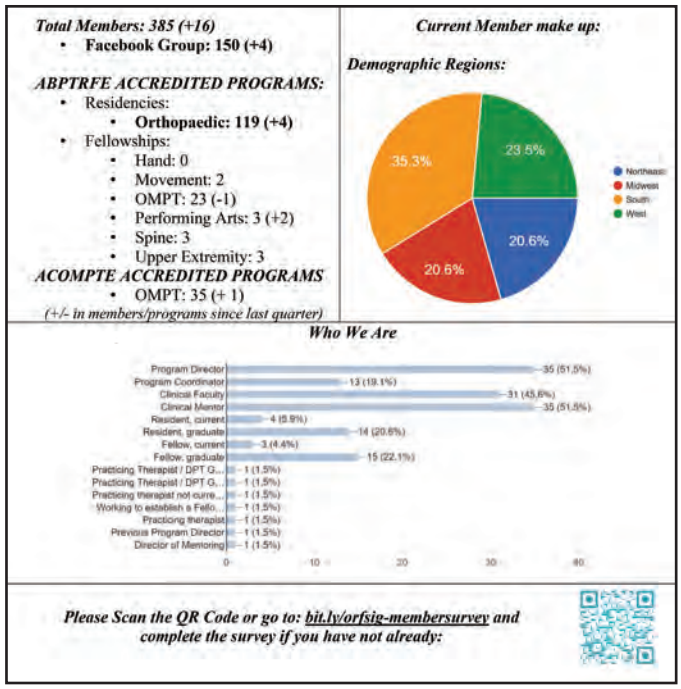
ORF-SIG Dashboard:



PRESIDENT'S MESSAGE

Spring is in the air bringing new life and rejuvenation. It is hard to believe that it has now been a year since the CoVid-19 pandemic started. While the pandemic created a significant strain on our livelihood, we are now beginning to see new growth and beginning. Often in life we find moments of struggle creating great sacrifice. It is with this sacrifice, we are challenged to grow and become stronger than where we started. Since the beginning, we have been looking for opportunity in the time of struggle. As the light starts to shine a bit brighter, we are now seeing some of these great opportunities.

Recently, Dr. Greg Hartley and colleagues published *"Residency Education: Is it Now or Never?"* in the *Physical Therapy Journal*.[1] Within this article, the authors highlighted some of the key gaps facing residency education from *Capacity* for residency program access, to *Evidence* highlighting the value of R/F education, to updating *Teaching and Learning models*, as well as the physical therapy's *Professional Progression*. While reading these it became humbling knowing that these focus areas were already known to members of the ORF-SIG. More importantly, these concerns have already been taken up by our members creating initiatives to make residency education a NOW rather than a never.

Capacity: Based on the recently published 2020 ABPTRFE Aggregate data, Orthopaedic Residency programs make up 37% of the accredited residency programs and 61% of the resident graduates[2] across the 12 different specialty areas. This most likely is due to the long history of orthopaedic residency/fellowship education within physical therapy practice. However, despite our long history and increased opportunity for access we still face great challenges for new programs to develop and for reaccreditation of more seasoned programs.

To tackle these battles, the Academy of Orthopaedic Physical Therapy and the ORF-SIG has provided grants as well as a base curriculum to assist new programs to move through accreditation. From an accreditation standpoint, we have focused on trying to highlight member concerns to our accrediting bodies by reducing some of the barriers to becoming accredited/reaccredited while still ensuring quality. Additionally, we have provided education to accredited and developing programs to ease some of the challenges provided with the accreditation process. It is our hope that these initiatives will continue to assist the growth and development of residency/fellowship education.

Evidence: Across the physical therapy residency and fellowship realm we recognize this as a priority in the future of residency and fellowship education. The ORF-SIG has been working with the Academy of Education Residency and Fellowship Special Interest Group supporting their efforts in publishing multi-specialty benefits of residency and fellowship education. Additionally, the ORF-SIG has focused on a better understanding of mentorship within residency and fellowship education.

Teaching and Learning Models: CoVid-19 likely placed the greatest strain on the traditional in-person educational infrastructure. It is here, where many programs were forced to re-invent some of their educational delivery and mentorship processes. Thankfully, several orthopedic programs already had a level of hybrid learning in place. Back in 2016, the ORF-SIG surveyed programs regarding their program model and educational delivery process. At this time, only 13% of the orthopaedic onsite programs had an online presence. Thanks to the collaboration and development of the CoVid-19 resource manual as well as several other resources provided by online educators, I would suspect this number is much higher.

Initially the hybrid learning model was highly scrutinized, however as time has gone by, we have come to realize that educational delivery does not need to be face-to-face 100% of the time. Nor does learning have to be 100% synchronous, removing several of the significant costs associated with in-person education. Technology via the use of online file sharing systems, video call services and various other communication platforms have truly redefined the way education and mentorship can and will occur. It is my hope that these innovations continue to allow programs to provide innovative practice-based learning models built to meet each of their learners needs.

Professional Progression: The future of residency and fellowship education is in our hands. It is our association that provides the vision and the resources to move forward however it is us down on the ground working through the daily grind that make these things happen. The minds of administrators need to be changed to invest in the rigorous process of accreditation and post professional education, students and clinicians need to be shown the value of ongoing mentorship and post-professional growth in their career. It is this balance of educators and accrediting bodies reducing the economic burden of the physical therapy educational process. The time is NOW to find more economical means for residency and fellowship education.

To assist in this process, the ORF-SIG will continue to serve as a community where programs can collaborate and share ideas and resources. We will continue to educate potential residents and fellows regarding the benefits of residency and fellowship education. Additionally, we will create opportunities for our members programs to connect with potential applicants.

Thank you again to all our members as it has been and will be your work that carries our profession's vision forward with putting a