest risk for bony overgrowth requiring revisional surgery. Indication for amputation, level of amputation, and surgical technique did not alter this risk. Due to the generally low rate of amputations in this patient population, additional research is needed to further investigate risk factors for bony overgrowth requiring surgical intervention and the efficacy of novel surgical techniques aimed at preventing it.

Significance:

Younger patients who undergo lower extremity amputation are at increased risk for bony overgrowth requiring revisional surgery. However, there is no difference in rate based on amputation technique.

8

Congenital Chopart Amputation: A Multi-center Study on Prosthetic Usage, Associated Anomalies and Surgical Interventions

Dylan Kluck, MD, Caleb Pawl, MD; Andrew Schaver, MD, and **Janet Walker, MD**

Short Bio of all Presenting Authors

Dylan Kluck is a pediatric orthopaedic surgeon at Shriners Children's Lexington and Assistant Professor of Pediatric Orthopaedics at the University of Kentucky. He provides general pediatric orthopedic care but has a specific interest in lower limb deformities and deficiencies, hip dysplasia, clubfoot, traumatic injuries and neuromuscular conditions.

He graduated with high distinction from the University of California, Berkeley and earned his medical degree from Washington University in St. Louis. He then completed his orthopaedic surgery residency at the University of California, San Diego and pediatric orthopaedic surgery fellowship at Texas Scottish Rite Hospital in Dallas.

Dr. Kluck is a member of the American Academy of Orthopaedic Surgeons (AAOS), the Pediatric Orthopaedic Society of North America (POSNA), and the Limb Lengthening and Reconstruction Society (LLRS).

Janet Walker is a pediatric orthopaedic surgeon at Shriners Medical Center and Professor of Pediatric Orthopaedics at University of Kentucky School of Medicine. Her expertise is all aspects of pediatric orthopaedics and she is certified by the American Board of Orthopaedic Surgery. She is involved in research on clubfeet, limb deficiencies, limb malalignment and children with amputations.

Dr. Walker graduated summa cum laude from The University of South Florida. She obtained her medical degree and completed her residency in orthopaedic surgery at University of South Florida College of Medicine, Tampa Florida. She specialized in pediatric orthopaedics with training at the Hospital for Sick Children, University of Toronto. She has had additional training in limb lengthening with Gavil Ilizarov in Kurgan, Russia.

Dr. Walker is a member of the American Academy of Orthopaedic Surgeons, The Pediatric Orthopaedic Society of North America, and the Association of Children's Prosthetic and Orthotic Clinics.

Abstract

*Introduction*There is minimal literature on pediatric congenital Chopart amputations with studies primarily focusing on adults as well as acquired and traumatic etiologies[1-6]. Even among a pediatric amputeepopulation, congenital partial foot amputations represent a small proportion of patients[7,8]. Byleveraging a multicenter database of children with lower extremity anomalies, the purpose of this studyis to provide an updated natural history on the prosthetic usage, associated anomalies and surgicalinterventions in children with this level of amputation.

Methods

A multicenter database encompassing 7 tertiary pediatric orthopaedic centers was queried for patients with congenital Chopart amputations with subsequent chart and radiographic review to confirm inclusion. Retrospective review was performed to identify demographic variables as well as etiology, associated anomalies, prosthetic usage, tibiotalar and subtalar range of motion and surgicalintervention.

Results

55 patients were identified with congenital Chopart amputations with an average of 8.9 years of follow-up (range 0-19.7). 71% were attributed to transverse deficiency, 20% were attributed to amniotic bands and 9% were associated with syndromes. There were associated limb anomalies in 47% of patients with 7% being isolated upper extremity, 2% being isolated contralateral lower extremity and 17% involving both upper and lower extremities. Tibiotalar motion was described as present in 60% of patients and subtalar motion was described as present in 13% of patients with other charts not mentioning range of motion. At most recent follow-up 40% were using a below kneeprosthesis, 31% were using a partial foot prosthesis, 22% were using an SMO or AFO with a toe-fillerand 7% were using no prosthesis. 27% of patients had changed prosthetic design during the follow-up period. 15 patients underwent lower extremity surgery with a total of 26 surgeries.

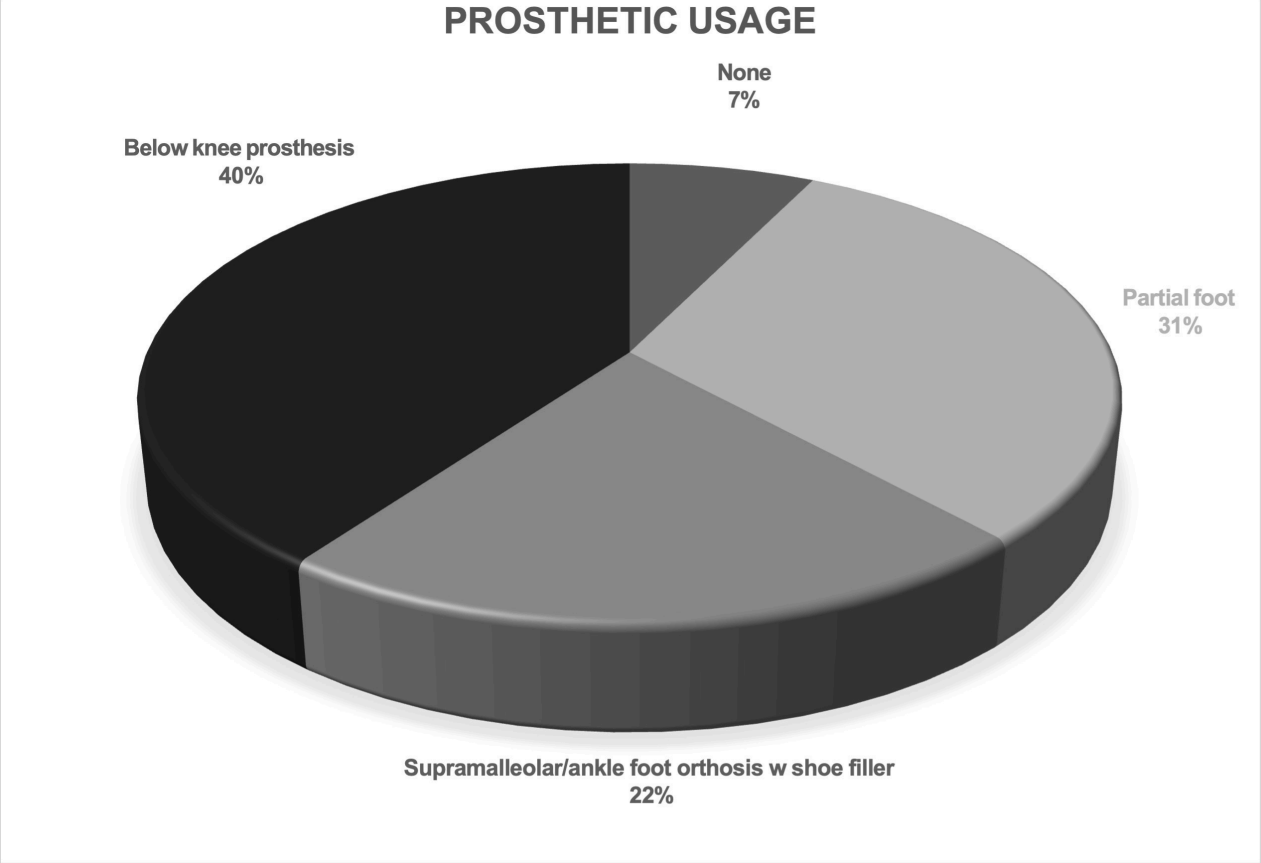
31% of surgeries were revision to Boyd amputation, with 27% for equalization of leg length, 12% for rotational correction, 8% for angular correction, 8% for ablation of vestigial toes, and 15% for other reasons. 15% of patients had documentation of rotational challenges with prosthetic/brace fitting.

Conclusion

Among patients with congenital Chopart amputations there was considerable variability in prostheticusage ranging from no prosthesis to below knee prosthesis. Nearly a third of patients changedprosthetic design during follow-up. If surgery was performed, it was most commonly for revision to Boydamputation and subsequently for equalization of leg length discrepancy.

Significance

There are several viable prosthesis options for congenital Chopart amputations with the ultimate decision as to prostheticdesign being dependent on patient and family goals.



9

PROMIS Evaluation of Knee Contracture Correction in Arthrogryposis by External Fixation

Nicholas Sinni, MPH, BS, Natalie Williams, BS, and **Sarah Nossov, MD**

Short Bio of all Presenting Authors

Dr. Sarah Nossov FAAOS is a pediatric orthopaedic surgeon specializing lower extremity issues. She is the Director of Limb Lengthening and Deformity Reconstruction at the Shriners Hospital for Children in Philadelphia. She has a particular interest in external fixation, limb lengthening, complex hip problems, foot problems, and lower limb deformity. She has a large rare-disease cohort- especially arthrogryposis and has a special interest in providing care to those with resource limit health access.

Abstract

Introduction

Knee flexion contractures are commonly seen in patients with arthrogryposis multiplex congenita (AMC) which can significantly affect their ability to ambulate. In severe contractures, a surgical solution may include use of an external fixation for gradual correction. Existing literature reports that external fixation can be a negative experience for patients. This study aims to evaluate the impact of the use of external fixation on pediatric patients with AMC.

Methods

We performed a retrospective review at a single institution of pediatric patients diagnosed with AMC with surgical plans that included external fixation on knee flexion contracture. Procedures were performed between 2017-2023. We collected demographics, surgical information, as well as PROMIS scores pre-operatively, during use of external fixation, and at latest follow-up. PROMIS scores were utilized to measure the impact of external fixators. We collected PROMIS scores for mobility, peer relationships, pain interference, and pain intensity. Statistical analyses were performed using one-way Repeated measures ANOVA tests and Tukey's multiple comparison test.

Results

A total of 35 patients were identified for this comparison cohort. 13 patients had three consistent mobility PROMIS that demonstrated statistical significance between time points ($p=0.0211$). There was a statistically significant worsening in the Mobility pre-operative versus the external fixator on ($p=0.0235$). Although, removal of the external fixator trended to show recovery and improved mobility. There was no statistical difference between peer relationship ($p=0.3236$), pain interference ($p=0.5476$), and pain intensity ($p=0.158$).

Summary Points/Significance

· External fixators significantly decrease mobility PROMIS scores during treatment. An unexpected finding, despite mobility significantly decreasing, was that this population of AMC patients did not show changes in the domains of peer relationships, pain interference, and pain intensity.

10

Physical Therapy and Prosthetic Management Following Complex Pediatric Lawnmower Injury and Unique Limb Salvage Procedure

Domenica Platenecky, PT, DPT, PCS, and Meagan Gulmi, PT, DPT, PCS

Short Bio of all Presenting Authors

Domenica received her Doctorate of Physical Therapy from University of the Sciences in Philadelphia in 2010. She currently practices primarily in the acute care setting, with an area of expertise in pediatric critical care, at the Children's Hospital of Philadelphia (CHOP). Domenica also is the primary physical therapist in CHOP's Limb Differences clinic as well as in the Center for Thoracic Insufficiency Syndrome. Domenica serves as the primary acute care mentor in CHOP's pediatric physical therapy residency program.

Meagan received her Doctorate of Physical Therapy from The George Washington University in 2019. She currently practices in the inpatient rehab setting at the Children's Hospital of Philadelphia. She is the backup physical therapist in CHOP's Limb difference clinic as well as the BRIDGE clinic, an interdisciplinary rehab follow-up clinic. Her main clinical interests revolve around limb difference and prosthetic training in the inpatient rehabilitation setting.

Abstract

Challenging case: The challenging case being presented today is that of a previously healthy 3-year-old male with suspected autism spectrum disorder who admitted after being accidentally hit by a power lawn mower. He sustained multiple traumatic injuries, the most impactful from a PT perspective include multiple RUE fractures, RLE distal femur fracture extending into the joint space, LLE open distal femur and proximal tibia fractures with traumatic amputation of patella, and penile degloving with traumatic amputation of glans and testicles. Surgeries performed included LLE "Tibial-up" procedure **(tibiofemoral fusion without rotation),** ORIF of right tibial plateau with medial meniscus primary repair and ORIF of multiple fracture sites at RUE. After the above stated operations, the patient demonstrated an absent knee joint on his LLE and roughly a 4-inch leg length discrepancy between his right and left legs. In addition, the medical team was anticipating at least a 3-4 year delay until his next potential lower extremity management surgeries based on his growth, growth plates, vascular patency, etc. Therefore, as a physical therapy team, we were challenged with the task of devising a way for this patient to continue to meet his developmental and functional needs while accommodating his significant leg length discrepancy while surgical planning was ongoing.

Solution: Based on the uncertainty of this patient's future surgical planning, regarding the timeline and potential surgical options available, this patient required prosthetic design creativity to meet his current developmental and functional needs. The early prosthetic decision making was guided by his current level of function and length of his residual limb. Initially, a 4-inch lifted cast shoe was prescribed for static weight bearing and activity. Due to his significant functional progress, a foot-on-foot prosthetic was initiated to allow for improved dynamic standing level activities and ambulation. Upon discharge, 5 months after his accident, he required supervision for all age-appropriate transfers, ambulated long distances with a posterior rolling walker independently, and required close supervision for ambulation without a device.

Based on the uniqueness of his presentation, prosthetic design creativity was essential to meet his developmental and functional needs. Whereas in the case of a transfemoral amputation or a rotationplasty, where the typical prosthetic trajectory is often known, this case was singular and required utilization of prosthetic prescription gathered from other types of limb differences to optimize his mobility. While he showed exceptional progress and mobility in his current prosthetic device, the role of physical therapy in his care remains imperative due to future surgical intervention and potential for new prosthetic designs. (Pictures will be provided)

11

Forefoot Narrowing Surgery in Split Foot Malformation- Predictors from a Multicenter Review

Janet Walker, MD, Grace Markowski, BS, MS, and David Westberry, MD

Short Bio of all Presenting Authors

Dr. Walker is a pediatric orthopedic surgeon at Shriners Children's-Lexington and a professor at the University of Kentucky Department of Orthopaedic Surgery and Sports Medicine in Lexington KY. She received her medical and orthopaedic training at the University of South Florida. She was a pediatric orthopaedic fellow at the Hospital For Sick Children in Toronto Canada. She has clinical and research interests in children with lower extremity deformities, deficiencies and amputations.

Abstract

Introduction

Split foot malformation (ectrodactyly) is a congenital central foot deficiency. Because the forefoot is wide, shoe wear may be difficult. Abraham, et al proposed that Type II deformity, with forefoot divergence/splay, should have forefoot narrowing surgery (FFNS), preferably <3 years of age, to avoid osteotomy. Our purpose is to determine anomaly factors that correlate with FFNS.

Methods

A retrospective review was performed of radiographs of 237 patients (330 feet) from 7 pediatric orthopedic centers. Classification was assigned using Abraham, et al and Blauth+Borisch (anatomic/descriptive) systems. Other bony abnormalities were recorded. The most severe category of each classification was excluded as FFSN is not indicated. Feet lost to follow-up <5 years of age, without having had any surgery, were excluded. Variables in the remaining 212 feet were evaluated for their predictive ability for FFNS. Weight-bearing radiographs were evaluated in160 feet, measuring splay-index (forefoot/hindfoot widths) and the 1st-5th metatarsal angle.

Results

The percentage of feet requiring FFNS is shown in Table 1. The rate of FFNS was actually higher in Abraham Type I than II. Using the Blauth+Borisch classification, the rate of FFNS was significantly highest in Type III and lowest in Type IV. FFNS was performed in 4/4(100%,p=.008) feet with bifurcated bones and 13/15(87%,p<.001) with cross bones in the cleft. Osteotomies for 1stray bracket physes were performed in 3/3(100%,p=.021) feet with FFNS. Automatic linear modeling was consistent with chi-square predictors in Table 1. The median preoperative splay-index was 1.83(1.38–2.60) for those having FFNS and 1.64(0.93–2.44) for those without (p<.001). The median preoperative 1st-5th metatarsal angle was 35.0^{o}(18.1^{o}–128^{o}) for those with FFNS and 28.1^{o}(0.5^{o}–67.2^{o}) without.(p<.001) However, these measures account for <8.3% of the predictive variability. Feet undergoing FFNS <3years of age, 8/32(25%) had osteotomies compared to 21/31(67%) in those >5years.

Conclusions

Abnormal bones of the cleft including cross bones, bifurcated bones, and 1stray bracket physes are significant predictors for FFNS in split foot malformation. Blauth+Borisch classification Type II and IV were significant positive and negative predictors, respectively, for FFNS. Contrasting with Abraham, et al, our rate of FFNS was not higher in Type II versus Type I. Splay-index and 1st–5th metatarsal angle were statistically different larger for those having surgery than not, but only fair predictors for FFNS. The use of metatarsal/midfoot osteotomies increased with age.

These findings show that forefoot narrowing surgery for split foot malformation is less extensive when performed at a young age, but current classification systems and radiographic measures are moderate at best for surgical decision-making.

Table 1: Forefoot Narrowing Surgery Variables

	Type	Total Feet n=330	Feet with Follow/up n=212	% Having Forefoot Narrowing Surgery
Abraham, et al	I	125	79	37%
	II	149	116	28%
	III	39	excluded	
	prior soft tissue surgery	17	excluded	p=.177
Blauth + Borisch	I	14	10	10%
	II	78	49	53%*
	III	111	90	41%
	IV	48	36	17%**
	V	40	27	26%
	IV	39	excluded	overall p<.01
Adjusted residuals *+2.8 **-2.7 both significant				

Summary of Chi Squares n=212 feet			
	P values	Predictive Value (Tau)	Association Strength
Blauth + Borisch	0.002	0.081	moderate
Cross bones	<.001	0.083	moderate-strong
Bifurcated bones	0.008	0.034	small-moderate
Bracket Physis-1st ray	0.021	0.025	small-moderate
Logistic Regression N=160 feet			
	P values	R^2	Predictive ability
Splay Index	<.001	0.068	fair
1st-5th metatarsal angle	<.001	0.066	fair

12

Nighttime Stretching Plantarflexion/Inversion AFOs for the Treatment of Complex Clubfoot and Vertical Talus

Erin Casey, CPO/LPO, and Matthew Westlake, CO/LO

Short Bio of all Presenting Authors

Presenters from the Paley Institute in West Palm Beach, Florida. Erin is a CPO and a Baylor College of Medicine alumnus. Matt is a CO and Newington alumnus with 26 years of experience in orthotics.

Abstract

Introduction: This abstract presents a novel orthotic style intervention utilizing Plantarflexion/Inversion (PF/IN) Solid Ankle Foot Orthoses (AFOs) for the treatment of complex clubfoot and vertical talus, aiming to improve range of motionand functional outcomes. In pediatric patients, bones tend to grow faster than muscles, and growth hormone is most active at night. This brace is utilized for night time stretching to ensure the pretibial and peroneal muscles maintain proper length as pediatric patients are growing in their deepest sleep. The PF/IN Solid AFO design is meant to help balance the stretched muscle length with the their respective antagonists, which creates more balanced standing foot posture.

Methodology: Our approach involves the application of custom-fabricated PF/IN Solid AFOs. These nighttime stretching AFOs are built in a static plantarflexed and inverted position of the foot, designed to induce a controlled stretch on the peroneal and pretibial muscles, facilitating muscle lengthening and increased dorsiflexion and eversion range of motion.Patient populations for this device are atypical and complex clubfoot presentations, and congenital vertical talus.

Indications for this style of bracing intervention include patients with significant muscle tightness and limited range ofmotion in plantarflexion and inversion. The fabrication and fitting process has encountered several challenges, which have been refined over the last 2 years.

Recommendations for plaster modifications, fabrication, and advice for proper fit will be presented.

Results: To assess the efficacy of the PF/IN AFO, the authors are currently collecting outcome measure data at the DobbsClubfoot Clinic at Paley Institute. These outcomes include measuring plantarflexion, dorsiflexion, and inversion range of motion at regular patient appointments and during regular follow up appointments. The number of patients dischargedfrom using the device and the timeframe of treatment before discharge will also be assessed. This quantitative data will be crucial for demonstrating improvement in range of motion and will form the basis of the results section.

Limitations: Current limitations include the absence of a compliance tracking mechanism, relying on patient-reportedcompliance, and a relatively short data collection period. Further research will be needed to address these limitations.

Conclusion: The PF/IN AFO offers a promising potential solution for improving the range of motion and standing footposture in patients with complex clubfoot and vertical talus. Ongoing data collection will provide crucial evidence of its effectiveness.

13

Prosthosis Management of the Child with Complex Clubfoot: Bilateral Prosthesis-Hybrid Solutions for Stability and Mobility

Lauren Levey, MSPO, CPO, and MacKenzie Conlen, MSPO, CPO

Short Bio of all Presenting Authors

Lauren is a Certified Prosthetist/Orthotist passionate about pediatric O&P care. After finishing training at Children's Healthcare of Atlanta and University of Michigan, she joined the OrthoPediatrics Specialty Bracing team at the Children's Hospital of Philadelphia clinic. Lauren specializes in complex lower limb difference and deformity management, high-level bracing for patients with spina bifida, and inpatient care. Lauren is passionate about multidisciplinary care settings to improve patient outcomes, and enjoys supporting practitioner development and training as a resident mentor. She is the prosthetics program director for OrthoPediatrics Specialty Bracing, helping to develop, promote, and improve care standards for children with limb loss and limb difference throughout the OPSB network.

MacKenzie is a CPO with OrthoPediatrics Specialty Bracing at the Boston Children's Hospital area clinics. She is passionate about toe-walking, and complex lower extremity deformity management and gait.

Abstract

Case Summary:

The problem: Children with bilateral treatment-resistant complex clubfoot deformities pose challenging clinical presentations for orthotist/prosthetists to accommodate the deformity while achieving ambulation and mobilitygoals. Biomechanically, these children are afected greatly by a shortened toe lever and inability to push-of.Frequently their knee and hip strength and mechanics are also impacted. Anatomically, they present with severely bony anatomy, sometimes insensate limbs in the setting of Spina Bifida, and comfort and skinbreakdown can be a challenge in these orthoses.

The solution:

We will examine two cases (a patient with Arthrogryposis and a patient with Spina Bifida) who presented to twoseparate OPSB clinics with similar presentations and challenges, as above. We will then examine a prosthesis-orthosis hybrid extension prosthesis solution that allowed these patients to achieve their mobility goals, whileimproving fit, comfort, and biomechanics via a prosthetic foot. “Prosthosis” design in both cases included ananterior-shell, stove-pipe design “socket” to fit the limb, with a distally attached prosthetic foot to restore gait biomechanics.

14

Rewriting the SMA Story: Lessons from a Decade of Breakthrough Therapies

Dr. Susan Apkon

Short Bio of all Presenting Authors

Dr. Susan Apkon is the Fischahs Chair in Pediatric Rehabilitation at Children's Hospital Colorado and Visiting Professor and Vice-Chair of the Department of Physical Medicine and Rehabilitation at University of Colorado School of Medicine. She leads a nationally recognized pediatric rehabilitation program that provides innovate and evidenced based care to children and adolescents with changes in function related to injury, illness, or congenital conditions.

Dr. Apkon's clinical focus is on the care of children with neuromuscular conditions and is the Co-Director of the Neuromuscular Clinic at Children's Hospital Colorado.

Dr. Apkon's research interests are focused on providing novel treatments to children with neuromuscular conditions and has been involved over the last 15 years in clinical trials, some of which have led to FDA approved drugs that are changing the course of pediatric neuromuscular diseases.

Abstract

15

Psychosocial Considerations in Caring for Families with Hereditary Neuromuscular Disease

Laurey Brown, PT, DPT, and Sara Beyler, CO/LO

Short Bio of all Presenting Authors

Dr. Brown is a Clinical Research Physical Therapist and Clinician III at Ann & Robert H. Lurie Children's Hospital of Chicago, where she divides her time between clinical care and research. She specializes in neuromuscular conditions including Spinal Muscular Atrophy (SMA), Dystrophinopathies, Charcot-Marie-Tooth disease, and other rare neuromuscular disorders. She led the Delphi survey on serial casting in SMA and co-authored its published outcomes. Her research contributions also include studies on the Assessment of Caregiver Experience in Neuromuscular Disease (ACEND) in SMA and the application of Timed Function Tests in ambulatory individuals with SMA treated with Nusinersen. As a Clinical Evaluator, Dr. Brown has participated in multiple clinical trials across a range of neuromuscular diseases. She has also served as a facilitator for STEP-IN SMA. Within the multidisciplinary neuromuscular clinic, she collaborates closely with colleagues to provide consultative care and guidance for patients and families.

Sara has been treating patients at Lurie Children's since 2009. She spends much of her clinical time in the outpatient setting, contributing to several clinic environments focused on multidisciplinary care. Her clinical focuses are treating patients with myelomeningocele and various forms of muscular dystrophy from infancy into young adulthood. Sara evaluates for total body orthotic needs including cranial remolding orthoses, spinal orthoses, upper extremity functional splinting, and lower extremity orthoses and emphasizes the importance of continuous care as their needs may change. She is passionate about connecting her patients with sports and recreational programming outside of the clinical setting and providing them with a supportive, holistic treatment plan.

Abstract

Living with a neuromuscular disease is a multifaceted experience, with lifespan expectations largely driven by diagnosis. Hereditary neuromuscular conditions often involve a unique constellation of multisystem effects that shape how individuals approach life. When providing holistic care for these individuals, it is crucial to consider the role of social systems in shaping a person's identity and their different roles within varying social contexts. Moreover, when a child inherits the disease from a parent, additional considerations arise, including the potential for increased family stress, medical decision-making influenced by parental experiences, and the child's observation of these experiences. Family expectations for the future also play a key role.

Honest, age-appropriate communication and strong caregiver partnerships are essential, especially when considering the how the parent's identify and decisions have been shaped. Healthcare providers may face challenges in care decisions influenced by parents' previous experiences, their interpretations of advancements in treatment, and the way disability impacts identity.

The emotional and mental health impacts on families affected by inherited diseases are often more profound than in families without a hereditary pattern. While the strain on caregivers is well-documented (Xu), less is known about the additional burdens placed on parents who themselves have the disease. Factors such as parental temperament, physical ability to care for the child, availability of social and economic supports, and past medical experiences can significantly influence the type of assistance and approach the caregiver is able to provide. Emotional support is vital, particularly in making treatment decisions (Pacione). Research suggests that depressive symptoms are higher in parents of children with chronic conditions and parental stress can negatively impact both the physical and psychological well-being of the child (Kentor). Strategies to improve family resilience are crucial in mitigating stress and fostering emotional strength.

This case series will examine families impacted by hereditary neuropathy. It will explore the diagnostic journey, quality of life determinants (including time, emotional, and financial burdens), access to testing and care, and family dynamics. It will highlight individual functionality in different environmental contexts and explore rehabilitation considerations, as well as the importance for all providers to give care that is psychologically informed.

Caring for families affected by hereditary neuropathy requires a multidisciplinary approach that addresses the physical, emotional, and psychological aspects of each individual's experience within the context of their family. It is essential to guide, ask meaningful questions, and support these families within a biopsychosocial model of care.

16

The Use of Hyper Selective Neurectomy to Improve Elbow Flexor Spasticity in Children with Cerebral Palsy

Eugene Park, MD

Short Bio of all Presenting Authors

Eugene Park, M.D., is a pediatric hand and plastic surgeon at Shriners Children's Philadelphia. He completed his residency training in plastic surgery at Northwestern University, followed by a fellowship in hand surgery at Stanford University. He completed extra training in pediatric hand surgery at Shriners Children's Philadelphia prior to joining as staff. He feels privileged to be able to contribute to the Shriners Children's mission and currently serves as the program director of the pediatric hand and upper extremity surgery fellowship.

Dr. Park has a special interest in peripheral nerve surgery, including brachial plexus reconstruction and the treatment of spasticity in children with cerebral palsy. He also performs nerve and tendon transfers to help patients with tetraplegia due to spinal cord injury.

Dr. Park has a passion for global surgery. He enjoys connecting with providers in developing countries to provide surgical education and to treat children who otherwise would not have access to care.

Abstract

Background: Spasticity is the most common motion disorder (80%) in patients with cerebral palsy.[1] The impaired motion and rigid postures associated with spasticity can lead to contractures and make therapy and splinting difficult. Historically, spasticity has been treated with tendon lengthening surgery and botulinum toxin injections. Hyperselective neurectomy is a novel surgical treatment which can decrease spasticity and improve upper extremity resting posture and range of motion in patients with spasticity.[2] We performed a retrospective review of children with cerebral palsy who underwent hyperselective neurectomy for elbow flexor spasticity.

Methods: We performed a retrospective review of all patients who underwent hyperselective neurectomy of the elbow flexors at our institution between 2021 and 2024. Pre and post-operative measurements were recorded for elbow flexor spasticity (Modified Ashworth Scale), elbow resting posture, and passive and active range of motion.

Results: 17 patients were identified who underwent hyperselective neurectomy of the elbow flexors, with an average age of 10.9 years at the time of surgery. Average pre-operative elbow flexor Ashworth score was 2.12. At one month post-operatively, this decreased to 0.12 and increased to 1.29 at 1 year. Average pre-operatively elbow resting posture was 83.1 degrees of flexion, and this improved to 16.5 degrees of flexion at 1 month, and 23.3 degrees of flexion at 1 year.

Conclusions: Hyperselective neurectomy of the elbow flexors decreases spasticity and improves resting elbow posture long-term in children with cerebral palsy. This permits a more relaxed posture of the upper limb and can help patients tolerate extension splinting, if needed.

17

Use of Custom KAFO-Prosthesis Hybrid in the Management of a Femoral Shaft Non-union Prior to Advanced Surgical Reconstruction

Eric Tecce, MD, Terence Ishmael, MD, and **Calli Clark, CPO**

Short Bio of all Presenting Authors

Eric is a PGY-2 Orthopaedic Surgery Resident at The Rothman Institute in Philadelphia, PA.

Abstract

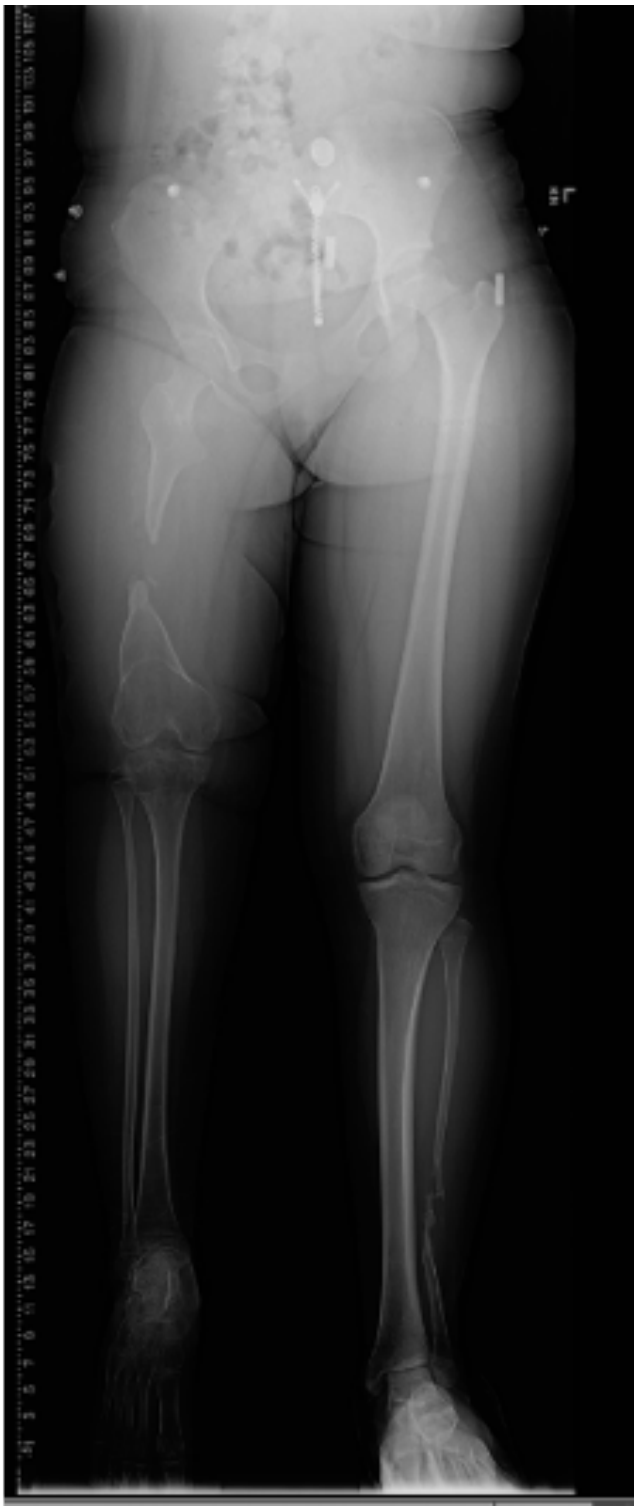
We present the case of a 16-year-old female from El Salvador who sustained an open right femur fracture at age 3, complicated by osteomyelitis requiring multiple debridement and reconstructive procedures. She subsequently developed an atrophic non-union with an 18 cm limb-length discrepancy (Figures 1-3). After exhausting limb-salvage options, her surgical team in El Salvador recommended an above-knee amputation—an option she and her family declined. They ultimately relocated to the United States in search of reconstructive alternatives, arriving at Shriners Hospitals for Children in Philadelphia.

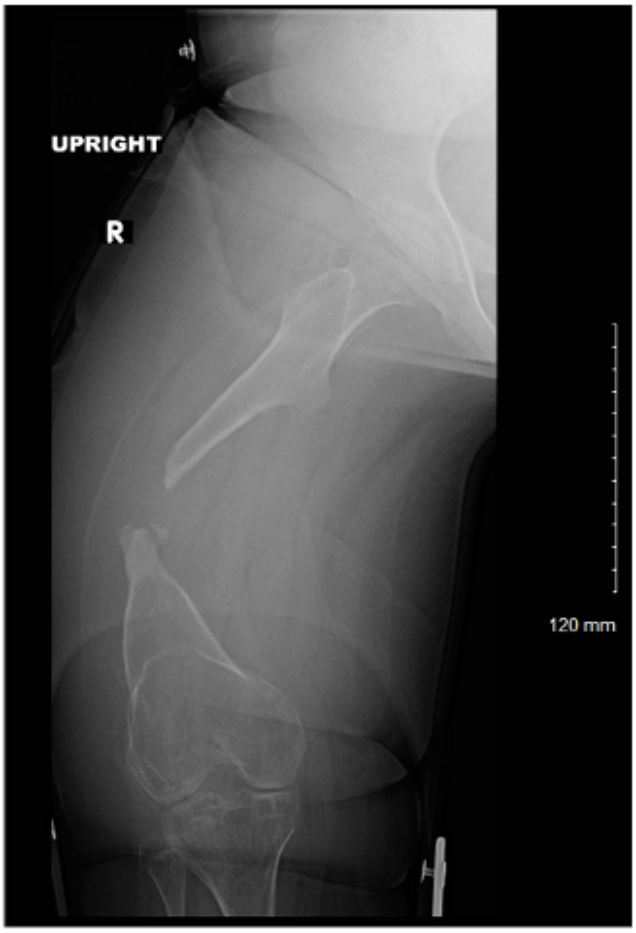
Upon evaluation, several surgical options were considered: rotationplasty, vascularized fibular graft with later limb-lengthening, and amputation. Imaging revealed occlusion of the superficial femoral artery, limiting perfusion to collateral vessels from the profunda femoris, which renders future lengthening procedures high-risk. Additionally, a significant portion of the contralateral fibula had already been harvested during previous surgeries which potentially limits the options for vascularized free fibula transfer.

The multidisciplinary team and family elected to proceed with a staged Masquelet-style reconstruction. Stage one will involve placement of a femoral intramedullary nail, collection of intraoperative cultures, and insertion of an antibiotic cement spacer to initiate pseudomembrane formation. Pending sterile cultures, stage two will involve removal of the spacer and grafting with autologous iliac crest bone, bone chips, and bone morphogenetic protein to achieve bony union.

In the interim, the Shriners Pediatric Orthotic and Prosthetic Services (POPS) team created a custom hybrid orthotic/prosthetic knee-ankle-foot orthosis (KAFO) to maintain mobility (Figure 4). The device compensates for her 18 cm limb-length discrepancy and provides proximal pelvic stabilization via an ischial containment socket, preventing rotation and enhancing weight-bearing capability. Compared to the orthosis she previously used in El Salvador, the new design is significantly lighter and more functional (Figure 4). This innovative orthotic solution has enabled her to remain ambulatory and engaged in daily life while awaiting reconstruction.

This case highlights the importance of creative, multidisciplinary problem-solving in the setting of complex pediatric limb salvage. While definitive reconstruction is still pending, the use of a custom hybrid KAFO has played a critical role in maintaining the patient's mobility, function, and quality of life during a prolonged treatment course. We hope this case sparks discussion on how such interim devices can be better utilized in pediatric limb reconstruction and invite feedback on optimizing orthotic strategies during extended salvage protocols.

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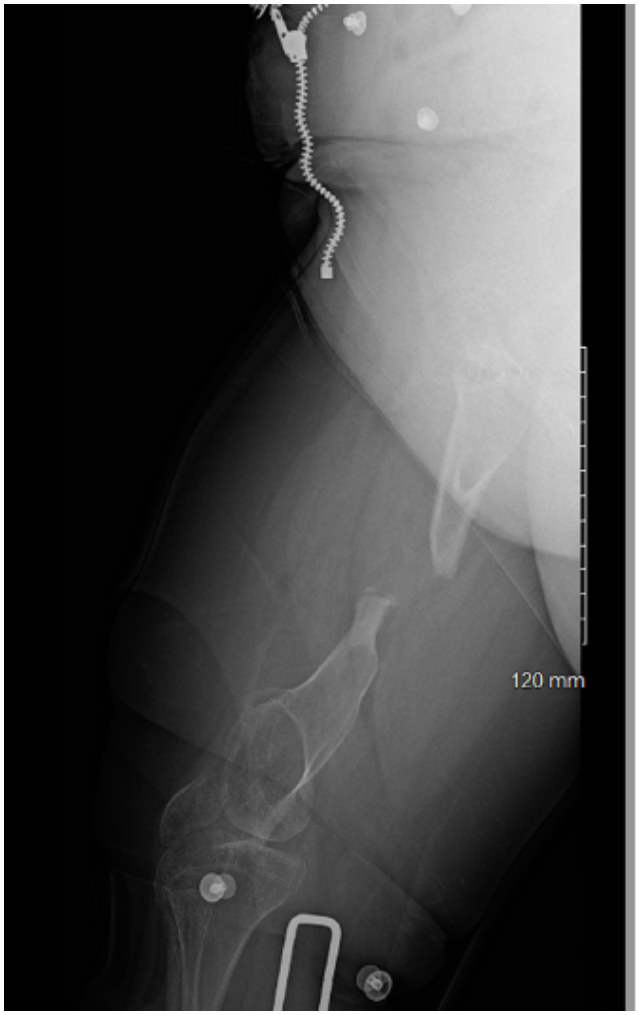
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From Quadriplegia to Independent Ambulation: Rehabilitation After Spinal Surgery in an Adolescent with Neuroblastoma History

Gabrielle Horchos, Medical Student, and Richard Goldberg, DO

Short Bio of all Presenting Authors

Gabrielle Horchos is a fourth-year medical student at Philadelphia College of Osteopathic Medicine (PCOM) with interests at the intersection of pediatric rehabilitation, bioethics, and healthcare leadership. She completed her undergraduate studies in Baltimore, where she was a collegiate tennis player, and went on to earn a graduate degree in Washington, D.C., before beginning her medical training.

Her clinical training has included diverse experiences, with highlights in pediatrics at St. Christopher's Hospital for Children, Shriner's Hospital for Children, and in physical medicine and rehabilitation where she gained exposure to pediatric rehabilitation and traumatic brain injury care. Gabrielle has also been active in healthcare business and leadership, serving as Director of Development for the nonprofit Aspiring Physician Executives (APEX), where she helped create educational programming to empower medical trainees with business and management skills. In addition, she is a member of the Student Advisory Board for the Expert Education Institute, where she contributes to event planning and resource design for physicians across specialties in musculoskeletal medicine and ultrasound-guided care.

Outside of medicine, Gabrielle is an athlete with lifelong involvement in sports, including tennis, biking, skiing, and hiking. She also enjoys the arts, music, and cooking, interests that continue to inform her approach to patient-centered care.

Gabrielle's career goals include pursuing residency training in physical medicine and rehabilitation with a focus on pediatrics. She is dedicated to advancing equitable, multidisciplinary, and humanistic care for children with complex medical needs while integrating innovation, ethics, and leadership into her practice.

Richard Goldberg, D.O., is a doctor of physical medicine and rehabilitation (PM&R) at Shriners Children's Philadelphia. He has more than 30 years of experience caring for patients with many conditions. He attended medical school at the Philadelphia College of Osteopathic Medicine and held his residency at the Robert Wood Johnson Rehabilitation Institute in Edison, New Jersey. He has served in a few different leadership roles with the American Osteopathic College of Physical Medicine and Rehabilitation, most notably being past president after serving two times.

Abstract

The Problem / Case Description

Spinal cord compression in children poses distinct clinical and rehabilitative challenges. This case involves a 14-year-old girl with a history of neuroblastoma (2018) and complex spinal deformities. Following tumor resection,she remained in remission but developed left bronchomalacia, presumed phrenic nerve injury, neuromuscularscoliosis, and kyphosis. The diagnosis of progressive spinal cord compression required urgent intervention topreserve neurologic function, in January 2025, she exhibited bilateral lower extremity paresis with incompleteparaplegia and neurogenic bowel and bladder dysfunction.

She underwent HALO placement for gradual correction at Shriner's Hospital Philadelphia. Her neurogenicbowel and bladder dysfunction corrected with placement of the HALO. Her hospitalization was complicated bytracheostomy and G-tube placement, aspiration pneumonia, peritonitis, and malnutrition, these conditionswere corrected with vigorous wound care, surgery, and nutrition. She underwent corrective spinal surgery onMay 15, 2025, including posterior fusion of T7–12, halo removal, multilevel pedicle screw placement, and partialT3–T5 vertebrectomy with anterior cage insertion. The surgery alleviated spinal cord compression, andintraoperative monitoring demonstrated improved motor-evoked potential, but her respiratory compromise,nutritional deficits, infection, and prolonged immobility required an extensive rehabilitation plan. On June 10,2025, she transitioned to the inpatient rehabilitation unit with TLSO bracing post spinal surgery.

Discussion

This case shows how managing pediatric spinal cord compression involves complex surgical, medical, andrehabilitation challenges. The patient's preoperative decline, immobilization, infections, malnutrition, and ventilator use contributed to her poor condition, delayed healing, and limited rehabilitation progress.

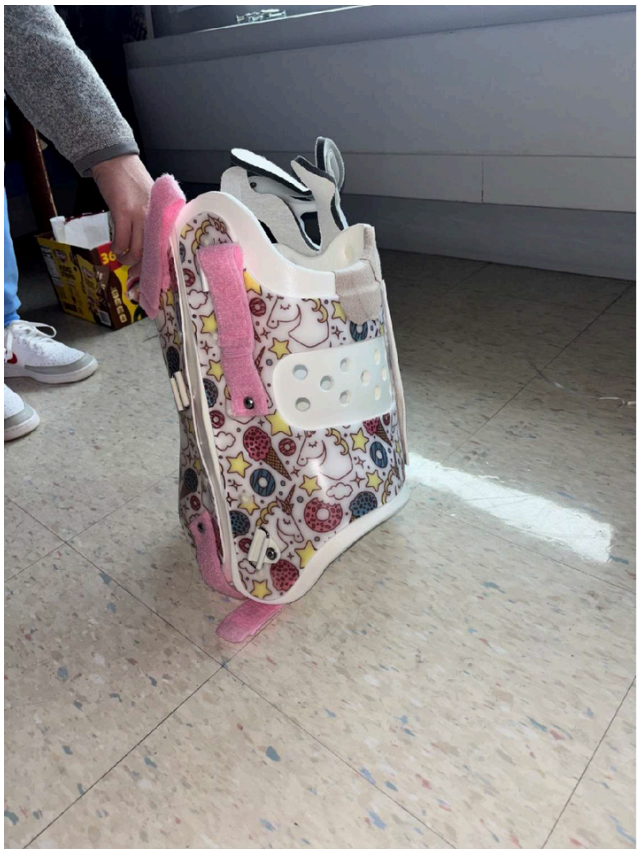
Within 24 hours post operatively in the IRU, the patient demonstrated remarkable neurological recovery. Initiallyquadriplegic, she regained sensation and motor function postoperatively, but her exam showed spasticity,clonus, diminished sensation, and absent voluntary lower extremity movement. Literature suggests prolongedbed rest is a predictive factor for returning to ambulatory function. Physical therapy focused on transfers,standing tolerance, and short-distance ambulation. By July, she achieved sit-to-stand transfers with bilateralupper extremity support, ambulation of 25 feet with a walker and contact guard assistance, and stair climbingwith moderate assistance. Occupational therapy addressed dressing, grooming, and endurance, while speech-language therapy targeted ventilator weaning.

Respiratory recovery was gradual, progressing from daily sprint trials to full-day capping of the tracheostomy byearly August. Nutritional goals transitioned from G-tube dependence to full oral intakewith weight maintenance. By September 9, 2025, she was ambulating independently with a posterior walker,aiming to transition away from assistive devices for all ADLs.

The major rehabilitative challenge was balancing medical fragility with intensive therapy. Frequent infections andventilatory fatigue initially limited progress. However, coordinated care and multidisciplinary communicationallowed for staged ventilator weaning, graded strengthening, and close nutritional monitoring.

The Solution

This case highlights the value of a multidisciplinary approach to treating complex pediatric spinal deformities.Despite severe complications and extended immobility, the patient progressed from quadriplegia to walkingthanks to early intervention, surgical correction, and focused rehabilitation. Integrating respiratory, nutritional,and neurologic care is essential, and milestone-based therapy supports adolescent motivation. The patient'srecovery shows that meaningful improvement is possible even with prolonged hospitalization and multiple complications.



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Short Limbs, Long Journey: Navigating Mobility Decisions in a Toddler with Quadruple Limb Differences

Domenica Platenecky, PT, DPT, PCS, and Meagan Gulmi, PT, DPT, PCS

Short Bio of all Presenting Authors

Domenica received her Doctorate of Physical Therapy from University of the Sciences in Philadelphia in 2010. She currently practices primarily in the acute care setting, with an area of expertise in pediatric critical care, at the Children's Hospital of Philadelphia (CHOP). Domenica also is the primary physical therapist in CHOP's Limb Differences clinic as well as in the Center for Thoracic Insufficiency Syndrome. Domenica serves as the primary acute care mentor in CHOP's pediatric physical therapy residency program.

Meagan received her Doctorate of Physical Therapy from The George Washington University in 2019. She currently practices in the inpatient rehab setting at the Children's Hospital of Philadelphia. She is the backup physical therapist in CHOP's Limb difference clinic as well as the BRIDGE clinic, an interdisciplinary rehab follow-up clinic. Her main clinical interests revolve around limb difference and prosthetic training in the inpatient rehabilitation setting.

Abstract

The challenging case that will be presented today is that of a female toddler (currently 25 months old) withmultiple congenital limb anomalies including- bilateral transhumeral and bilateral transfemoral amputations ofvarying lengths (Pictures and x-rays will be provided for visualization). She has been followed in the limbdifference clinic at CHOP since she was 4 months old with collaboration from Physical Therapists, OccupationalTherapists, Prosthetists and Physicians to track her developmental progress to assess appropriateness forupper and lower extremity prosthetics and provide recommendations surrounding her current developmentalstatus. Over the course of her lifespan, recommendations have included maximizing her range of motion,utilization of adaptive equipment to better access play and feeding opportunities, and facilitation of developmentally appropriate play and gross motor skill acquisition. We have also had ongoing discussions as amultidisciplinary team and with her family surrounding available possibilities for future functional mobility. These options included power mobility and bilateral LE prosthetics for ambulation. Currently, power mobility trials areunderway to further her mobility and improve access to her environment. Appropriate access points are beingidentified, including her mouth and residual left upper extremity, with promising success thus far. Our challengeas her treatment team revolves around the decision whether to initiate lower extremity prosthetics, and if so,what the timing of this introduction should be. In current practice, lower extremity prosthetics are typically introduced to children when they perform a pull to stand transition, around 8-10 months of age. Questions: In achild that may never achieve this developmental transition based on her specific limb differences, what are other potential indicators of lower extremity prosthetic readiness? If a prosthetic device is introduced and not successful, what indicators would you be tracking across the lifespan as a sign of future prosthetic readiness? For this specific patient's anatomy, does her limb length impact her more than her developmental status from achieving success?

20

Double Trouble: Orthotic and Rehabilitative Management of the Conjoined Twin Population —Problem Solving in Challenging Populations

Lauren Levey, MSPO, CPO, and Michelle Lacroce, PT, DPT

Short Bio of all Presenting Authors

Lauren is a Certified Prosthetist/Orthotist passionate about pediatric O&P care. After finishing training at Children's Healthcare of Atlanta and University of Michigan, she joined the OrthoPediatrics Specialty Bracing team at the Children's Hospital of Philadelphia clinic. Lauren specializes in complex lower limb difference and deformity management, high-level bracing for patients with spina bifida, and inpatient care. Lauren is passionate about multidisciplinary care settings to improve patient outcomes, and enjoys supporting practitioner development and training as a resident mentor. She is the prosthetics program director for OrthoPediatrics Specialty Bracing, helping to develop, promote, and improve care standards for children with limb loss and limb difference throughout the OPSB network.

Abstract

The Problem:

Rehabilitative treatment for conjoined twins poses unique challenges for the neonatal care teams. Ensuringappropriate motor development during hospitalization, such as head control, independent sitting, crawling, andother gross and fine motor milestones, can be exceptionally challenging in this population due to the underlyinganatomy. These children may be medically complex, and require lengthy hospitalization in their early lives toensure medical stability for separation surgeries, if appropriate. These lengthy hospitalizations can further cause motor delays which impact their mobility after separation surgery, which may be exacerbated by the underlying anatomy and limited ability for traditional motor development.

The Solution:

This session will discuss some of the unique rehabilitative challenges both before and after separation surgery in the conjoined twin population, examining 3 recent case examples.

We will discuss eforts from the OT and PT teams for motor rehabilitation, as well as collaborations with theorthotics and engineering teams to create customized seating devices to work on head control and seatingbalance. We will also examine unique orthotic solutions required for these patients after separation surgery, including chest protectors for omphalopagus twins who’s chest wall is malformed following separation, and a custom hip orthosis for ischiopagus twins requiring hip and lower leg stability after separation.

Though this is an extremely small population, these discussions will focus on the underlying problem-solving, biomechanics, and developmental concepts that anchored clinical decision making for these extraordinarily unique populations. We hope to inspire creative problem solving for other rare pediatric patient populations bysharing these experiences.

21

Neurodiversity and Limb Difference

J. Michael King, MD, Roberta Ciocco, MSOTR/L, Meagan Gulmi, PT, DPT, PCS, and Domenica Platenecky, PT, DPT, PCS

Short Bio of all Presenting Authors

Dr. King completed a combined residency program in Pediatrics and Physical Medicine and Rehabilitation at Thomas Jefferson University Hospital and A.I. Dupont Hospital for Children in 2017. He has been an Attending Physician at CHOP since that time and currently serves as the Medical Director for inpatient rehabilitation. He has wide clinical interests, and has helped to establish multi-disciplinary clinics, including Limb Difference clinic for children with congenital and acquired limb differences as well as BRIDGE clinic following patients longer term after discharge from inpatient rehab.

Roberta have been working at CHOP since 2015 and spent my first 19 years at Shriners Hospital of Phila. As a staff therapist and department manager. I have also worked in school settings and private OT clinics. Areas of interest and expertise include Prosthetics and Orthotics, Seating and Adaptive equipment, Hand therapy, Rehab and Splinting.

Domenica received her Doctorate of Physical Therapy from University of the Sciences in Philadelphia in 2010. She currently practices primarily in the acute care setting, with an area of expertise in pediatric critical care, at the Children's Hospital of Philadelphia (CHOP). Domenica also is the primary physical therapist in CHOP's Limb Differences clinic as well as in the Center for Thoracic Insufficiency Syndrome. Domenica serves as the primary acute care mentor in CHOP's pediatric physical therapy residency program.

Meagan received her Doctorate of Physical Therapy from The George Washington University in 2019. She currently practices in the inpatient rehab setting at the Children's Hospital of Philadelphia. She is the backup physical therapist in CHOP's Limb difference clinic as well as the BRIDGE clinic, an interdisciplinary rehab follow-up clinic. Her main clinical interests revolve around limb difference and prosthetic training in the inpatient rehabilitation setting.

Abstract

With increasing awareness of neurodiversity, we wanted to explore the implication of neurodiversity and neurodivergence on pediatric patients with limb difference. This would include some discussion on implications for patients with both congenital and acquired limb differences. Because neurodiversity exists on a spectrum, we would provide some general background and definition of neurodiversity as well as review typical cognitive development. We would explore the DSM criteria for the diagnosis of autism spectrum disorder as an example of a child with neurodivergence. We would also review some general recommendations for supporting people with neurodivergence. This would be followed by superimposing the recommended timeline of prosthetic fit for patients with congenital limb difference, with specific highlight to the implications on cognition as it relates to prosthetic fit and training. We would provide case examples to highlight the complexity of patients with both straightforward and more complex limb differences, including longitudinal deficiencies or having multiple limbs affected. For patients with acquired limb difference, we would like to discuss implications on pre- and post-operative care, as well as choice regarding prosthetic componentry and some of the modifications that may be necessary for prosthetic training to be successful, revisiting some of the strategies previously discussed. Again, we would highlight this with some case examples. Finally, we would conclude by providing some ways in which children with neurodivergence can also surprise you with how quickly they might accept and use a prosthesis successfully.

Goals:

1. Improve general understanding and recognition that children exist on a spectrum of neurodiversity.
2. Recognize some of the challenges that neurodiversity can present related to limb difference care, including prosthetic design, acceptance and therapy training.
3. Provide general education around supporting children with neurodivergence, specifically targeting children with both congenital and acquired limb differences.

Learning objectives:

1. Be able to describe what neurodiversity is.
2. Be able to explain how typical or atypical neurodevelopment might impact decision making around prosthetic use, including prosthetic design.
3. Be able to explain how typical or atypical neurodevelopment might impact decision making around therapy delivery.
4. Be able to come up with ideas for how improving your understanding of neurodiversity can lead to practice change in you interactions and decision making when working with patients and families who identify as neurodivergent.

22

Complementary Approaches to Assessing Children with Prosthesis or Orthoprosthesis: Performance-Based (CAMP) and Patient-Reported (LIMB-Q KIDS) Outcome Measures

Sharon Eylon, MD, Corey Gill, MD, and Harpreet Chhina, PhD

Short Bio of all Presenting Authors

Dr. Sharon Eylon MD, has been a physician at ALYN Hospital (Jerusalem) since 2006 and has served as Head of Pediatric Orthopedic Services since 2013. She is a principal investigator for ALYN PARC, where her research is dedicated to the development and evaluation of clinical assessment tools. She uses retrospective and prospective methodologies to investigate novel treatments for children diagnosed with a diverse range of pathologies including arthrogryposis.

Corey S. Gill, MD/MA, is a Pediatric Orthopaedic Surgeon at Scottish Rite for Children and an Associate Professor in the Department of Pediatric Orthopaedic Surgery at UT Southwestern Medical Center in Dallas, Texas. He completed medical school and orthopaedic residency at Washington University in St. Louis, followed by a Fellowship in Pediatric Orthopaedic Surgery at Scottish Rite for Children. Dr. Gill is a Fellow of the American Academy of Orthopaedic Surgeons (AAOS) and is an Active Member of the Pediatric Orthopaedic Society of North America (POSNA) and the Association of Children's Prosthetic-Orthotic Clinics (ACPOC). He serves on the ACPOC Board of Directors and the POSNA Pediatric Orthopaedic Global Outreach (POGO) Committee. Clinically, Dr. Gill treats patients with a variety of congenital and acquired pediatric orthopaedic conditions such as musculoskeletal trauma, hip dysplasia, and clubfoot. He has a particular interest in treatment of children with lower limb differences who have undergone amputation and/or utilize prosthetic devices.

Abstract

A child with leg length differences requires a prosthesis or orthoprosthesis (also known as an Extension-prosthesis) to participate in home, school, and community activities. Typically, evaluation of children and adolescents with leg length differences includes physical examination (e.g., range of motion and manual muscle testing) and observational assessment of functional capabilities such as transitioning from sitting to standing, maintaining standing balance, or hopping on one leg. Clinicians enhance their evaluation using functional assessment tools or mobility and balance performance-based measures. Patient-Reported Outcome Measures (PROMs) add complementary valuable insights into patient's own experiences of their health, symptoms, and quality of life, independent of interpretation by clinicians or others. The most commonly used assessments in the prosthetic-orthotic world are designed for adults, whereas most assessments designed for children and adolescents are not specific for those in need of a prosthesis or orthoprosthesis. Hence, a gap was identified and two complementary assessments for children with prosthesis or orthoprosthesis were developed to improve clinical outcomes and support patient-centered care.

The Children's Amputee Mobility Predictor (CAMP) is a new 26-item functional assessment developed specifically to assess the functional capacity of children with leg length differences requiring a prosthesis or orthoprosthesis. It aims to provide a more accurate prosthetic fitting and targeted rehabilitation by equipping clinicians with the data to accurately evaluate the functional challenges of children with leg length differences. This leads to the achievement of long-term mobility and participation in daily activities.

The LIMB-Q Kids is a new, validated patient-report outcome measure for children and adolescents with lower limb differences that assesses outcomes important to patients from their perspective. It comprises 9 independently functioning scales measuring physical, social, and psychological functions; symptoms related to the leg, hip, knee, ankle and foot; leg-related distress and how much the children like their leg appearance. It has been translated and culturally adapted to multiple languages. A new PROM to measure children's satisfaction with their prosthesis is under development at this time.

The aim of this symposium is to present these two assessments, with the overall goal of showing how their findings combine to improve treatment programs and short- and long-term outcomes. Example cases will be taken from pediatric rehabilitation populations.

Learning objectives:

1. Become aware of the implications of the cliche that "children and adolescents are not just small adults".

2. Identify the unique aspects of that require specialized tools to assess children's and adolescent's performance and mindset.

3. Discuss cases illustrating the assessments' administration, scores and influence on short- and long-term clinical goals and implementation.

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Adjustable, Immediate-Fit Prostheses to Accommodate Growth in the Pediatric Population

Timothy Dillingham, MD, MS

Short Bio of all Presenting Authors

Timothy R. Dillingham, MD, MS is currently the William J. Erdman II, Professor and Chair for the Department of Physical Medicine and Rehabilitation (PM&R) at the University of Pennsylvania in Philadelphia, PA.

He attended the University of Washington in Seattle, Washington where he earned his Medical Degree in 1986 and where he completed an internship and residency in Rehabilitation Medicine in 1990. He is board certified in PM&R and Electrodiagnostic Medicine. Following his training, Dr. Dillingham served for four years in the United States Army at Walter Reed Army Medical Center, in Washington, D.C. during the Persian Gulf War. In 1994, Dr. Dillingham joined the Department of PM&R at the Johns Hopkins University. In 2003, he assumed the Chairmanship of the Department of PM&R at the Medical College of Wisconsin in Milwaukee, Wisconsin. His research interests have encompassed, prosthetic engineering, and rehabilitation health services use, effectiveness, and outcomes. He has received continuous federal funding from both the VA, CDC, and NIH for his investigative work over the past 24 years.

Dr. Dillingham is the founder and CEO of iFIT Prosthetics, the first company to commercialize a line of adjustable and immediate fit prosthetics. He pioneered the concept of subischial transfemoral adjustable sockets and supracondylar transtibial sockets.

Abstract

Children are a unique group of prosthetic users whose high activity and fast growth often require frequent socket adjustments or replacements. Conventional prosthesis fabrication results in a hard socket that quickly becomes uncomfortable when the person’s limb changes in shape and size—a common issue for children. Reports indicate that up to 74% of children experience resulting skin breakdown, leading 16% to temporarily discontinue use of their prosthesis. Conventional prostheses also require numerous appointments for fabrication and modification, resulting in children missing an average of 5 days of school per year and up to 56% of dual parents taking extended leave of absence from work.

This session will focus on adjustable prosthetics and their benefits for growing adolescents. The current literature on children’s prosthetics will be reviewed, and we will address why an adjustable socket could be beneficial for this population.

Several case studies will be presented, showcasing patients with issues that couldn't be rectified by conventional prostheses but were effectively managed with adjustable sockets. New adjustable prosthetic devices that are currently on the market will be introduced along with a discussion of the pros and cons of each device. There will be several physical device components available for the audience view and see how they work. New billing codes will also be discussed.

Lastly, the relevance of these devices for serving the population of children internationally will be discussed.

Goals and Learning Objectives:

· Explore the most recent research on adjustable sockets

· Learn about current adjustable devices on the market

· Identify patients who are right for this type of technology

· Learn about real-life examples of how adjustable devices can help address issues in the pediatric population.

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Motion Analysis: Beyond Gait for Pediatric Orthotic and Prosthetic Decision-Making and Outreach Medicine in Puerto Rico

Robert Courter, PhD, **Spencer Warshauer, MS, Ross Chafetz, PT, DPT, PhD, MPH, Sean Waldron, MD, and Jacqueline Weiss, PT, DPT**

Short Bio of all Presenting Authors

Robbie Courter, PhD is the East Region System Engineer within the Shriners Children's network of Motion Analysis Centers. He has explored human movement from multiple perspectives – including academic, sport science, and clinical – for the past 10 years, and has over 15 peer-reviewed abstracts and publications. Beyond movement biomechanics, his pursuits include motor control, behavioral neuroscience, statistical modeling, and data visualization.

Spencer Warshauer, MS, is the Motion Analysis Center Engineer at Shriners Children's Philadelphia. He has been with Shriners since 2016 and has worked on both clinical and research projects. At Shriners Children's, he has worked to improve the lives of children with a variety of orthopedic conditions such as cerebral palsy, scoliosis, and sports injuries. His professional interests include gait analysis, return to sports testing, spine motion analysis, and markerless motion capture.

Ross Chafetz, PT, DPT, PhD, MPH, is the Corporate Director of Shriners Children's fourteen Motion Analysis Centers. He has been at Shriners Children's for 26 years and has practiced as a physical therapist for 30 years. At Shriners Children's, he has worked in the Department of Rehabilitation, the Department of Clinical Research, and the Motion Analysis Center. He has over 60 peer-reviewed publications and has been an investigator on more than 10 grants. His professional interests include outcomes research, spinal cord injury, cerebral palsy, brachial plexus, and sports.

Sean Waldron, MD is the Medical Director of the Shriners Children's Philadelphia Motion Analysis Center and the Director of Sports Medicine at Shriners Children's Philadelphia. He has been at Shriners Children's for 3 years and has practiced pediatric orthopedics for 14 years. At Shriners Children's, he primarily treats children with neuromuscular disorders and sports medicine injuries. He has over 15 peer-reviewed publications. His professional interests include cerebral palsy, pediatric sports medicine, and gait analysis.

Jackie Weiss, PT, DPT is the Motion Analysis Center System Physical Therapist at Shriners Children's Philadelphia. She has been with Shriners since 2019, working as a physical therapist in both the MAC and Rehab departments. Since transitioning to the role of System PT for the MAC in 2024, she has worked on a multidisciplinary team to optimize and standardize the MAC evaluation across the Shriners system. She also works clinically to guide improvements of gait and safe sports performance in children with a variety of orthopedic and neuromuscular conditions. Her professional interests include pediatric gait analysis, return to sport testing, and cerebral palsy.

Abstract

Motion Analysis has long been used as an essential tool for gait analysis, especially in pediatrics. As leaders is this area, Shriners Children's (SC) has been providing clinicians with objective data toguide patient care including but not limited to surgical interventions, orthotics and prosthetics modifications, andphysical therapy decisions. In the case of lower extremity orthotics and prosthetics, this technology gives the clinicians a deeper understanding of how thespecific devices influence walking mechanics and overall function on a case-by-case basis.

However, motion analysis can also be used to inform decision-making beyond that of gait. The rich data encoded from motion capture can be utilized for sports medicine [1], upper extremity function [2], and – with modern machine-learning techniques – as a quick screening tool that empowers portable laboratories [3]. Through a series of four sessions, this symposium will explore how motion analysis is used in orthotic andprosthetic evaluations using a multidisciplinary approach including physicians, physical therapists, biomedical engineers, and researchers. We will emphasize how thesetechnologies directly inform patient management, improve outcomes, and are currently evolving.

Key Topics:

1. *An Overview of Gait Analysis and Orthotic Decision-Making:* In this first session, a brief background ongait analysis will be provided and how its data is interpreted, including: kinematics, kinetics, electromyography (EMG), and physical examination.

2. *Sample Case Reviews of Gait Including Bracing*: Gait analysis enables detailed comparisons ofkinematics and kinetics with and without braces, while wearing different brace configurations, or theirchanges over time. This session will include discussions from PTs and physicians as they perform mockcase reviews and use the data-at-hand to make informed decisions regarding orthotic/prostheticprescription or interventions.

3. *Motion Analysis for Sports Medicine, Spine, and Upper Extremity:* Return-to-sport decisions can beinformed with a battery of simulated sports movements [1], trunk/spine motion assessed after fusion and/or tethering for scoliosis [4], and upper extremity function evaluated with a functional test of reachable workspace [2]. In this session, sports medicine, spine, andupper extremity uses of motion analysis will be discussed, and how they may be adapted for prosthetic and/or orthotic users.

4. *Markerless Motion Capture:* With advancing computer vision and machine-learning techniques,markerless motion capture is developing quickly and offers more flexibility for analyzing motion. This session will discuss ongoing research at SC both validating anddeveloping markerless techniques, and its implications for the future.

Through discussion and interactive case examples, participants will have the opportunity to explore common clinical challenges and share perspectives on integrating motion analysis into routine care. This session will highlight the unique value of these quantitative data in enhancingclinical decision-making and patient outcomes through a lens involving prosthetic/orthotic function and usability.

Goals and Learning Objectives:

1. To demonstrate how motion analysis enhances clinical evaluations of gait, especially for thosepatients with lower extremity orthoses and/or prostheses.

2. To illustrate how objective, quantifiable gait data informs clinical decisions related to prescription, alignment, and functional outcomes.

3. To review case examples showing how motion analysis can detect compensatory strategies and guide interventions.

4. To outline use cases for motion analysis beyond that of gait, such as for return-to-sport decisions and upper extremity function.

5. To illuminate advances in markerless motion capture and its implications for increased portability and availability of these data.

6. To encourage audience participation in discussing practical applications of motion analysis in daily clinical practice.

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Longterm Function following Initial Nonoperative Treatment for Idiopathic Clubfoot Deformity

Kelly Jeans, MS, Victoria Blackwood, MS, Sara De Salvo, MD, Daniela Marletta, MD, and Anthony Riccio, MD

Short Bio of all Presenting Authors

Kelly Jeans earned her Bachelor of Science degree from the University of Southern California in Exercise Science and her Masters of Science degree from California State University, Long Beach, and then joined the Movement Science Lab at Scottish Rite for Children, Dallas. Over the last 25 years, she has collaborated with researchers interdepartmentally, including orthopedics, orthotics and prosthetics, therapy services and with outside organizations. Her career has focused on the study of movement patterns and cardiovascular fitness in clinical populations including clubfoot, lower extremity amputation, cerebral palsy, adolescent idiopathic scoliosis and early onset scoliosis. She is currently the Division Director of the Movement Science Lab in Dallas. She is a member of the Gait and Clinical Movement Analysis Society and the Association of Children's Prosthetic-Orthotic Clinics, where she serves on the board of directors.

Abstract

Introduction

Globally, nonoperative treatment has been shown to be effective in correcting deformity in infants presenting with idiopathic clubfoot. The French physiotherapy (PT) method[1] was initially adopted and later, the Ponseti casting technique (Ponseti).[2] Excellent clinical and functional outcomes have been reported in feet that remain nonoperative compared to those requiring surgical correction.[3,4] Feet treated with intra-articular surgery, have shown functional decline through growth.[5] The purpose of the current study was to evaluate clinical, function and patient reported outcomes, in adolescents with idiopathic clubfoot initially treated nonoperatively, at skeletal maturity.

Methods

This IRB approved study was conducted following the scheduled research gait lab visit at skeletal maturity. Data collected included: surgical history, initial Dimeglio score, xray measures, isokinetic muscle strength (dorsi/plantar-flexors) and 3D motion capture data. Patient reported outcome surveys included the Adolescent Pediatric Outcomes Data Collection Instrument (PODCI), Foot and Ankle Mobility measure (FAAM) and Oxford Ankle Questionnaire (Oxford). A group of 40 typically developing age matched controls, free of orthopedic diagnoses, who underwent gait analysis and Biodex testing were used as a comparison group. Statistical analysis included evaluation of normalcy and a nonparametric Kruskal-Wallis with a Dunn test and Bonferroni correction for multiple group comparisons ($p<0.017$ and $p<0.013$).

Results

A group of 143 patients (72 bilateral; 106 male) with 215 treated clubfeet (87 Ponseti and 128 PT) were seen for gait analysis at 16.6 years of age (15.6 - 19.7 years). At the time of testing, 22 feet had undergone extra-articular surgery, 69 feet required intra-articular surgery, while 124 feet remained nonoperative (NO). There was no difference in age at testing, walking speed, body weight, height, or any patient reported outcome score (PODCI, FAAM, Oxford; $p>0.05$). Comparisons of gait variables for the NO, EA, IA and the control group can be found in Table 1.

Discussion

Results show the IA feet to have been more severe (Dimeglio score) initially compared to the NO group, with a Meary's angle indicating flatfoot at skeletal maturity. Overall, ankle dorsi/plantarflexion ROM were not different. The EA feet remain in slight plantarflexion at the end of swing phase compared to NO, indicating a slight foot drop following tendon release. The only difference found between EA and IA feet was in foot rotation, which was balanced by femoral rotation and did not affect the overall foot progression angle. The NO group had significantly better ankle power during gait and stronger dorsiflexors and plantar flexors than the IA group. When compared to controls, the IA group had worse ankle plantarflexion, ROM and power. Both surgical groups showed significantly reduced Biodex strength. The only deficit in NO compared to controls, was increased internal foot rotation, which was also found in the EA group. Despite these findings, patient reported outcome scores on the PODCI show that patients with clubfoot treated nonoperatively or surgically, all rated their overall Happiness (range 84.5-93.6) and global function (~90+) to be in the normal to excellent functional range despite deficiencies identified in their ankle motion or strength.

	Control n=40	NO n=124	EA n=22	IA n=69	CF Groups	Controls
Variable	**Mean (SD)**	**Mean (SD)**	**Mean (SD)**	**Mean (SD)**	**P**	**P**
Initial Dimeglio Severity Score		**12.2 (2.3)**	**13.6 (2.6)**	**14.6 (1.9)**	**<0.001 ***	
Ankle Kinematics- Maximum						
DF - GC (degrees)	13.5 (3.7)	12.3 (4.5)	13.3 (3.9)	13.7 (4.3)	0.055	0.106
PF - GC (degrees)	23.2 (10.1)	19.6 (7.6)	20.8 (7.2)	16.5 (6.4)	0.025	**0.001** [c]
ROM - GC (degrees)	36.6 (9.2)	31.9 (6.4)	34.1 (6.7)	30.2 (6.5)	0.087	**0.001** [c]
DF - Sw (degrees)	-1.1 (4.0)	0.3 (5.6)	-3.9 (7.4)	-0.51 (5.5)	**0.006 ^**	**0.003**
Rotation- Average in Stance						
Foot Rotation (degrees)	15.6 (9.0)	18.4 (9.4)	22.49 (10.7)	15.3 (7.7)	**0.002** [#]	**≤0.010** [a,b]
Foot Progression (degrees)	-0.1 (29.6)	-5.25 (7.4)	-2.36 (6.7)	-4.6 (8.2)	0.272	0.430
Ankle Kinetics- Maximum						
Moment (Nm/kg)	1.42 (0.18)	1.28 (0.20)	1.30 (0.25)	1.20 (0.24)	0.042	**<0.001** [c]
Power (Watts/kg)	4.38 (1.25)	3.58 (1.07)	3.52 (0.97)	3.12 (1.10)	**0.015 ***	**<0.001** [c]
Isokinetic Biodex Strength- Maximum				n=65		
DF (Nm/kg)	0.44 (0.24)	0.33 (0.09)	0.32 (0.09)	0.28 (0.13)	**0.002 ***	**≤0.011** [b,c]
PF (Nm/kg)	0.72 (0.22)	0.54 (0.25)	0.51 (0.18)	0.40 (0.21)	**<0.001 ***	**≤0.004** [b,c]
Adolescent PODCI		n=79	n=14	n=43		
Sport/Physical Function	*(85-100)* +	93.8 (8.7)	89.7 (10.2)	88.5 (12.4)	0.029	
Global Function Score	*(85-100)* +	94.7 (6.8)	91.8 (8.8)	91.9 (8.0)	0.133	
Happiness	*(85-100)* +	89.2 (14.0)	93.6 (9.3)	84.5 (16.8)	0.067	
Radiographs		n=93	n=19	n=49		
Meary's Angle (degrees)	*(0-4.0)*+	**5.0 (4.7)**	**5.4 (4.5)**	**8.0 (7.4)**	**0.011 ***	

Table 1. Comparison of CF treated with NO, EA, or IA (dorsiflexion- DF; plantarflexion PF; range of motion ROM; gait cycle GC; swing - Sw; + reference from literature). Statistically significant findings include: ^ NO v EA, [#] EA v IA and * NO v IA ($p<0.017$) and [a] Control v NO, [b] Control v EA, [c] Control v IA ($p<0.013$).

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Lower Limb Alignment Changes Following Proximal Fibular Epiphysiodesis or Resection- A Multicenter Study

Lindsey Poynter, BS, Grace Markowski, BS, MS, and **Janet Walker, MD**

Short Bio of all Presenting Authors

Dr. Walker is a pediatric orthopedic surgeon at Shriners Children's-Lexington and a professor at the University of Kentucky Department of Orthopaedic Surgery and Sports Medicine in Lexington KY. She received her medical and orthopaedic training at the University of South Florida. She was a pediatric orthopaedic fellow at the Hospital For Sick Children in Toronto Canada. She has clinical and research interests in children with lower extremity deformities, deficiencies and amputations.

Abstract

Introduction

Fibular head prominence may complicate comfortable prosthetic fitting for patients with below-knee prostheses, often aggravated by proximal fibular migration due to disparate growth between the tibia and fibula, as seen in tibial deficiency and tibiofibular synostoses. Management strategies include proximal fibular epiphysiodesis and fibular head resection. Our hypothesis is that, in growing children, these procedures may alter lower limb alignment.

Methods

Retrospective review of a consecutive series proximal fibular epiphysiodesis (n=19) or resection (n=8) at 7 tertiary pediatric orthopaedic centers was performed. All patients had previously undergone transtibial or ankle level amputations. Preoperative and follow up ≥2 years radiographs were measured regarding the medial proximal tibial angle (MPTA), anatomic distal femoral angle (aLDFA), and proximal fibular height relative to the proximal tibial physis. Patients having concomitant procedures that affect alignment and those with closed proximal tibial physes were excluded.

Results

The preop alignment and fibular heights are shown in Table 1 along with their final measures. Following epiphysiodesis or resection of the proximal fibula, 14 tibias went into ≥4^{o} more valgus than preoperatively. Five tibias went into ≥3^{o}varus, and 8 tibias changed ≤2^{o} in either direction. Five femurs went into ≥3^{o} more varus and 5 went into ≥3^{o} valgus. Seventeen femurs changed <3^{o}. As a result of proximal fibular epiphysiodesis, the fibular height increased >3mm in 3 patients, 1 of which was revised for failed physeal closure. Eleven fibular heights decreased by >3mm. Five fibulas changed <3mm. Of the 19 epiphyseodeses, 9 tibias and 10 femurs changed alignment categories (valgus, normal or varus). Eight fibular head resections changed alignment categories in 7 tibias and 3 femurs. Magnitude and rate of change were variable and could not be correlated with age at surgery. Mean age at follow-up was 14.1yrs with 13 patients still having open proximal tibial physes.

Conclusions

Because of the wide range of normal, 10/27 proximal fibular heights were normal preoperatively. For most patients, proximal fibular epiphysiodesis resulted in a more distal fibular location. Most tibias were in varus preoperatively and became more valgus, some excessively. Most femurs were in varus preoperatively and remained there. Although proximal fibular epiphysiodesis or resection may reduce the fibular prominence, growing children require close observation for subsequent changes in frontal plane tibial and femoral alignment, especially progressive valgus.

Table 1.

Changes in Lower Limb Alignment with Proximal Fibular Epiphyseodesis or Resection						
Tibia (MPTA)			**Valgus**	**Normal**	**Varus**	
Preoperative:		**Follow up:**	**>90°**	**85°-90°**	**<85°**	
	Valgus (n=6)		4	2		
	Normal (n=9)		3	3	3	
	Varus (n=12)		5	3	4	
		Total	12	8	7	
Femur (aLDFA)			**Valgus**	**Normal**	**Varus**	
Preoperative:		**Follow up:**	**<79°**	**79°-83°**	**>83°**	
	Valgus (n=4)		2	1	1	
	Normal (n=9)		1	3	5	
	Varus (n=14)			5	9	
		Total	3	9	15	
Fibular Height			**Too proximal**	**Normal**	**Too distal**	**Resected**
Preoperative:		**Follow up:**	**>3mm**	**-9 to 3mm**	**<9mm**	
	Too proximal (n=16)		6	7	2	1
	Normal (n=10)		2*	1	1	6
	Too distal (n=1)					1
		Total	8	8	3	8
	***1 was revised for failure of physeal closure**					

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Think Outside the Shoe

Jessica Cox

Short Bio of all Presenting Authors

Jessica Cox is a motivational speaker featured on TV shows like Ellen, CNN, National Geographic, Fox and Friends, and BBC News. Her speaking career spans 18 years, 28 countries, and audiences up to 40,000 people. Companies like AT&T, NASA, the Smithsonian, State Farm, and Cisco have asked her for inspirational workshops, keynotes, and more.

Jessica was born without arms and uses her feet the way most people use their hands. Jessica grew up asking with frustration and anger, “Why me? Why do I have to be different?” She learned to see the blessings in her life and accept herself as a whole person. Now, Jessica flies airplanes, drives cars, is married, and otherwise lives a normal life. Jessica is the author of Disarm Your Limits, an autobiographical self-help book that has sold more than 10,000 copies. She also writes a monthly article for Flying Magazine.

In 2020, Jessica announced plans to build The Impossible Airplane, a custom 200 mph, 4 seat airplane she will use to circumnavigate the world. When she’s not flying off into the sunset, Jessica continues to train in Taekwondo, where she’s a Fourth Degree Black Belt.

Abstract

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Clinical Outcome Measurement in Pediatric Lower Limb Prosthetics: A Modified Delphi Consensus Study

Anna Cook, MPO, CO, LO, Sara Morgan, PhD, CPO, Dylan Mann, MD, Lauren Levey, MSPO, CPO, LPO, Annabelle Vaage, PT, DPT, Meghan Munger, PhD, MPH, Jennifer Laine, MD, Michelle Hall, MS, CPO, LPO, FAAOP(D)

Short Bio of all Presenting Authors

Anna Cook is a certified orthotist and board eligible prosthetist working at Gillette Children's Specialty Healthcare in St. Paul, MN. She recently completed a combined prosthetics and orthotics residency at Gillette. She previously earned a Bachelor of Science in biomedical engineering from the University of Rochester and a Master of Prosthetics and Orthotics from the University of Washington. She is passionate about combining her interests in biomechanics, research, and improving the lives of others to advance the field of prosthetics and orthotics.

Abstract

Introduction: Insufficient information exists on the use of outcome measures for children with lower limb loss or difference (LLLD) who use a prosthesis. This study aimed to determine which areas of assessment clinicians perceive as important whenproviding holistic care to these children and provide recommendations on which outcome measures to use, when to administer them, and how measurement strategies change throughout a child's development.

Methods: A modified Delphi study, using REDCap for data collection, was conducted with a multidisciplinary group of clinical experts, including prosthetists, researchers, physical therapists, orthopedists, physiatrists, and advanced practice providers. Experts completed four survey rounds: one open-ended and three iterative postulate rounds. Consensuswas defined as at least 75% agreement among experts for each postulate.

Results: Twenty-nine of the thirty-five enrolled experts (83% response rate) completed at least three of the four survey rounds. Atotal of 54 postulates met consensus. Postulates were organized into measurement strategies for four pediatric age groups (toddlers/preschoolers, early elementary school children, late elementary schoolchildren, and adolescents) to facilitate clinical implementation. Some constructs were consistent across age groups while others varied. Mobility, pain, and comfort were important across all groups, although specific measure tools changed with age. Developmental milestone assessment was determinednecessary only when developmental delay was suspected of children in early elementary school with a shift to functional assessmentsthereafter. Other constructs became increasingly important with age included prosthesis satisfaction, independence, and quality of life beginning in early elementary school and peer attitudes/psychosocial factors and body image beginning in late elementary school. A concise and comprehensive summary table, organized by age group, with specific outcome measure recommendations across ten areas of assessment is included for clinical reference.

Clinical Relevance: To our knowledge, this study is the first to provide multidisciplinary expert consensus on measurementstrategies to guide clinical practice for treating children with LLLD who use a prosthesis. The findings highlight the importance of customizing assessments based on age and specific patient circumstances.

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Short-Term Outcomes of the Boston Night Shift in the Treatment of Adolescent Idiopathic Scoliosis: A Retrospective Study

Courtney Klapka, CPO, Mallory Silvers, MPO, Sophia Valls, CO, and James Wynne, CPO, FAAOP

Short Bio of all Presenting Authors

Courtney's journey into the field of orthotics and prosthetics began as an undergraduate research assistant at Vanderbilt University, where I was part of a team focused on pediatric prosthetic devices. Throughout her time in the lab, she had the privilege of meeting incredible individuals—patients, clinicians, educators, and friends—who inspired me to pursue a career in patient care. Their impact continues to motivate me every day. She then attended Northwestern for my Master of Prosthetics and Orthotics and now a Board-Certified Prosthetist/Orthotist at OP Specialty Bracing in our Annapolis, Maryland office. While now primarily focused on clinical care, it has been a privilege to return into research and share our findings in the field.

Mallory's tenure as a rehabilitation technician at an outpatient neurological rehabilitation clinic that she discovered the field of orthotics and prosthetics. After completing my education, she is now completing my residency with OPSB and am a board eligible Orthotist and a Prosthetic Resident. She is passionate about the opportunity to assist patients in improving their mobility, enhancing their comfort, and ultimately reclaiming their independence.

Sophia first discovered the field of orthotics as a 10-year-old scoliosis patient. After completing her education, she moved from Texas to Boston to focus on pediatric care by completing my orthotic residency with OPSB. She is now a certified orthotist and a prosthetic resident. She is passionate about helping children reach their mobility goals and dedicated to providing high-quality, compassionate care to every child who visits our clinics.

Abstract

Introduction: Idiopathic scoliosis is characterized by a lateral curvature of the spine with a Cobb angle greater than 10 degrees, along with vertebral rotation. Bracing with thoracolumbosacral orthoses (TLSOs) has been shown to prevent curve progression. Nighttime-only brace wear is an alternative bracing approach that eliminates the need for TLSO use during waking hours. The aim of this study is to retrospectively assess the outcomes of the Boston Night Shift orthosis in the non-operative management of adolescent idiopathic scoliosis (AIS) based on the Scoliosis Research Society (SRS) and the International Society on Scoliosis Orthopedic and Rehabilitation Treatment (SOSORT) criteria.

Methods: An electronic medical records search was conducted to identify first-time brace wearers who were fit with a Boston Night Shift scoliosis TLSO at a Boston Orthotics and Prosthetics clinic between January 1, 2019 – February 1, 2023. The initial out-of-brace (OOB), in-brace (IB), and last follow-up X-rays (taken at least 12 months after initial fitting) were independently reviewed by three blinded clinicians, and data were compared. The following variables were assessed: initial Cobb angle (°), IB Cobb angle (°), follow-up Cobb angle (°), first sensor reading (hours/day) (FSR), IB correction (%), curve location (thoracic, thoracolumbar, or lumbar), compensation (compensated, decompensated left, or decompensated right), single or double curve pattern, sex (male or female), and Risser sign (0, 1, or 2).

Results: 31 patients were included in this study. Six (19.4%) patients' major curves improved by six degrees or more, 20 (64.5%) patients' major curves remained unchanged, plus or minus five degrees, and five (16.1%) patients' major curves progressed by six degrees or more. When separated by curve type, thoracolumbar curves displayed the greatest stability, with 83.3% of thoracolumbar curves classified as unchanged and 16.7% improved. 70% of thoracic and lumbar curves improved or stayed the same.

Conclusion: The Boston Night Shift scoliosis orthosis is an effective part-time wear brace for non-surgical scoliosis treatment. Short-term results show efficacy in preventing progression, and, in some cases, improving scoliotic curves. In this study sample, the Boston Night Shift appeared to have more favorable outcomes in adolescent idiopathic scoliosis patients with major thoracolumbar curves, compensated curves, Risser signs 0-1, or who are female, warranting further investigation in powered, larger studies.

Key words: adolescent idiopathic scoliosis, outcomes, Boston night shift

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Development and Implementation of a Bibliotherapy Intervention to Improve Attitudes Towards Device Use for Orthoses and Prosthesis Users Aged 3-12

Caitlin Bowman Martwinski, MSPO

Short Bio of all Presenting Authors

Caitlin Bowman Martwinski, MSPO is a Resident Pediatric Orthotist/Prosthetist at Children's Healthcare of Atlanta (2024-Present). Her journey as a Pediatric Orthotist/Prosthetist is driven by a passion for research and a commitment to making a positive impact for both our littlest patients and the profession. She is an alumna of Virginia Tech and the University of Pittsburgh. Prior to residency, Caitlin worked in the field of O&P as a fitter/assistant and as a technician.

Abstract

Introduction: Lower-limb prostheses and orthoses have been proven to improve gait, function, and quality of life, and discourage or prevent deformities in children, yet noncompliance rates are as high as 81% in the pediatric population.1 Analysis of literature on O&P device noncompliance shows peer attitudes, perceived social support, and the child's own view of the brace to be barriers to compliance.2 Bibliotherapy, or the use of books as a tool for patient education, has been shown to be effective at improving self- and peer-perceptions of disability and treatment compliance in other pediatric healthcare settings, but has not been studied in O&P.3,4 Furthermore, few children's books on lower extremity orthotics are available.

Objectives: This research aims to quantify psychological perceptions of pediatric O&P device users' social support and attitudes toward device use. This research also aims to quantify how bibliotherapy can positively influence attitudes about the child's O&P device.

Study Design: Subjects were blocked into a study group based on appointment type (initial evaluation, delivery/fitting, follow-up, or control) and device type (orthosis versus prosthesis).

Methods: Ethics approval for this study was obtained from the Children's Healthcare of Atlanta Institutional Review Board (IRB00009860). Forty children age 3–12 years who utilize a lower-limb orthosis (n=20) or prosthesis (n=20) and were fluent in English volunteered for the study. Following informed consent, subjects were given a demographic survey, the Multidimensional Scale of Perceived Social Support (MSPSS) and the Device-specific attitude Likert scale (DSAS) to fill out prior to their O&P appointment.5 The prosthetic group was given the book *I Have a Doll Just Like You,* and the orthotics group was given the book *Anthony's Amazing AFOs!6* to read during their appointment. The control group was not given any book materials to read. All groups received traditional patient education from their treating orthotist/prosthetist. At the conclusion of their appointment, all subjects completed an exit survey consisting of the MSPSS and DSAS. Changes in scores were analyzed using a paired-t test. Open-ended questions were analyzed for themes.

Results: 37 full data sets were analyzed for statistical significance (21 males / 16 females). Mean age was 7.5 years, with a range of 3.08±12 years. Participants by device type included supra-malleolar orthoses (two), ankle-foot orthoses (14), knee-ankle-foot orthoses (two), Symes/transtibial prostheses (nine), knee-disarticulation/transfemoral prostheses (seven), and rotationplasty prostheses (three). No significant difference was found in pre- versus post-MSPSS scores for the bibliotherapy group (p=0.18) nor the control group (p=0.12). Pre- to post-DSAS scores improved significantly for the bibliotherapy group (p= 0.038). Further analysis of bibliotherapy timing showed a significant increase in DSAS scores for subjects who received bibliotherapy at follow-up appointments (p=0.024). Open-ended device-satisfaction question themes included concerns about physical fit or cosmesis of device (18.9%), feeling stared at (8.1%), and wearing the device to school (5.2%). Overall, 64.2% of subjects reported they "strongly agree" that they felt more empowered to wear their devices in public after receiving bibliotherapy. Analysis of open-ended question feedback about bibliotherapy included representation of a character that used a device just like the subject (32.1%), characters in the book being supportive (25%), the moral of the story (18.5%), and the main character advocating for themselves (10.7%) were helpful to subjects.

Discussion: Our results support the hypothesis that after receiving bibliotherapy, attitudes toward the device would improve while perceived social support would remain the same. This is consistent with the development of theory of mind.

Conclusions: Bibliotherapy is a simple and accessible education tool that healthcare professionals can use to encourage confidence and improve psychological outcomes for pediatric patients in O&P. Bibliotherapy appears to be most effective at follow-up, but further data on the timing, dosing, and training effects of bibliotherapy is needed. Subjective

differences in book preference across participants support that increasing the variety of resources available for patients increases engagement across different patient demographics.

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Infant Gait Training with Prostheses: Collaborative Strategies in Design and Early Rehabilitation

Edward Krische, MS, CPO, LPO, Carissa Stoddard, PT, DPT, PhD, PCS, and Ashley Vesotsky, PT, DPT

Short Bio of all Presenting Authors

Edward Krische, MS, CPO, is an ABC-certified prosthetist/orthotist at Scottish Rite for Children in Dallas, specializing in pediatric prosthetic care. He earned his Bachelor of Science in Biomedical Engineering from Binghamton University–SUNY and a Master of Science in Orthotics and Prosthetics from Baylor College of Medicine. Through Baylor's nationally recognized rotating residency program, Edward gained broad clinical experience across the United States. Edward began his career at Scott Sabolich Prosthetics and Research, where he served as Clinical Manager of the Dallas facility. In 2023, he joined the prosthetics team at Scottish Rite, drawn by a deep commitment to pediatric care. His clinical interests focus on complex limb loss—including hip disarticulations, hemipelvectomies, and rotationplasties—as well as the integration of additive manufacturing technologies (3D scanning and printing) in pediatric prosthetic design. He currently serves on the Board of the Association of Children's Prosthetic-Orthotic Clinics (ACPOC) and has presented nationally and internationally, including at ISPO. His research efforts focus on improving outcomes for children with high-level limb differences, early gait training protocols, and the role of interdisciplinary collaboration in pediatric rehabilitation. Edward is dedicated to advancing the field of pediatric prosthetics through innovation, education, and collaborative, patient-centered care.

Dr. Carissa Stoddard is a board-certified specialist in pediatric physical therapy with extensive experience treating children of all ages across diverse clinical settings, including home health, outpatient clinics, and hospitals. She earned both her Doctor of Physical Therapy (DPT) and Doctor of Philosophy (PhD) in Physical Therapy from Texas Woman's University in Dallas, Texas.

Dr. Stoddard's clinical focus is in pediatric orthopedics, with recent roles at renowned institutions such as Scottish Rite for Children and Shriners Children's. In addition to her clinical practice, she has served as an assistant faculty member in a physical therapy program, teaching pediatric physical therapy and mentoring students.

She is actively involved in research and scholarship, contributing to the advancement of pediatric physical therapy through three peer-reviewed publications and more than ten presentations at regional, national, and international conferences.

Ashley Vesotsky, PT, DPT is a physical therapist at Scottish Rite for children in Dallas and the primary PT for the hospital's intensive program. She earned her Bachelor of Science in Kinesiology at the University of Kentucky and her Doctorate of Physical Therapy at the University of Miami.

Abstract

Early prosthetic fitting and gait training in infants and young toddlers with limb loss is critical for promoting motor development, independence, and family confidence. At Scottish Rite for Children, our multidisciplinary team of prosthetists and physical therapists has developed a structured approach to prosthetic design and gait training for infants with a variety of amputation levels, including Syme's, below-knee, knee disarticulation, above-knee amputations, and hip disarticulations.

This symposium will provide a case-based overview of our collaborative protocols, highlighting the unique challenges and strategies for each level of limb difference. The prosthetist perspective will focus on socket design, suspension methods, and component selection appropriate for rapid growth and early mobility. The therapy perspective will emphasize age appropriate gait patterns, motor milestone progression, family education, and structured gait training techniques.

Clinical photos and videos will illustrate real-world patient outcomes across multiple stages of care, from initial prosthetic delivery through early ambulation. Case examples will demonstrate how individualized prosthetic modifications and therapy interventions support optimal development, even in the presence of comorbidities or complex family circumstances.

The session will encourage interactive discussion, with practical take-home strategies for clinicians to implement in their own practice settings. By integrating prosthetic design considerations with therapy-based motor development and gait training protocols, this symposium aims to expand the evidence base for infant and young toddler prosthetic care and improve functional outcomes in the youngest patient populations.

Goals and Learning Objectives:

Upon completion of this discussion, attendees will be able to:

1. Identify key prosthetic design considerations for infants and young toddlers at varying amputation levels (Syme's, BK, knee disarticulation, AK).
2. Describe age-appropriate gait mechanics and developmental milestones for infants and young toddlers with prostheses.
3. Recognize the importance of family education and psychosocial support in early prosthetic rehabilitation.
4. Apply collaborative care models that integrate prosthetic and therapy perspectives to optimize outcomes for infants and young toddlers.

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Prosthetic Design and Gait Training for Bilateral Knee Disarticulation of Polyneuropathy

Edward Krische, MS, CPO, LPO, Carissa Stoddard, PT, DPT, PhD, PCS, and Ashley Vesotsky, PT, DPT

Short Bio of all Presenting Authors

Edward Krische, MS, CPO, is an ABC-certified prosthetist/orthotist at Scottish Rite for Children in Dallas, specializing in pediatric prosthetic care. He earned his Bachelor of Science in Biomedical Engineering from Binghamton University–SUNY and a Master of Science in Orthotics and Prosthetics from Baylor College of Medicine. Through Baylor's nationally recognized rotating residency program, Edward gained broad clinical experience across the United States. Edward began his career at Scott Sabolich Prosthetics and Research, where he served as Clinical Manager of the Dallas facility. In 2023, he joined the prosthetics team at Scottish Rite, drawn by a deep commitment to pediatric care. His clinical interests focus on complex limb loss—including hip disarticulations, hemipelvectomies, and rotationplasties—as well as the integration of additive manufacturing technologies (3D scanning and printing) in pediatric prosthetic design. He currently serves on the Board of the Association of Children's Prosthetic-Orthotic Clinics (ACPOC) and has presented nationally and internationally, including at ISPO. His research efforts focus on improving outcomes for children with high-level limb differences, early gait training protocols, and the role of interdisciplinary collaboration in pediatric rehabilitation. Edward is dedicated to advancing the field of pediatric prosthetics through innovation, education, and collaborative, patient-centered care.

Dr. Carissa Stoddard is a board-certified specialist in pediatric physical therapy with extensive experience treating children of all ages across diverse clinical settings, including home health, outpatient clinics, and hospitals. She earned both her Doctor of Physical Therapy (DPT) and Doctor of Philosophy (PhD) in Physical Therapy from Texas Woman's University in Dallas, Texas.

Dr. Stoddard's clinical focus is in pediatric orthopedics, with recent roles at renowned institutions such as Scottish Rite for Children and Shriners Children's. In addition to her clinical practice, she has served as an assistant faculty member in a physical therapy program, teaching pediatric physical therapy and mentoring students.

She is actively involved in research and scholarship, contributing to the advancement of pediatric physical therapy through three peer-reviewed publications and more than ten presentations at regional, national, and international conferences.

Ashley Vesotsky, PT, DPT is a physical therapist at Scottish Rite for children in Dallas and the primary PT for the hospital's intensive program. She earned her Bachelor of Science in Kinesiology at the University of Kentucky and her Doctorate of Physical Therapy at the University of Miami.

Abstract

Children with neuromuscular disorders and progressive lower extremity deformities often present with unique clinical and psychosocial challenges where amputation and prosthetic rehabilitation are required to optimize function. This symposium will focus on the importance of a multidisciplinary team approach during pre and post operative phases with emphasis on the collaboration between prosthetist, physical therapist, and surgeon. Specific examples of collaborative implementation will be presented in the case of a 15-year-old male with congenital axonal polyneuropathy who underwent bilateral knee disarticulation amputations following severe femoral deformity, contractures, and functional decline.

The session will integrate perspectives from the prosthetist, physical therapist, and medical team to demonstrate a comprehensive care model. Focus areas will include:

- Prosthetic design and alignment for bilateral knee disarticulation sockets in atypical anatomy.
- Implementation of an intensive three-week inpatient gait training program.
- Strategies to address complex psychosocial dynamics that influence rehabilitation and functional progress post discharge.

Clinical photos and videos will be used to illustrate the patient's progress at multiple stages: pre-amputation, post-amputation gait training, three-month follow-up, and anticipated long-term updates. The symposium will also facilitate discussion on how collaborative team models can optimize outcomes and guide future prosthetic modifications as pediatric patients grow. Audience participation will be encouraged to explore alternative approaches and future prosthetic considerations.

Goals and Learning Objectives:

Upon completion of this discussion, attendees will be able to:

1. Identify prosthetic design and alignment considerations in bilateral knee disarticulation for pediatric patients.
2. Describe the role and outcomes of intensive physical therapy protocols in early rehabilitation.
3. Recognize the impact of psychosocial and family dynamics on pediatric prosthetic adaptation.
4. Apply collaborative care strategies that integrate medical, prosthetic, and therapy perspectives in complex cases.

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Contractures Treatment and Prevention During External Fixation – Now What?

Caryn Meth-Gottfried, CPO, LPO, Ellen Dean, MD, and Aura Shoval, MD, PMR

Short Bio of all Presenting Authors

Caryn is a certified practitioner for over 25 years with a strong concentration in pediatric care. She enjoys working as a team member in the hospital and clinic settings. She is excited to have joined the team at Boston O&P where she can do what she loves the most and that is to work with children. She is the mother of two young adults who make her proud every day. She lives in North Jersey with her husband and rescue dog, Snoopy.

Ellen is a Board-certified in orthopedic surgery and fellowship-trained in pediatric orthopedic surgery, Dr. Ellen Dean is highly skilled in diagnosing and treating musculoskeletal injuries and conditions affecting children and young adults. Her special interests include sports medicine, pediatric and young adult trauma, disorders of the hip, clubfoot, and cerebral palsy.

Dr. Dean is the Chief of Pediatric Orthopedic Surgery at Morristown Medical Center, the top ranked orthopedic hospital in New Jersey. Patients with complex cases throughout the Northeast seek treatment with Dr. Dean because of her outstanding reputation. She has been invited to speak about musculoskeletal conditions on the national level and is instrumental in the education of orthopedic residents and fellows.

She serves as the Orthopedic Surgery Residency Program Director at Morristown Medical Center where she leads the education of orthopedic surgery residents completing their training at Morristown Medical Center.

As a mother of five, she understands how injuries and conditions affect the entire family, and she believes in treating every child as if they were one of her own. Dr. Dean takes a compassionate and personalized approach with each family to ensure that the treatment plan best serves their child's individual needs.

Hannah Shoval, MD, is a specialist in pediatric physical medicine and rehabilitation at Atlantic Health System's Goryeb Children's Hospital. Fellowship-trained in pediatric rehabilitation and triple board-certified in physical medicine and rehabilitation, pediatric rehabilitation medicine, and brain injury medicine by the American Board of Physical Medicine and Rehabilitation, she specializes in the care and management of children with conditions that impact their neurologic, muscular and/or skeletal systems.

With more than 10 years of experience caring for young patients, Dr. Shoval's expertise lies in delivering high-quality and personalized care to improve the function and quality of life for children. Working closely with families, she treats children with cerebral palsy, brain or spinal cord injury, muscular dystrophy, and genetic conditions, helping them to stand, walk, use their arms and hands, develop language skills, as well as improve chewing and swallowing. She is dedicated to advancing her field and participates in ongoing clinical research to discover novel treatments, such as innovative robotic technologies, biofeedback techniques, therapies and injection techniques to help children. She has published in journals, written textbook chapters, and has lectured nationally and internationally.Dr. Shoval serves as a clinical assistant professor at Rutgers New Jersey Medical School in the Department of Physical Medicine and Rehabilitation.

She is a member of numerous professional organizations including the American Academy of Physical Medicine and Rehabilitation, and the American Academy for Cerebral Palsy and Developmental Medicine.After earning her degree from Tufts University School of Medicine in Boston, MA, Dr. Shoval completed her residency and fellowship in pediatric rehabilitation at New York-Presbyterian Hospital. She has a special interest in incorporating adaptive sports, dance and the performing arts in medical practice and is certified in performing arts medicine by the American College of Sports Medicine and the Performing Arts Medicine Association. She is a participating provider of the Atlantic Accountable Care Organization.

Abstract

Background: External fixation is a widely used method to treat lower limb deformities, including bone defects, nonunion, congenital limb deficiencies, and limb length discrepancies1. Distraction osteogenesis and external fixation has been used for limb lengthening for many years, as it is minimally invasive and allows for correction in multiple planes2. External fixators are also commonly used to treat open fractures, once again because of their minimal invasiveness and ability to quickly stabilize fractures, treating both bone and soft tissue damages. However, external fixation has known complications, including infection, injury to neurovascular structures, stress fractures at pin sites, and loss of joint range

of motion or stability. Transfixion of soft tissue and musculature for an extended period can lead to muscle stiffness and contracture, and the reduction of joint range of motion (ROM)3.

Search Strategy:

Databases Searched: PubMed, CINAHL

Search terms: 'external fixation', 'contracture', 'lengthening' or 'fracture'

Inclusion/Exclusion criteria: full text, English, published in the last 5 years, and excluding the terms 'hand','finger', 'humerus' and 'elbow'

This search yielded 24 results on PubMed and four on CINAHL, of which two were included for analysis in this paper: one prospective randomized study and one prospective case series study (level IV). Four other studies werereviewed to help establish the incidence of joint contracture and the general functional outcomes for patients treated with ex-fix devices. Their summaries are also included in the evidence table.

Synthesis of Results:

Studies show that patients who are treated with an external fixator, for either limb lengthening or fracture, are often prescribed physical therapy to stretch the Achilles and/or night-splints to provide passive stretch while sleeping. Studies show that both physical therapy and the application of night-splints are successful tools at preventing equinus contracture in these patients. In a study where twelve patients total developed equinus contractures after lengthening, eight were successfully treated with physical therapy, while four patients had such severe equinus contractures they required percutaneous Achilles tendon lengthening. The four patients who had to be treated surgically for contracture

had lengthening of over 25% of pre-operative tibial length and did not use the night-stretching splints provided to them. Additionally, six patients in the study developed knee flexion contractures1. While the authors state that all patients "attained complete recovery" of joint motion by the final follow up, they do not provide details as to ROM at ankle and knee, neither pre- nor post-operatively, which brings into question the reliability of these statements1.

The prospective randomized study, included 56 patients who were treated for tibial fractures with external fixation and were randomized into two treatment groups: posterior plaster cast that held the ankle plantigrade, and physical therapy plus night splinting. The physical therapy group was given a strip of car tire inner tubing (elasticband) and instructed to perform dorsiflexion exercises twice per day, as well as wear the elastic band hookedunderneath the forefoot and wrapped around the ex-fix device at night to hold the ankle. This study concluded that stretching and physical therapy were more effective at maintaining ROM and preventing equinus contracture than the posterior casting, likely due to the progressive nature. While there was no statistically significant difference inimprovement of ROM six weeks post-op, there was statistical significance in the smaller reduction of ROM in thestretching group, and less patients developed a plantarflexion contracture overall (one patient in the stretching groupcompared to seven patients in the casted group). Of note, the casting treatment may also have been less effective due to lack of appropriate stiffness of the posterior casts, as the author states that some of the casts broke or got wet and softened3.

Clinical Message:

Overall, this literature review sought to understand the incidence and current treatment for joint contractures in patients using an external fixation device. The incidence of ankle joint contracture among patients with open tibial fractures being managed with an ex-fix device is high at 15-16%3. There is evidence in the literature of different treatments that seek to prevent or reduce the magnitude of contracture in patients using an external fixator, and in general stretching and physical therapy appear to remain paramount to improved functional outcomes. Stretching using a night splint or cast is a useful method to provide a passive stretch while resting that has been shown in theliterature to be useful in preventing joint contracture. However, the one randomized prospective study demonstratedthat a progressive form of stretching using an elastic band and physical therapy exercises is more beneficial than astatic splint at preventing equinus. The ability to gradually increase the stretch on the Achilles rather than constantly maintaining the ankle in a plantigrade, neutral position is more beneficial to maintaining ROM and preventing lossof joint mobility. Additionally, the concern for lack of appropriate stiffness in the study involving posterior castingbrings to light the need for an intervention that can provide gradual progressive stretch to the Achilles and maintains stiffness, integrity, and tension to prevent the patient from plantarflexing through the device.

Lastly, there is no evidence in these studies that any specific interventions are being utilized to prevent knee flexion contractures in tibial lengthening or knee extension contractures in femoral lengthening. There is need forsuch an intervention to be studied to help further improve functional outcomes for these patients. More research with larger sample sizes and the development of specific orthotic interventions to help prevent such contractures will alsoprovide greater insight for surgeons treating patients with tibial hemimelia. If the incidence of complications such as joint

contracture can be reduced, then limb salvage and elongation may become a more viable treatment method than amputation for patients with this condition, improving overall quality of life.

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Restoring Upper Extremity Function after Cervical Spinal Cord Injury

Richard Goldberg, DO, Scott Kozin, MD, and Justine LaPierre, MS, OTR/L, CHT

Short Bio of all Presenting Authors

Richard Goldberg, D.O., is a doctor of physical medicine and rehabilitation (PM&R) at Shriners Children's Philadelphia. He has more than 30 years of experience caring for patients with many conditions. He attended medical school at the Philadelphia College of Osteopathic Medicine and held his residency at the Robert Wood Johnson Rehabilitation Institute in Edison, New Jersey. He has served in a few different leadership roles with the American Osteopathic College of Physical Medicine and Rehabilitation, most notably being past president after serving two times.

Scott Kozin, M.D., graduated from Duke University in 1982 with a degree in computer science. He completed medical school at Hahnemann University in Philadelphia, followed by orthopedic residency at Albert Einstein Medical Center. In 1992, he completed a fellowship at the Mayo Clinic focusing on hand and microvascular surgery.

Dr. Kozin cared for both adults and children until 2000, when he devoted his practice and research to children at Shriners Children's Philadelphia. Since that time, Dr. Kozin has been an advocate for improving the lives of children via research, education and patient care. He has published over 100 peer-reviewed papers, mainly on the care of children with various diagnoses including brachial plexus injury, spinal cord injury and congenital differences.

Justine LaPierre, MS, OTR/L, CHT is an occupational therapist and certified hand therapist with 15 years of experience in a complex setting serving children birth through 21 years of age from all over the world, diagnosed with spinal cord injury and orthopedic conditions. Her areas of specialty include acute rehabilitation and upper extremity surgical rehabilitation, particularly related to spinal cord injury, brachial plexus injuries, and arthrogryposis.

Abstract

Restoring upper extremity function after cervical spinal cord injury is crucial to enhancing quality of life and improving independence but remains a critical challenge in neurorehabilitation due to complex neural and musculoskeletal impairments involved. This symposium will detail the essential multidisciplinary collaboration between physiatrists, surgeons, and occupational therapists necessary for optimizing functional outcomes in this patient population.

Tendon transfer surgical interventions are well documented methods for restoring movement in the upper extremity following spinal cord injury. Nerve transfer procedures have increased the potential for improving functional outcomes, but require time sensitive intervention, comprehensive evaluation for optimal patient selection and procedure planning, and structured postoperative rehabilitation to prevent joint stiffness and engage cortical retraining strategies.

In this symposium, our team will present:

- Pre-operative clinical assessment and electrodiagnostic evaluations – A review of patient selection and determination of the availability and strength of donor tendons and nerves.

- Surgical techniques – A review of available surgical procedures for improving function in the upper extremity including tendon and nerve transfers

- Occupational Therapy / Rehabilitation – A review of pre-operative clinical evaluations, post-operative rehabilitation protocols, and neuromuscular re-education intervention strategies

Participants will gain insight into the complexity of restoring upper extremity function in the cervical spinal cord injury patient and how the collaboration of an expert multidisciplinary team is essential for optimizing functional outcomes.

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Innovative 3D-Printed Solutions for Independence: Occupational Therapy and Prosthetics Collaboration for Pediatric Patients

Edward Krische, MS, CPO, LPO, Amy Sitabkhan, OTR, OTD, and **Grace Evasco, OTR, MOT**

Short Bio of all Presenting Authors

Edward Krische, MS, CPO, is an ABC-certified prosthetist/orthotist at Scottish Rite for Children in Dallas, specializing in pediatric prosthetic care. He earned his Bachelor of Science in Biomedical Engineering from Binghamton University–SUNY and a Master of Science in Orthotics and Prosthetics from Baylor College of Medicine. Through Baylor's nationally recognized rotating residency program, Edward gained broad clinical experience across the United States. Edward began his career at Scott Sabolich Prosthetics and Research, where he served as Clinical Manager of the Dallas facility. In 2023, he joined the prosthetics team at Scottish Rite, drawn by a deep commitment to pediatric care. His clinical interests focus on complex limb loss—including hip disarticulations, hemipelvectomies, and rotationplasties—as well as the integration of additive manufacturing technologies (3D scanning and printing) in pediatric prosthetic design. He currently serves on the Board of the Association of Children's Prosthetic-Orthotic Clinics (ACPOC) and has presented nationally and internationally, including at ISPO. His research efforts focus on improving outcomes for children with high-level limb differences, early gait training protocols, and the role of interdisciplinary collaboration in pediatric rehabilitation. Edward is dedicated to advancing the field of pediatric prosthetics through innovation, education, and collaborative, patient-centered care.

Amy Sitabkhan, OTR, OTD works primarily in the outpatient therapy department and clinic setting with the Hands Surgical Service at Scottish Rite for Children in Dallas, TX. She received her Bachelor of Science in Kinesiology and Health at The University of Texas at Austin, in addition to a Master of Science and Clinical Doctorate in Occupational Therapy at the University of Texas Medical Branch. Amy is also the Director for the Hand in Hand Support Group at Scottish Rite for Children. Amy is a member of the American Occupational Therapy Association and has presented nationally and internationally. She has a passion for creating unique solutions to increase everyday independence, in addition to addressing psychosocial and biomechanical care for patients with congenital hand and upper limb differences.

Grace Evasco, OTR, MOT, is an occupational therapist at Scottish Rite for Children in Dallas. She earned her Bachelor of Science in Health Education from Texas A&M University and her Master of Occupational Therapy from Nova Southeastern University. At Scottish Rite, Grace primarily serves as an outpatient therapist, providing care for children with conditions such as arthrogryposis, spina bifida, cerebral palsy, and congenital or traumatic upper limb differences. She also supports the spina bifida and hereditary spastic paraparesis clinics as one of the primary occupational therapists.

In addition to her clinical work, Grace is deeply committed to Scottish Rite's Camp Joint Adventure, a week-long inclusive and adaptive summer camp for children with multiple limb differences, arthrogryposis, and arthritis. She has also presented at both state and national conferences, including the Florida Occupational Therapy Association, the American Occupational Therapy Association, and the American Academy for Cerebral Palsy and Developmental Medicine. Grace is especially passionate about creating and developing innovative, cost-effective solutions that promote participation, independence, and improved quality of life for children and their families.

Abstract

Children with upper limb differences frequently face significant barriers to independence in activities of daily living (ADLs) due to potential joint contractures, limitations in range of motion, and muscle weakness. Recent evidence highlights the effectiveness of intensive, occupation-based interventions incorporating assistive technology (AT) and environmental modifications to improve functional performance and caregiver confidence. At Scottish Rite for Children, occupational therapists and prosthetists/engineering have partnered to design and fabricate **custom 3D-printed devices**that address self-care, feeding, grooming, and hygiene challenges in this unique population.

This symposium will provide a practical, case-based overview of how 3D printing technology can be leveraged to expand the options available to occupational therapists in clinical practice. We will describe our **collaborative workflow**, beginning with patient evaluation and task analysis, followed by digital design (CAD modeling), material selection, rapid prototyping, and iterative testing. Examples will include 3D-printed adaptations for dressing (modified dressing sticks and AFO donning device), grooming (hairbrush modifications), feeding (magnetic feeding devices), and recreational use (bicycle modifications and HALO traction setup devices).

Clinical videos and images will demonstrate functional improvements before and after device implementation, supported by outcome measures. The session will also address **caregiver education**, patient-specific customization for growth, and

cost considerations—critical factors for sustainable AT interventions.

By combining occupational therapy's expertise in task analysis with prosthetic design and 3D printing, this collaborative model promotes independence, reduces caregiver burden, and increases access to customized solutions at a fraction of the cost of commercially available devices.

Goals and Learning Objectives:

1. Identify opportunities to apply 3D printing technology to create low-cost, customized assistive devices for pediatric patients with complex needs.
2. Describe an interdisciplinary workflow for device design, fabrication, and clinical implementation.
3. Analyze functional outcomes of case examples using standardized measures (COPM, FIM/WeeFIM).
4. Discuss caregiver training strategies and cost-effectiveness considerations for implementing 3D-printed solutions in clinical practice.
5. Explore future directions for research and education to expand the use of 3D printing in occupational therapy interventions.

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Applying Partial Hand Prosthetic Technology to the Pediatric Congenital and Acquired Population

Roberta Ciocco, MS, OTR/L, and Joseph Kersch, CP

Short Bio of all Presenting Authors

Joe Kersch, CP is a Certified Prosthetist, Upper Limb Prosthetic Specialist – Eastern PA & DE. Joe is an ABC-certified prosthetist for Hanger Clinic in Pennsylvania and Delaware. With more that 15 years of experience in the field, Joe specializes in upper limb prostheses. He supports patients of all ages, leveraging the latest technologies like 3D scanning and modeling to develop prosthetic sockets. Additionally, Joe plays a vital role in training local prosthetic residents.

Passionate about developing innovative solutions that create an immediate impact, Joe is dedicated to making his patients' lives easier and helping them achieve their goals. When working with pediatric patients and their families, he treasures the opportunity to witness children accomplish their "firsts," admiring the creativity they bring to adapting and thriving with their technology.

Roberta Ciocco MS,OTR/L education has been working at Children's Hospital of Phila. since 2015. I also spent my first 19 years as an OT at Shriners Hospital of Phila. as a staff therapist, senior staff and then department manager where I was heavily involved in the prosthetic program. I have also worked in school settings and private OT clinics. I have been serving as the OT in Limb Difference Clinic since its inception, and have the pleasure of training prosthetic users and mentoring other OT staff in prosthetic treatment via my role as an outpatient Occupational Therapist. Areas of interest and expertise include Prosthetics and Orthotics, Seating and Adaptive equipment, Hand therapy, Rehab and Splinting.

Abstract

Prosthetic solutions for partial hand amputees in the adult world have been evolving with improvements in technology and design to enhance function through passive, functional, and body-powered devices. As with other technologies, there is often a delay in translating these developments to the pediatric population. This lag is typically due to challenges in miniaturizing components, reimbursement limitations, and the unique presentations and needs of pediatric patients.

This presentation will serve to share our experiences using creative applications of partial hand technology now available due to component downsizing for pediatric partial hand patients. To date, we have fitted nine pediatric patients with prostheses addressing varying levels of partial hand deficiency.

Presentation Goals:

- Identify currently available components and sizing

- Highlight key differences among component types

- Identify functional goals for the application of this technology

- Discuss patient selection criteria and lessons learned

- Share cases of acceptance and rejection

- Inspire manufacturers and designers to continue working on improving options for the pediatric patient

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From Muscle to Cortex: Neural and Muscular Signatures of Missing Hand Movements in Congenital Limb Deficiency

Suniyya Waraich, PhD, Pierre Gianferrara, PhD, Jonathon Schofield and Wilsaan Joiner, PhD

Short Bio of all Presenting Authors

Suniyya Waraich is a computational neuroscientist who completed her PhD in Neuroscience at the Weill Cornell Graduate School of Medical Sciences and is currently a postdoctoral researcher at the University of California, Davis in the laboratory of Dr. Jonathon Schofield. Her research combines behavioral experiments, neuroimaging, and tools such as surface electromyography to investigate how information is represented in the brain and peripheral nervous system.

Pierre G. Gianferrara (he/him/his) is a Postdoctoral Fellow in the department of Neurobiology, Physiology and Behavior at the University of California, Davis (2023-present). He holds a Ph.D. in Cognitive Neuroscience from Carnegie Mellon University. During his Ph.D., he investigated the computational and neural mechanisms underlying sensorimotor learning in complex task environments such as video games. His current research focuses on sensorimotor learning and the neural basis of motor control with an emphasis on translational neuroscience.

Abstract

Congenital limb deficiencies occur in 4 to 6 children per 10,000 live births, with upper limb and unilateral deficiencies jointly representing an estimate of approximately 1 per 10,000 births[1]. Our prior work has shown that children with unilateral congenital below-elbow deficiency (UCBED, one hand absent) retain the capacity to attempt movements of the missing hand, with coordinated muscle activity patterns that predict the intended grasp[2,3]. Specifically, spatiotemporal changes in tissue deformation identified with ultrasound imaging were found to successfully delineate ≥ 6 unique hand movement patterns in UCBED participants with > 80% classification accuracy in the missing hand at least 83% of the time[3]. This has important implications for the control of modern prosthetic systems, but the mechanism for why they retain these innate abilities, and how the missing hand is represented cortically, remains unknown. While prior neuroimaging work has focused primarily on the brain[4], here we extend this approach by explicitly linking forearm muscle activity to cortical representations. Here, we aim to provide a holistic representation of motor control capabilities in UCBED children across the levels of the brain and muscles. We recruited a cohort of 8-20 year-old children with UCBED. Participants executed five different grasps that are representative of everyday activities (pinch, power, point, wrist extension, and wrist flexion) with either their missing hand or their typical hand, first outside the MRI scanner with ultrasound imaging, and second inside the MRI scanner. Based on a custom-made algorithm developed in previous work[3], we turned tissue deformation patterns into pixelated images that resemble a “QR code.”

A machine learning algorithm assessed the similarity of any given grasp’s QR code to movements’ corresponding prototypical muscular representations from a library. This was done to predict the executed pattern of muscle deformation’s target hand grasp. We then extracted hand grasps’ patterns of neural activity in the affected and unaffected limb’s contralateral hemisphere in sensorimotor cortex using fMRI imaging. To get a holistic representation of motor control capabilities in UCBED children, we linked peripheral-muscular and neural-cortical representations using a technique called representational similarity analysis (RSA). This technique quantifies similarities in the structure of the two data sets (i.e., connects patterns of muscle activation to patterns of sensorimotor cortical activation), helping us more clearly understand how muscle activation is represented in the brain of this unique population.

This study is a milestone in terms of holistically capturing both the neural (cortical) and peripheral (muscular) representations of motor control in UCBED children. In the long-term, this knowledge can be critical for the development of next-generation prosthetic devices as well as training and therapeutic interventions to maximize prosthetic outcomes for children with upper limb deficiencies.

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Grasp Taxonomy of Children with Unilateral Congenital Below Elbow Deficiency

Kartik Kumar, BS, Vo Ly, BS**,** Wilsaan Joiner, PhD, Michelle James, MD, and Anita Bagley, PhD

Short Bio of all Presenting Authors

Kartik is a Master's Student at UC Davis working in the Sensorimotor Integration Lab under guidance from Dr. Wilsaan Joiner. He is interested in short term motor adaptation and analyzing how children with unilateral congenital upper limb differences learn to coordinate their day to day activities.

Abstract

Intro: During childhood, upper limb function is essential for developing motor control and learning to perform activities of daily living (ADL). Children with congenital upper limb differences often develop compensatory strategies for ADLs that are not fully captured in traditional clinic-based assessments. Current evaluations frequently rely on patient/parent reported outcomes or task-based assessments comprised of carefully selected activities, which, while valuable, are relatively constrained and may not completely reflect real-world limb use (or disuse) during participation in ADLs. This study aimed to assess real-world upper limb usage in children with unilateral congenital below-elbow deficiency (UCBED) by analyzing first-person recorded video of hand usage in participant's home environments and establishing a classification system with quantitative metrics. These metrics were then used to examine correlations with self-report “PROMIS” scores to provide insight into the relationship between self-reported instruments and real world limb usage.

Methods: Five children with UCBED (ages 5–14 years; 4 male, 2 female) participated in this study. Each child was trained in the clinic to operate a head-mounted GoPro camera and then sent home with the device. They were instructed to wear the camera and record daily activities that involve frequent upper limb usage. Examples includedwashing dishes, playing with Legos, engaging in arts and crafts, and more. They were recorded for a couple of days to weeks collectively, totalling more than 12 hours of data. We examined the data and tabulated movements performed by the affected limb. Affected limb movement was categorized into 9 different classifications: Pin to Body, Pin to Surface, Support Hold, Object Hold, Weight Bearing, Elbow Hold, Object Manipulation-Push, Object Manipulation-Pull, Object Manipulation-within Hand, and Other. For each classification we recorded the frequency and duration of the movement by the affected limb.

Results/Discussion:

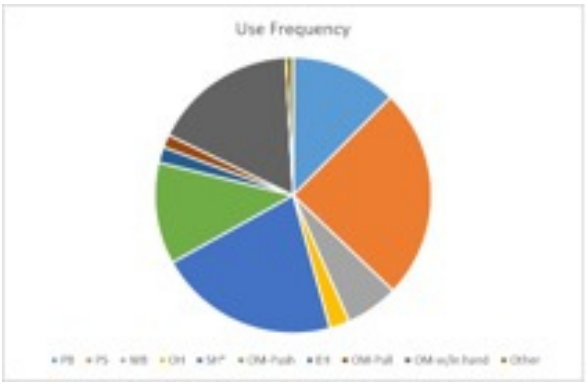

Figure 1: Pie Chart of Frequency of Classified Movements byAffected Limb for Single Participant

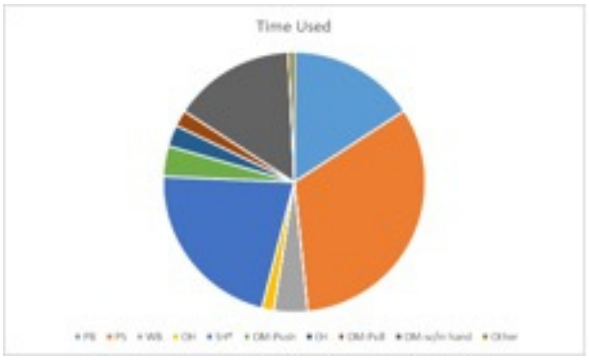

Figure 2: Pie Chart of Duration of Classified Movements byAffected Limb for Single Participant

For one participant, a majority of movements (~70% for frequency; ~85% for duration) were represented by 4classifications: Support Hold, Object Manipulation within Hand, Pin to Surface and Pin to Body. We observed various other movement types within the extensive data set, particularly dexterous bimanual tasks and their duration. We found a mix of affected and unaffected limb usage with the unaffected being used on average 1.5 times more (in time duration) than the affected side. Using our frequency and duration metrics we also examined correlations with PROMIS Upper Extremitysubdomains to quantify their predictive power for our real-world upper limb usage metrics.

Our findings hold importance for the assessment of upper limb function in children with UCBED. The correlation scores we derive between portions of the PROMIS tests and our data analysis provides insight into the degree to which real-world limb use may be reflected in self-reported function scores. Further, the broad amount of activities and affected limb usage highlights how effectively children adapt to their limb differences. This information can help inform the design of prostheses andother assistive devices to best benefit children with UCBED both in their participation in ADLs and in their choices about how to engage with those activities.

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Treatment of Hip Pathologies: Orthopedic and Orthotic Perspectives for the Complex Pediatric Hip from aMultidisciplinary Clinic

Wudbhav Sankar, MD, Lauren Levey, MSPO, CPO, and Grace Gibbs, Engineering Manager

Short Bio of all Presenting Authors

Wudbhav (Woody) N. Sankar is a nationally recognized leader in pediatric orthopedic surgery. He serves as Director of the Young Adult Hip Preservation Program and heads up the Hip Disorders Program at the Children's Hospital of Philadelphia (CHOP) — programs that care for infants, children and young adults with all types of hip conditions including hip dysplasia (DDH), femoroacetabular impingement, Legg-Calvé-Perthes disease, and Slipped Capital Femoral Epiphysis.

Since joining the faculty in 2009, Dr. Sankar has been committed to improving the care of patients with both hip and spinal disorders. As a leading national expert in hip dysplasia, he has pioneered the use of non-traditional braces for infants that fail standard Pavlik harness therapy, developed advanced techniques for evaluating blood flow during and after surgery for dislocated hips, and has optimized care for young children by offering ultrasound within his own clinic (which improves medical decision-making and streamlines appointments).

He is the Associate Director of the International Hip Dysplasia Institute (IHDI) and a member of several other multi-center research groups, including the International Perthes Study Group (IPSG) and the Academic Network of Conservational Hip Outcomes Research (ANCHOR). He also serves on the board of directors for the Legg-Calvé-Perthes Foundation. His active areas of research include public health improvements in hip dysplasia, novel ultrasound techniques for infantile DDH, the optimal management of slipped epiphysis, and hip instability in trisomy 21.

Dr. Sankar is a graduate of Cornell University’s college of engineering and the University of Pennsylvania School of Medicine. He completed his orthopedic surgical training at the University of Pennsylvania, followed by two pediatric orthopedic fellowships at Children’s Hospital Los Angeles and the Shriners Hospitals for Children in Los Angeles. He then pursued advanced training in the area of adolescent and young adult hip preservation at Boston Children’s Hospital.

Dr. Sankar has published more than 120 peer-reviewed scientific articles, reviews or textbook chapters, and has written and edited two books.

Lauren is a Certified Prosthetist/Orthotist passionate about pediatric O&P care. After completing training at Children's Healthcare of Atlanta and University of Michigan, she began working for OrthoPediatrics Specialty Bracing at the Children's Hospital of Philadelphia clinic. Lauren has a deep understanding for the benefits of collaborative/multidisciplinary care, and specializes in orthotic & prosthetic treatment for children with complex limb differences and orthopedic deformities, inpatient care, and treating children with Spina Bifida.

Learning Objectives: Attendees will be able to:

• Describe protocol development for treatment pathways for patients with DDH and Perthes Disease

• Describe utilization of orthotic tools to expand treatment pathways for improved patient outcomes withboth conservative and surgical management

• Identify collaborations with orthotists and researchers to improve available bracing options for more versatile treatment protocols

Abstract:

This symposium will explore the multidisciplinary care team involved in treatment of pediatric hip pathologies,including DDH and Perthes Disease. We will first introduce the pathologies, orthopedic management, andsurgical options for treatment protocols within these patient populations, with a particular focus on developmentof treatment protocols using bracing tools at hand. Nursing team will describe their involvement in terms of family support, care coordination, seating accommodations, and troubleshooting treatments.

Orthotists will review bracing treatment protocols, tools, and troubleshooting used in both operative and non-operative management of these patients. Finally, we will then explore the collaboration between orthopedist,orthotist, and researcher in new product development to improve existing market products and develop newdevices for improved wholistic care of patients with complex hip pathologies. The focus of the

session will be on collaborative care for patients with DDH and Perthes Disease in a multidisciplinary clinic setting.

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Preferences and Priorities for Decision Making in Congenital Femoral Deficiency (CFD): A Stated Preference Survey of Patients, Caregivers, and Clinicians

Sarah Nossov, MD, Ilene Holin, PhD, MPH, Schmalfuss Henrike, and Corinna Franklin, MD

Short Bio of all Presenting Authors

Dr. Sarah Nossov FAAOS is a pediatric orthopaedic surgeon specializing lower extremity issues. She is the Director of Limb Lengthening and Deformity Reconstruction at the Shriners Hospital for Children in Philadelphia. She has a particular interest in external fixation, limb lengthening, complex hip problems, foot problems, and lower limb deformity. She has a large rare-disease cohort- especially arthrogryposis and has a special interest in providing care to those with resource limit health access.

Abstract

INTRODUCTION

Congenital femoral deficiency (CFD) is a rare disease that is a spectrum of longitudinal deficiency and lower extremity deformity. There are many alternatives to treatment that range from amputation and accommodation to highly complex reconstruction and limb lengthening [1]. The decision between treatment pathways can be controversial and is subject to preferences. To understand preferences for treatment decision making in CFD and sources of decisional conflict, we asked: 1) What is the importance of various treatment features when making this decision? 2) What are the most/least difficult aspects of making a treatment decision?

METHODS

52 children (>=14 years old), 135 parents, and 55 clinicians were surveyed. Patients and caregivers were identified using an administrative database from a multicenter, pediatric orthopedic hospital system. Surveys included a discrete choice experiment to measure treatment features that influence decision making to calculate weight of importance [2]. A best worst scaling experiment measured the greatest sources of decisional conflict via preference shares [3].

RESULTS AND DISCUSSION

Children and parents ranked importance of treatment features similarly. The highest weighted treatment feature was mobility outcome, followed by similarly weighted features (Table 1). The least weighted treatment feature was number of follow-up appointments - weighted more heavily by parents than children (11.3% vs. 4.8%). Clinicians also placed the greatest weight on mobility outcome (47.2%) - more than double the weight of the next most important feature (chance of serious complications; 19.3%). For clinicians, less weight was assigned to avoiding amputation (10.2%) than for children (23.3%) and parents (21.7%).

The preference share for decisional conflict sources varied across groups (Table 2). For children, lack of information about conditions and treatments was the most difficult aspect of decision making, for parents it was permanency of the decision. The least difficult aspect for children was worry that their parent would disagree with their choice, for parents it was the timing of the decision. Clinicians believed that the most difficult aspect for their patients and families would be weighing the pros and cons of treatment options and the least difficult aspect of decision making would be the lack of information about conditions and treatments.

CONCLUSIONS

Preference-sensitive decisions (i.e., those in which an efficacy advantage is unclear) are difficult for decision makers as there is no obvious best choice. The results of this study improve our understanding of the priorities of decision makers, as well as these sources of decisional conflict. This is foundational to developing decision tools and aids that can help selection of treatment strategies that are concordant with decision maker's values, and in turn reduce decisional conflict and regret. Differences between preferences and clinician perceptions of preferences highlights the need for a patient-centered approach to shared decision-making.

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Creative Solution for Post Operative Immobilization after Cloacal Extrophy Surgery with an Adjustable Spica Brace

Anna Vergun, MD, Josh Kessler, CPO, and Sean Zeller, CPO

Short Bio of all Presenting Authors

Anna Vergun is the Division Chief of Pediatric Orthopedics at UNC and has a clinical focus is on hip dysplasia, clubfoot, limb deformity, and limb deficiencies. She has a subspecialty interest in child amputees (congenital and acquired).

Josh Kessler is a CPO at UNC Chapel with a clinical interest in pediatric prosthetics and orthotics, 3D printing, scoliosis, upper extremity prosthetics. He is a Certified Prosthetist Orthotist. He has a Bachelor of Science in Bioengineering from Rensselaer Polytechnic Institute and a Masters of Science from Georgia Institute of Technology

Abstract

Clinical problem:

The orthotics and orthopedic team comanaged a challenging patient with bladder exstrophy, imperforate anus, chromosomal microdeletions (15q13.3, 22q11.21-q11.22), and VSD (asymptomatic) with a custom TLSHO post op hip immobilizing orthosis. The clinical challenge was to completely limit active hip flexion or hip abduction for 6 weeks to avoid stress on her pelvic and abdominal repair. She also required access to multiple surgical sites at her abdomen, anus and spine, but with pressure over the trochanters to aid in closure of the pelvic ring and thigh cuffs that hold the thighs in adduction. The goal was to allow the child to be extubated but fully immobilized for 6 weeks. Prior attempts at immobilization with a pelvic traction sling and Petrie casting in adduction at our institution had not provided enough immobilization in the past. Prior studies suggest that immobilization is key to successful surgical outcomes.

The patient was scanned pre-op using an ipad with structure sensor. The patient was scanned in the prone position. The scan was sent to a central fabrication company to be carved out of foam and sent back to UNC. The carved foam was modified in house to adjust for the patient's unique anatomy. The modified foam model was placed on a vacuum forming press. Heated and vacuum formed 3/16" aliplast followed by 3/16" copolymer plastic. The plastic was allowed to cool for 24 hours and was cut proximally and distally to appropriate lengths. The device sat from mid sternum to just proximal to the knees with separated leg troughs. Neoprene straps were added at the thigh, hips, and sternum to hold the patient in the orthosis.

While fitting the patient the orthosis needed to be further modified to accommodate the location of the pelvic pins for the external fixator and for hip flexion contractures that became evident after the closure of the pelvic ring after the first staged procedure. The pin site area was cut out after being marked by the surgeon after the 1st stage of the surgery. The device was then cut and split at the hips. The plastic was heated, flexed, and then riveted with copper rivets to hold in place. The sacrum area was then cut out to help with checking for potential wounds and to assist in the situation of soiling. Aliplast padding was added to the inside of the orthosis to offload the plastic edges. Added 2 aluminum stays posteriorly and 1 between the leg troughs to increase rigidity. Attached the aluminum stays with copper rivets and then covered the aluminum stays with mole skin. The knees were left open for active and passive ankle and knee motion to minimize postoperative stiffness and deconditioning. The orthosis remained in place for 6 weeks without complications and offered a novel form of immobilization for this complex patient.

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Orthotic Management of Bladder Exstrophy

Ashton Wagner, CPO, and Ronni Robinson, CRNP

Short Bio of all Presenting Authors

Ashton Wagner, CPO, has been working within pediatric O&P specialties since her time as a COA. She began at OrthoPediatrics Specialty Bracing as a COA based in the Children's Hospital of Philadelphia and then as an MSPO student interning at Shriners Hospital for Children Honolulu, treating pediatric patients in the state and in the surrounding Pacific Basin islands. Returning to CHOP for her residency and as a CPO, she specializes in complex lower limb and spinal deformities, along with interdisciplinary orthotic problem solving for challenging cases.

Abstract

Bladder exstrophy is a rare and complex congenital disorder. While the bladder is developing in the womb, theabdominal wall fails to fully form, leaving the pubis bones separated and the bladder exposed through the skin inan opening in the lower abdominal wall.

Treatment for bladder exstrophy is surgical repair including both urological and orthopedic specialties. Bladderexstrophy closure typically occurs between two and four months old and often includes complete primarybladder exstrophy repair, epispadias repair, suprapubic tube placement, umbilicoplast, and bilateral pelvic osteotomies.

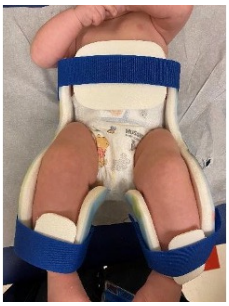
Historical immobilization of the patient following these procedures included application of a hip spica cast for 6weeks. With the high occurrence of skin breakdown following the surgery, casts were often removed for skinintegrity concerns. Orthotic management of the patient following their procedure was assessed, and an orthosis mimicking the immobilization of the hip spica cast was suggested.

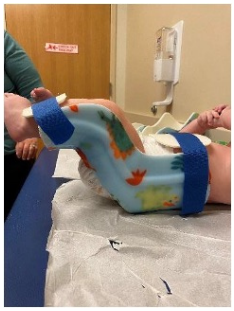
Ideal range of motion limitations for pelvic healing included 80 degrees of hip flexion, slight hip adduction, 90degrees of knee flexion, and 30 degrees internal rotation of the femurs to take pressure off the osteotomies. At theinitial creation of the brace, the patients were scanned using a structure scanner on a hip spica casting table.Measurements were obtained and the brace was fabricated as a bi-valve orthosis with an aliplast lined copolymer posterior aspect featuring a void at the perineum and buttocks for diapering. A thinner MDPE anteriorshell was also used to prevent sagittal plane movement of the hips or lower extremities, complete with a void atthe abdomen for additional diapering and incision care.

Fitting the initial designs of bracing was difficult. Patients would present with significant swelling post operativelyand would continue with skin breakdown. Being in the brace for 6 weeks full time, the pediatric patients wouldquickly grow out of their custom brace and require extensive adjustments to continue use. Range of motionlimitations were questioned, needing to balance the required healing efficiency while keeping bracing fabrication restrictions in mind.

As more braces were fabricated, CAD became more adept at optimizing the design without the need for scanning.Global increases were implemented along with layers of laminated foam to remove for potential growth. Theanterior shell was also replaced with padding and straps at the xyphoid and ankle, removing the concern forincreased skin irritations and growth restrictions while allowing the care team full access to the abdomen.Design changes included corrugations at the posterior legs to prevent the patients from abducting in the brace.

The bladder exstrophy hip spica brace continues to be improved with each new patient. Surgeons are pleasedwith the immobilization and likeliness to the cast, care teams are pleased with the ratification of skin concerns,and parents are thrilled with the lighter weight of the device and the customization of the transfer patterns. Thecustom hip spica brace has become the new standard of care with bladder exstrophy patients at CHOP and presents as a versatile tool to use with other orthotic treatments.





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Bracing Considerations and Clinical Protocols for Pediatric Patients with Arthrogryposis: Insights from an Arthrogryposis Prevalent Practice

Megan Marema, CPO, LPO, MPO and Matthew Westlake, CO, LO

Short Bio of all Presenting Authors

Megan Marema, CPO, is a prosthetist orthotist at Paley Orthopedic and Spine Institute, where she works alongside world-class orthopedic surgeons specializing in limb deformities, rare diseases, and complex orthopedic conditions. With over seven years of experience in orthotics and prosthetics, she provides care ranging from scoliosis bracing, cranial remolding orthoses, and lower limb orthotics to advanced prosthetic solutions. Megan holds a master's in prosthetics and orthotics from the University of Washington. Her current role at the Paley Institute allows her to serve patients from around the world. She is enthusiastic about patient education and finding new and unique ways to meet her patients' needs through innovation. Outside of the clinic, Megan enjoys staying active outdoors playing sports like sand volleyball, pickleball, and golf as well as trail running, snorkeling, and backpacking.

Abstract

Background/Introduction: Arthrogryposis multiplex congenita (AMC) presents with multiple congenital joint contractures, muscle weakness, and significant variability in severity and function. These children frequently demonstrate complex orthopedic needs, including deformities of the hips, knees, feet, and upper extremities often requiring early and ongoing orthotic intervention. In high-volume pediatric practices, the establishment of structured protocols for casting and bracing is essential to provide consistent care, streamline decision-making, and improve long-term outcomes.

Methods: This presentation draws on extensive clinical experience with a large AMC patient population. Protocols for evaluation, casting, and bracing are presented to illustrate effective pathways of care. Casting strategies are discussed in detail, including corrective positioning, serial casting approaches, and preparatory steps for orthotic fitting. Bracing considerations are categorized by device type, including ankle-foot orthoses (AFOs), knee-ankle-foot orthoses (KAFOs), hip-knee-ankle-foot orthoses (HKAFOs), and specialty devices such as nighttime Abduction Dorsiflexion Mechanisms (ADMs). Design features such as joint characteristics at the hip, knee, and ankle/foot complex are analyzed relative to patient-specific goals. Family-centered care, compliance, and the practical challenges of fitting and follow-up are also emphasized.

Results: Protocols highlight three central orthotic goals: alignment support, contracture management, and facilitation of mobility (standing, transfers, or ambulation). Clinical experience demonstrates that AFOs provide stability in milder presentations, while KAFOs are frequently required to address severe contractures and, at times, knee instability. HKAFOs are considered in cases with significant hip involvement, and nighttime ADMs address clubfoot and varus deformities. Key brace features including knee and hip joint selection, adjustability, lightweight materials, quick disconnects, condylar extensions, kneecap straps, heel wedging and lifts, flexible inner boots, and soft interfaces are essential to maximizing comfort, functional changes, lifestyle logistics, joint alignment, and skin integrity. Challenges such as growth spurts, skin integrity, tolerance, painful stretch, and family compliance remain central considerations. Adjustments in casting, strapping, and padding techniques have been shown to improve tolerance and functional ability.

Conclusion: Bracing for children with AMC requires careful integration of clinical findings, structured casting protocols, individualized orthotic prescriptions, and brace adjustability. In high-volume practice, consistent frameworks improve efficiency and patient outcomes while maintaining flexibility for patient-specific needs. Although challenges persist, thoughtful brace design and standardized clinical pathways enhance mobility, comfort, participation, and overall quality of life for this unique population. This presentation will share practical insights, clinical pearls, and protocol-driven strategies to support orthotists in both specialized AMC centers and broader pediatric practices.

Disclaimer: The bracing protocols presented are currently utilized exclusively at the Paley Orthotics and Prosthetics Clinic. They have been developed to support the management of a high volume of pediatric patients with arthrogryposis, particularly following surgical procedures addressing soft tissue tightness and rotational deformities of the hips, knees, and feet. These protocols are applied in both postoperative care and long-term management throughout growth. As our AMC patient population continues to expand, the protocols are continually refined, reflecting our commitment to innovation and ongoing improvement in order to meet the evolving needs and goals of our patients.

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A Novel Multidisciplinary and Staged Approach to Caring for Children with Lower-Limb Loss

Priya L. Jayakumar, MD, Eileen Shieh, MD, Paul T. Enlow, PhD, Jana L. Teagle, MS, CTRS, CCLS, CBIS, and **Jeanne M. Franzone, MD**

Short Bio of all Presenting Authors

Priya Jayakumar is a research assistant and recent graduate of Case Western Reserve University.

Dr. Jeanne Franzone is a pediatric orthopaedic surgeon and the Elizabeth W. Snyder Endowed Chair in Osteogenesis Imperfecta. She is part of the multidisciplinary prosthesis clinic at Nemours Children's Hospital.

Dr. Eileen Shieh is a pediatric PM&R physician. She is the Pediatrics/PM&R residency program director at Thomas Jefferson University Hospital/Nemours. She is part of the multidisciplinary prosthesis clinic at Nemours Children's Hospital.

Abstract

Case Diagnosis

Patient 1 is a 9-year-old male diagnosed with fibular hemimelia, a congenital limb difference, at a young age.

Patient 2 is a 16-year-old female who was diagnosed with a pilomyxoid astrocytoma between T8-L2 when she was young.

Case Description

Patient 1 presented at 3-years-old and was recommended a Boyd amputation of the right lower limb. Postoperatively, he was fitted with a prosthesis that has a window and door closure. By age 9, he developed right lower extremity genu valgus malalignment and underwent medial hemi-epiphysiodesis of the right distal femur and epiphysiodesis of the right proximal tibia to better accommodate future prosthesis components. Routine mental health screenings later revealed elevated mood concerns. Psychology provided psychoeducation and community referrals.

Patient 2 underwent resection of her tumor, which caused left lower extremity monoplegia, at 5-years-old. Following the surgery, due to the lack of sensation in her left leg, she sustained multiple fractures and infections over the years. At 13-years-old, the patient presented with a severe left knee effusion. Upon recovering from this, her left knee was auto-fused at about 10 degrees of flexion, limiting her ability to perform daily activities such as sitting. Shortly after, at age 14, the patient wrote a detailed letter to the multidisciplinary care team requesting an amputation. Following athorough evaluation with Psychology and a meeting with the entire care team, patient, and her parents, a transfemoral amputation was ultimately scheduled and performed when the patient was 14. Since then, the patient has completed extensive physical therapy and adjusted well to her prosthesis. She uses different componentry such as a running blade and microprocessor knee and is now able to perform many activities she previously struggled with.

Discussion

Children with lower limb differences have evolving physical and emotional needs due to growth and development. Regardless of patient age or type of amputation, a multidisciplinary approach is essential for comprehensive care. At our hospital, the team includes a prosthetist, orthopedic surgeon, physiatrist, physical and occupational therapists,psychologist, and child-life specialist.

While each provider naturally addresses different priorities, aligning team members around the specific goals of each rehabilitative stage—pre-amputation, immediate post-amputation, functional rehabilitation, and long-term maintenance—helps clarify roles and ensure coordinated care. Establishing an explicit framework for each stage supports more consistent communication, reduces gaps in counseling or intervention, and promotes truly comprehensive, patient-centered rehabilitation.

Conclusion

Clearly defining team roles across each stage of prosthetic rehabilitation enhances coordination and ensures that evolving patient and family needs are consistently met. These two cases demonstrate that a structured, stage-based model can serve as a guide for delivering more deliberate, comprehensive care in pediatric limb difference populations.

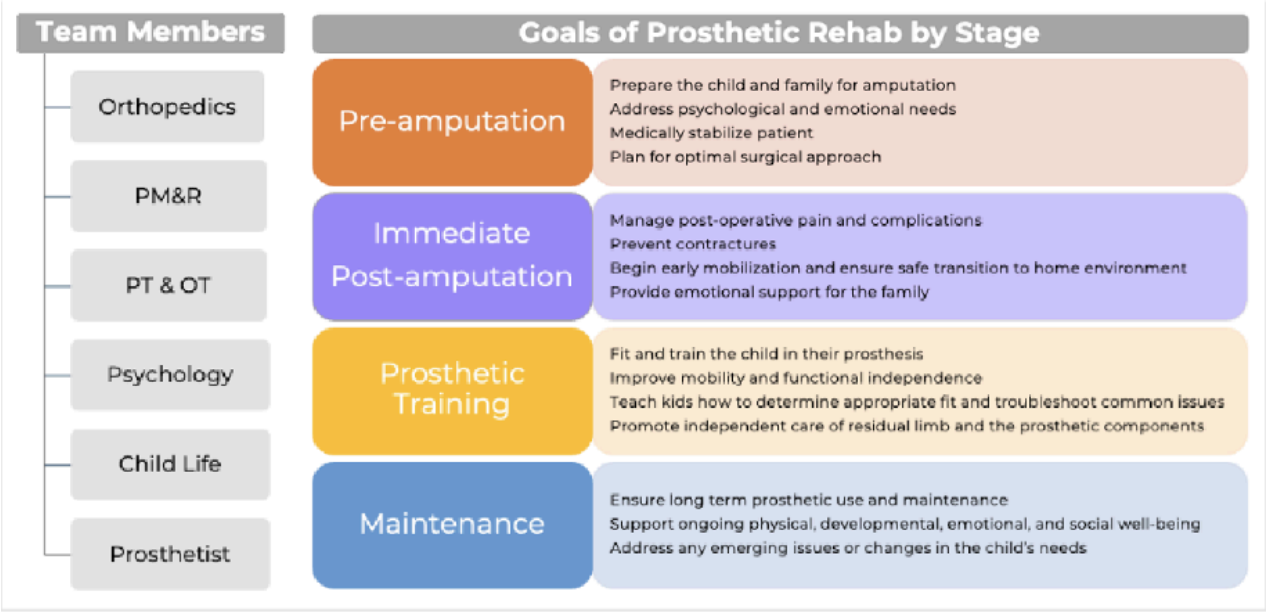

Figure 1. Chart detailing the multidisciplinary care team members and the goals they focus on during each stage of prosthetic rehabilitation.

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Comprehensive Care for Children with Spina Bifida: Rehabilitation Perspectives from a Walking-Focused Clinic

Andrew McCoy, MD, Lauren Levey, MSPO, CPO, Danielle D'Amico, BSN, RN, and Kristen Reilly, DPT

Short Bio of all Presenting Authors

Andrew McCoy, MD, specializes in Physical Medicine and Rehabilitation (PM&R) for the Spina Bifida Program at Children's Hospital of Philadelphia. Dr. McCoy brings expertise and a passion for improving the lives of children through comprehensive rehabilitative care.

He completed his medical education at Drexel University College of Medicine, followed by a residency in Physical Medicine and Rehabilitation at the University of Pittsburgh Medical Center. He further honed his skills through additional fellowship training in Pediatric Rehabilitation Medicine at Children's Hospital Colorado.

Dr. McCoy has a comprehensive understanding of the complexities associated with pediatric rehabilitation and is dedicated to advancing the field through innovative practices.

Lauren is a Certified Prosthetist/Orthotist passionate about pediatric O&P care. After finishing training at Children's Healthcare of Atlanta and University of Michigan, she joined the OrthoPediatrics Specialty Bracing team at the Children's Hospital of Philadelphia clinic. Lauren specializes in complex lower limb difference and deformity management, high-level bracing for patients with spina bifida, and inpatient care. Lauren is passionate about multidisciplinary care settings to improve patient outcomes, and enjoys supporting practitioner development and training as a resident mentor. She is the prosthetics program director for OrthoPediatrics Specialty Bracing, helping to develop, promote, and improve care standards for children with limb loss and limb difference throughout the OPSB network.

Danielle D'Amico, BSN, RN, is the operational nurse manager with the Spina Bifida Program at Children's Hospital of Philadelphia. She works within the institution to coordinate care for over 600 patients within the Spina Bifida program, including within the fetal diagnostic center, neurosurgery teams, orthopedic & rehab teams, and working on the transition to adult care program.

Abstract

Learning Objectives: Attendees will be able to:

• Describe the rehabilitative stages for children with Spina Bifida, including initiation of mobility with therapies, bracing, and equipment

• Identify patient candidates for an ambulation program, including those who are appropriate for higher-level bracing

• Discuss therapeutic rehabilitation strategies for mobility goals, including therapies and orthotic interventions

• Identify barriers and facilitators to comprehensive care at a collaborative multi-disciplinary clinic

Abstract:

This symposium will examine the collaborative, multi-disciplinary setting of the Spina Bifida clinic at theChildren's Hospital of Philadelphia, focusing on rehabilitation perspectives and mobility for children with SpinaBifida.

Spina Bifida, a congenital neural tube defect, occurs in 1 in approximately 2,000 live births, and impacts around1,500 babies per year. Spina Bifida impacts children in a multi-system setting, including neurologic function,bowel/bladder function, cognitive development, and mobility. Understanding the whole picture of the child withSpina Bifida can help improve mobility and functional outcomes and impact the approach to care for thesechildren.

Presenters will include a PMR physician, Physical Therapist, Orthotist, and clinical care coordinator (RN) fromthe clinic, and each will examine the vital role that those team-members play in the setting of a walking andmobility-focused clinic. Topics of discussion will include:

• Rehabilitation considerations including the wholistic view of the child & family setting: we willdiscuss family

access to resources, medical comorbidities impacting mobility and rehab planning,as well as rehabilitation philosophies guiding the walking-clinic's values

• Care coordination including multidisciplinary collaboration between departments throughout the institution

• Physical Therapy and rehabilitation, standardized programs and goal setting for bracing and mobility success

• Orthotic perspectives including bracing design philosophies and coordination of care between orthotists and therapists, both institutional and community care providers

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Bilateral Crawling Kinetic Symmetry in Infants with Cerebral Palsy and Limb Loss

Larissa Brehm, BSN, and Mark Geil, PhD, BS

Short Bio of all Presenting Authors

Larissa Brehm is an honors student at Kennesaw State University. She is in her junior year and in Kennesaw's nursing school. She is a part of the Wellstar Tom and Betty Phillips nursing cohort and scholarship recipient. Larissa has been a part of Dr. Mark Geil's research project since her freshman year, being one of the few chosen students to continue research in the junior scholar program.

Abstract

Introduction

Despite the observation that 95.7% of human infants crawl as part of their neuromotor development toward upright bipedal locomotion [1], there is a lack of quantitative data available to understand the biomechanics of infant crawling. Crawling can relay information about an infant's development and indicate certain health-related conditions [2]. Specifically, properly characterized crawling patterns (with quantified outcomes alongside observation) might indicate the presence of conditions like cerebral palsy (CP) in a developmental window in which other definitive diagnoses are impractical due to contraindications for imaging. This study quantified kinetics and spatiotemporal outcomes of infant crawling in two atypically-developing populations: children with spastic hemiplegic CP and children with limb loss or limb difference (LLD).

Methods

The study assessed crawling in infants using a 4.9m x 0.6m Zeno pressure transducer mat (ProtoKinetics, Havertown, PA). The mat incorporates a distributed array of 1 cm^2 force sensors that output 16 levels of pressure sampling at 120 Hz. PKMAS4 software was used to identify timing, location, and integrated pressure under each arm and leg during crawling. Children were encouraged to crawl back and forth across the mat until at least three trials of five consecutive crawling passes were obtained; results were averaged across all steady-state steps. The primary outcome measure was bilateral weight-bearing symmetry, expressed as the ratio of left-versus-right (sum of arms and legs) integrated pressure ratio (IPR L-R).

Results:

The study included two children with left side spastic hemiplegic CP and three children in the LLD group: one with right arm and right leg limb difference (IPR L-R values inverted for comparison) and two with left lower limb involvement, with one being an acquired absence of their left foot, and the other having a congenitally short left femur. The infants with CP and the child with arm and leg difference showed a substantial amount of pressure being put on their involved side compared to their contralateral side (mean 1.88). The other two LD infants, with only leg involvement, bore more weight on their right side (mean 0.85).

Discussion:

To our knowledge, these are the first quantitative kinetics data collected during crawling for these populations. The study compared crawling in infants with CP, who present with both neurological and structural changes that may affect locomotion, and infants LLD, who present with only structural (anatomical) limb changes. The results demonstrate the importance of upper limb involvement in crawling, as the two populations were very different in their weight-bearing strategy with the exception of the LLD child with both leg and arm involvement. The asymmetrical crawling in both groups may have clinical implications on early therapies and the potential importance of early prosthetic and orthotic interventions.

IPR L-R			
Subject	Condition	Mean	Standard Deviation
CP 1	Left spastic hemiplegia	1.75	0.81
CP 2	Left spastic hemiplegia	1.25	0.21
LLD1	Congenital right ulnar deficiency, right fibular hemimelina	2.54*	0.46*
LLD2	Acquired absence of left foot	0.83	0.17
LLD 3	Congneital short femur, Left	0.89	0.15
*Ratios inverted due to right side involvement			

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Orthotic Solution for Active Patient with Acute Flaccid Myelitis

Rebecca Suddaby, MSPO, CO, LO

Short Bio of all Presenting Authors

Rebecca is an ABC-certified Orthotist at Shriners Children's Hospital in Philadelphia where she specializes in pediatric orthotics. She holds a Bachelor of Science degree in Sport and Exercise Science from Gannon University and a Master of Science degree in Orthotics and Prosthetics from the University of Pittsburgh. Rebecca has had an interest in pediatrics since completing an internship at Shriners Hospital in Erie, PA during undergraduate. After completing her residency in 2016, she joined the team at Shriners Philadelphia where she has had an opportunity to treat various complex orthotic patients. Rebecca has a knack for biomechanics which allows her to come up with creative solutions to complex orthotic problems. She remains committed to providing high quality, patient-centered care for children through collaboration with families and a multidisciplinary care team. She believes every child should have the opportunity to function at the best of their ability.

Abstract

The average height and weight of an 8-year-old female is 47 to 54 inches and 48 to 80 lbs [1]. These numbers are taken into consideration when deciding on appropriate componentry for a KAFO. But what happens when your 8-year-old female patient is 58" and 166lbs?

The patient was diagnosed with Acute Flaccid Myelitis (AFM) at the age of three. AFM is a polio-like illness that is characterized by profound muscle weakness following an enterovirus infection in most cases resulting in long-term disability [2]. What started with a simple ear infection ended in paralysis of the right upper extremity and left lower extremity. Despite a mostly flaccid left leg, she remained highly active at the expense of the structural integrity of her KAFO. After multiple repairs and adjustments, we gradually upgraded the strength of the componentry. At the age of five when she was torquing and breaking the stainless-steel uprights of her KAFO, we knew we needed to come up with a creative solution to allow her to remain as active as possible while maintaining the structural integrity of her orthosis.

In addition to her size, we face other challenges. Her many caregivers, her impulsiveness and lack of concern for her personal safety, joint contractures and her femoral and tibial torsion that have developed over the years due to improper use of her orthoses. She had an Achilles lengthening procedure in 2020 and 2023, both of which resulted in a recurrence of the equinus contracture. We utilized our gait lab to provide insight into how she functions with and without a brace. This resulted in a recommendation for surgery to improve her leg position. We have been hesitant to recommend surgery again due to previous procedures failing as a result of poor brace compliance. All of these factors were being considered when deciding what style of orthosis would work best for her.

In this presentation we will take a look at her bracing history, including the many repairs and adjustments that we have had to make over the years. We will also look at how her left leg has changed and what we could have done to prevent these changes from occurring. We will discuss our successes and our failures, what we have learned and how we will use this information to better treat her in the years to come. This presentation will show the importance of a detailed and comprehensive, multidisciplinary approach to the care of AFM patients. It will also highlight the role that the family unit plays in patient care outcomes.

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Distinct Clinical Patterns and Correlating Patient Factors in Tibial Deficiency: A Multi-Center Study

Grace Markowski, MS, Alyssa Barre, MD, Shelby White, PhD**, Janet Walker, MD**

Short Bio of all Presenting Authors

Dr. Walker is a pediatric orthopedic surgeon at Shriners Children's-Lexington and a professor at the University of Kentucky Department of Orthopaedic Surgery and Sports Medicine in Lexington KY. She received her medical and orthopaedic training at the University of South Florida. She was a pediatric orthopaedic fellow at the Hospital for Sick Children in Toronto Canada. She has clinical and research interests in children with lower extremity deformities, deficiencies and amputations.

Abstract

Introduction

Tibial deficiency (TD) is a rare congenital lower limb deficiency, or failure of formation, characterized by a short or absent tibia. It is the rarest congenital lower extremity longitudinal deficiencies occurring in 5-21/million births. Reported to be associated with a high rate of other congenital anomalies, our purpose was to discern patterns of anomalies in a large TD cohort.

Methods

A retrospective review was performed of consecutive patients with TD from seven tertiary pediatric orthopedic centers (2004 to 2022) including 492 patients (650 limbs). Data collected from existing medical records and radiographs included sex-at-birth, race/ethnicity, medical/family/social history, and other abnormalities. Jones TD classification, with Type 5, proposed by Clinton+Birch 2015, was assigned.

Results

Of the 492 TD patients, 209 (42%) were female and 283 (58%) were male. Race/Ethnicity distribution was 46% White, 30% Black/African American, 15% Hispanic, 5% Asian and 4% other. Bilateral tibial involvement was found in 158 patients (32%). 9.6% had family history of TD and 7.3% of those born in the US had maternal history of pregestational diabetes. Jones Type 1 was most common (51% of limbs), followed by Type 2 (16%), Type 4 (13%), Type 5 (7%), unknown (12%) and Type 3 least common (3 limbs). Table 1 shows the associated anomalies. 57% of limbs had ipsilateral lower limb anomalies, with medial ray hypoplasia/absence being the most common foot anomaly (24%). Type 5 TD limbs had the most medial polydactyly.(49%,p<.001) Females had 2.5X greater odds of spine abnormalities.(p<.001) Patients with family history of TD had limb-focused abnormalities and were less likely to report Black/African American race.(p<.001) Patients with a history of maternal pregestational diabetes were more likely female, presenting with spine, cardiac, craniofacial, or genitourinary abnormalities.(p<.001)

Conclusions

Medial ray hypoplasia/absence was the most common foot anomaly in our tibial deficiency cohort, in contrast to literature citing lateral ray hypoplasia/absence most common. We found Jones classification and other anomalies accompanying tibial deficiency at previously reported rates. Tibial deficiency cases with familial inheritance tended to have anomalies limited to the upper limbs with greater lower limbs bilaterality. History of pregestational diabetes was 7 times the US rate and linked to spine and non-orthopedic abnormalities, with a higher frequency in females. Findings from this largest reported cohort redefine the anomaly profile of tibial deficiency and suggest two distinct presentations: familial limb-focused vs. maternal diabetes–linked systemic impact. These findings will enhance patient counseling and help direct basic research.

Table 1: Associated Abnormalities in Tibial Deficiency (TD)

Patient Associated Abnormalities	**N=492 TD patients**	**%**
Upper Extremity	137	28%
Spine	89	18%
Craniofacial	46	9%
Cardiopulmonary	77	16%
Gastrointestinal	40	8%
Genitourinary	58	12%
Neurological	31	6%
Ophthalmological	6	1%
Skin	3	1%
Ipsilateral Lower Limb Abnormalities	**N=650 TD Limbs**	
Foot	325	50%
Tibia, Knee or Femur	98	15%
Hip or Pelvis	97	14%
Contralateral Lower Limb Abnormalities	**N=334 Unilateral TD Limbs**	
Foot	50	15%
Tibia, Knee or Femur	14	4%
Hip or Pelvis	13	4%

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Potty Training Challenges in a Pediatric Above-Knee Amputee with PFFD and Upper Limb Difference: When Suspension Gets in the Way

Kristen Peterson, CP, and Edward Krische, MS, CPO, LPO

Short Bio of all Presenting Authors

Kristen Peterson is a certified prosthetist with a background in biomedical engineering and a master's in Orthotics and Prosthetics. She completed her residency at Scottish Rite for Children, where she gained experience with complex pediatric and young adult cases. Kristen is passionate about embracing innovation and patient-centered care to improve comfort, independence, and quality of life for her patients.

Edward Krische, MS, CPO, LPO is an ABC-certified prosthetist/orthotist at Scottish Rite for Children in Dallas, specializing in pediatric prosthetic care. He earned his Bachelor of Science in Biomedical Engineering from Binghamton University–SUNY and a Master of Science in Orthotics and Prosthetics from Baylor College of Medicine. Through Baylor's nationally recognized rotating residency program, Edward gained broad clinical experience across the United States. Edward began his career at Scott Sabolich Prosthetics and Research, where he served as Clinical Manager of the Dallas facility. In 2023, he joined the prosthetics team at Scottish Rite, drawn by a deep commitment to pediatric care. His clinical interests focus on complex limb loss—including hip disarticulations, hemipelvectomies, and rotationplasties—as well as the integration of additive manufacturing technologies (3D scanning and printing) in pediatric prosthetic design. He currently serves on the Board of the Association of Children's Prosthetic-Orthotic Clinics (ACPOC) and has presented nationally and internationally, including at ISPO. His research efforts focus on improving outcomes for children with high-level limb differences, early gait training protocols, and the role of interdisciplinary collaboration in pediatric rehabilitation. Edward is dedicated to advancing the field of pediatric prosthetics through innovation, education, and collaborative, patient-centered care.

Abstract

Potty training is a developmental milestone that can pose unique challenges for children with limb differences, particularly for toddlers with above-knee (AK) residual limbs. This case study highlights a 4.5-year-old patient with unilateral left PFFD "symes" amputation and a bilateral upper limb hand difference, who struggled with independent doffing of her prosthesis during toilet training due to limitations imposed by her suspension system.

At the time of intervention, the patient was ambulating with a short AK prosthesis using a TES belt for suspension. While this provided sufficient security and comfort during gait, it significantly limited her ability to independently remove the prosthesis when needing to use the bathroom. This became especially frustrating for the patient and her caregivers, as she was developmentally ready for potty training but physically limited by her device. She also was starting pre-k and needed extra help at the bathroom, which the school was concerned about.

In collaboration with the family and clinical team, we trialed a liner and lanyard suspension system to allow easier donning and doffing. However, due to the short residual limb and the patient's active nature, she was able to wiggle out of the liner and lanyard on her own.

Despite our efforts, the patient rejected the liner system due to discomfort and security issues and ultimately returned to using the TES belt. While this provided improved suspension, it also reinforced her dependence on caregivers during toileting—highlighting a critical area of reduced independence in an otherwise developmentally appropriate child.

This case underscores the unique intersection between developmental milestones and prosthetic management in pediatric populations. It also raises important questions about how prosthetic design can adapt to support independence in daily living activities beyond ambulation. Considerations for future care include exploring hybrid suspension methods or integrating upper limb prosthetic solutions to improve bimanual function for clothing/prosthesis removal. Collaboration between prosthetists, occupational therapists, and families will be essential in finding innovative solutions for this population.

We hope this case sparks discussion among clinicians about suspension strategies that support functional independence in early childhood. Additional shared experiences, modifications, or design ideas are welcomed as we collectively work to enhance quality of life for our youngest patients. We

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Changes in Social Interaction and Joystick Activation Over Time in Young Powered Mobility Learners with Motor Disabilities

Jasmine Jones, SPT, Shariphine Agoalikum, PT, MPhil, Kimberley Ingraham, PhD, Kat Steele, PhD, and Heather Feldner, PT, PhD, PCS

Short Bio of all Presenting Authors

Shariphine Agoalikum is a second-year PhD student in Rehabilitation Science at the University of Washington, Seattle. Before beginning her doctoral studies in September 2024, she served as a Principal Physiotherapist with the Ghana Health Service, bringing over ten years of experience in clinical practice and teaching. She holds an MPhil in Disability Rehabilitation and a BSc in Physiotherapy. Her research focuses on pediatric rehabilitation, particularly improving access to assistive devices and Physical therapy services, as well as advancing community health initiatives to enhance outcomes in underserved populations

Jasmine Jones is a third-year DPT student at the University of Washington. She completed her Bachelor's of Science degree in Health Sciences at Hofstra University in Hempstead, NY, in 2023. Her current clinical interests are in orthopedics and neurology, and her research interests are in early powered mobility and environmental exploration in toddlers.

Abstract

INTRODUCTION

Self-initiated mobility is crucial to an infant's learning, sense of autonomy, and social development. As infants learn to crawl and walk, their world grows, allowing for increased interactions with objects and caregivers. For children with motor disabilities, powered mobility (PM) devices are a way to access self-initiated mobility and thus the surrounding environment. However, research is lacking on PM use for children under three years old, particularly quantitative research examining how driving behaviors and social interaction change over time in early PM users. The purpose of this study was to quantify the evolution of social interaction and joystick activation across short-term PM intervention in young children with motor disabilities.

METHOD

In this quantitative observational study, participants engaged in 12 PM driving visits utilizing the Permobil Explorer Mini, a powered mobility device specifically designed for children 12-36 months of age. The Explorer Mini has a fixed midline joystick that allows 360o of exploration, 5 speeds with a maximum of 1.5 mph, and can be driven in a seated or standing position. Each visit took place in a lab-based enriched play space and involved two 15–20-minute video-recorded driving sessions. Behavioral video coding was completed independently by two researchers using momentary time sampling. Sessions were coded for driving behaviors, socialand joystick interaction, and emotional state at visits 1, 6, and 12, resulting in a total of 11,976 observational data points, which were analyzed using descriptive statistics. Inter-rater reliability was established between researchers with ≥90% agreement across all categories, and portions of each video were cross-coded for consistency.

Figure 1. A photo of a participant driving the Explorer Mini powered mobility device during a research visit.

RESULTS

Four children aged 21-27 months ($\bar{x}$ =23.75) with motor disabilities and their caregivers. On average, from baseline to study completion, driving time increased, both in exploratory driving (early stage, not targeted from point A to B) ($\bar{x}$ =12.30%, range 0.53% to 38.46%) and in goal directed driving (advanced, directional intention) ($\bar{x}$ =8.46%, range 0% to 30.77%). On average, the frequency of adult interaction slightly increased ($\bar{x}$ =1.69%, range -7.27% to 19.44%) and the frequency of time spent stationary decreased ($\bar{x}$ =-18.56%, range -43.14% to 2.52%). An example showing decreasedstationary time for one participant is shown in Figure 2.

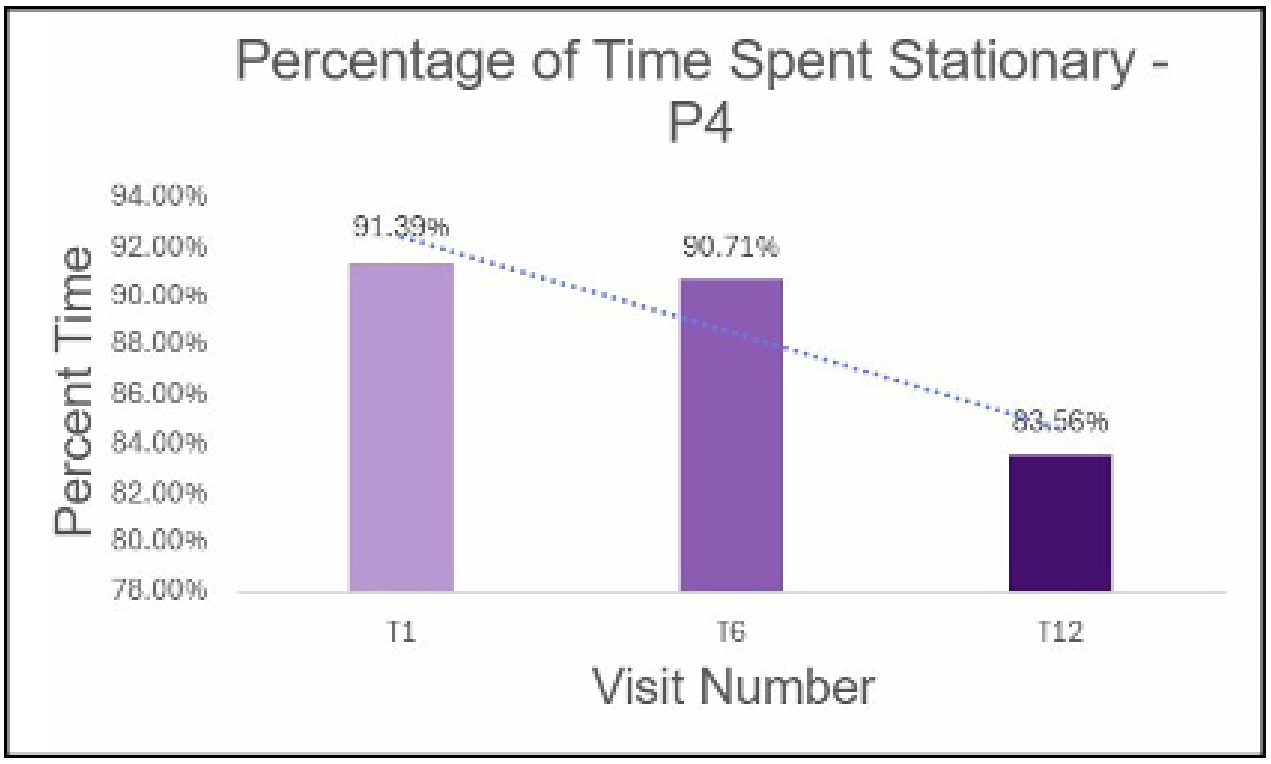

Figure 2. An example of the change in time spent stationary for the course of this study for one participant, P4.

Here stationary time steadily decreased, and the child spent more time driving as sessions progressed.

DISCUSSION AND CONCLUSION

Results indicate that there is substantial variability in the acquisition of driving behaviors in early PM users. There was a positive trend in exploratory driving, goal-directed driving, and adult interaction across sessions, accompanied by a decrease in stationary time. These patterns are consistent with other powered mobility learning literature and may correlate with the children's increased proficiency in driving and ability to explore their surrounding environment, utilizing driving to access toys and caregivers during play

CLINICAL APPLICATIONS

Clinicians can use powered mobility as a critical tool for enabling young children with motor disabilities to independently explore their surroundings and exercise autonomy over their play preferences. Behavioral video coding can be a valuable tool for researchers and clinicians alike to quantify driving and social behaviors, demonstrate change over time, and improve access to PM in key developmental stages.

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Barriers and Facilitators for Guiding the Co-Design of an Adapted Cycling Training Program for Children with Motor Disabilities: Preliminary Results

Yousra Bendakir, OT, Evemie Dube, PhD, Liam Lett, Marie Laberge, and Yosra Cherni

Short Bio of all Presenting Authors

Yousra Bendakir is an occupational therapist with nearly three years of specialized experience working with pediatric amputees and children affected by musculoskeletal disorders. She practices within the only provincial public healthcare program dedicated to the rehabilitation of this clientele, where she contributes to the development of custom-made sports adaptations using patented evaluation technologies. Her clinical and research interests have led her to participate in the 4th International Symposium on Arthrogryposis. Fluent in both French and English, Yousra is committed to advancing inclusive rehabilitation practices and innovation in pediatric care.

Abstract

Introduction: In Québec, about 20% of families include a child living with a disability[1]., which often limits autonomy, physical activity, and social participation. Cycling is not only a beneficial physical activity but also a social experience that promotes peer interaction and inclusion[2,3]. However, due to complex motor impairments, safe cycling often requires technical adaptations and specialized support. To date, few structured programs exist to promote learning and safe practice of adapted cycling. This project therefore aims to identify barriers and facilitators to cycling participation among children with motor disabilities, and to co-create, with families and community partners, an accompaniment program that fosters active participation and social inclusion.

Method and results: A semi-structured interview guide was developed through discussions using the Human Development Model – Disability Creation Process (HDM-DCP)[4] conceptual model. Online semi-structured interviews were conducted between May and September 2025, audio recorded and transcribed verbatim for thematic analyses. So far, 14/20 participants (range 7-13 years old, mean 10.4 years) and their parents were recruited in a rehabilitation center and interviewed. Most participants (35.7%) were from Montreal and had a congenital hand amputation (35.7%). Other diagnostics included congenital forearm amputation (7.1%), congenital amputation of the hand and lower limb (7.1%), brachial plexus injury (7.1%), polymalformative syndrome (7.1%), cubital hypoplasia (7.1%), VACTERL syndrome (7.1%), phocomelia (14.3%), arthrogryposis of the upper and lower limbs (7.1%). Preliminary findings revolve around the three key concepts of the HDM-DCP model which are personal factors, environmental factors and life habits. The data suggests that family and friends support, and life habits are key facilitators. Most participants use their adapted bikes to perform similar activities to friends and siblings which brings them confidence and freedom, especially when living far from others. Several children reported feeling ‘like any other kid’ when biking with family, highlighting the psychosocial impact of adapted cycling. Barriers include environmental physical factors such as hills, uneven sidewalks or surfaces, environmental social factors such as family and friends not being big fans of biking and personal factors such as not feeling comfortable with the adaptation.

Conclusion: To our knowledge, this is the first project in Quebec aimed at jointly designing an adapted cycling program with the direct participation of families and community partners. Preliminary results underscore the importance of considering both personal (i.e., family and peers) and environmental factors when promoting adapted cycling among children with motor disabilities. Our findings will guide the co-design of a structured, family- and community-informed cycling program aimed at promoting autonomy, physical activity, and social inclusion. Clinically, such a program could contribute to improved motor skills, confidence, and participation in meaningful activities, ultimately supporting long-term health and well-being of children with motor disabilities.

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Medical Specialty Camps for Children with Physical Disabilities: A Scoping Review

Phoebe Scott-Wyard, DO, Eden Winslow, Joshua Siegel, Jonathon Schofield, PhD, and Wilsaan Joiner, PhD

Short Bio of all Presenting Authors

Dr. Phoebe Scott-Wyard is a rehabilitation medicine specialist at Rady Children's Hospital-San Diego and an associate professor at UC San Diego School of Medicine. She is double board-certified in pediatrics and physical medicine and rehabilitation.

Originally from Maine, Dr. Scott-Wyard completed her undergraduate degree in behavioral biology at Johns Hopkins University before attending medical school at Western University of Health Sciences here in Southern California. She completed a combined residency in pediatrics and physical medicine and rehabilitation at Cincinnati Children's Hospital Medical Center and University of Cincinnati. She served two years as a Peace Corps volunteer in Ecuador and is fluent in Spanish.

Dr. Scott-Wyard is especially interested in treating children with limb differences. Before joining the team at Rady Children's, she served as the medical director of the Child Amputee Prosthetics Project clinic at Shriners Hospital in Los Angeles for six years. She is also the President of the Association of Children's Prosthetic and Orthotic Clinics (ACPOC), the only professional organization dedicated to pediatric prosthetic and orthotic care. She has served as a volunteer for Camp No Limits, Challenged Athlete's Foundation, and Angel City Games.

Abstract

Children and youth with physical disabilities face significant psychosocial challenges compared to their able-bodied peers, including greater social impairment and lower self-esteem [1, 2]. Medical specialty camps provide a space where children can enjoy a typical camp experience alongside peers with similar conditions, offering programming and support tailored towards various levels of ability. Although some studies and review papers have evaluated the effects of involvement in medical specialty camps on children with burns, diabetes, cancer, visual impairment, and chronic illnesses [3-8], there is a paucity of data available for children with physical disabilities (e.g. limb differences).

Our objective was to assess the impact of such camps on the psychosocial well-being of children with physical disabilities. Following the methodological framework of the PRISMA extension for scoping reviews (PRISMA-ScR) [9], a literature search performed in PubMed and Science Direct uncovered n=31 research articles meeting our inclusion criteria. The existing literature consists of a mixture of qualitative studies (n=15) such as interviews and focus groups, and quantitative studies (n=18) using validated surveys collected at multiple time points.

The results collectively suggest that medical specialty camps can lead to measurable improvements in children's quality of life, self-esteem, and self-perception, while also fostering positive social connections, enjoyment, belonging, and empowerment. However, questions remain about the long-term benefits of these camps, with extinguishing effects potentially being offset by follow-up programming, and the absence of control data limits the strength of the conclusions that can be drawn. This scoping review aimed to build on the body of literature suggesting that medical specialty camps offer positive improvements to the lives of children and youth with illnesses and disabilities, and suggested key components of effective research in this field, as well as avenues for future study.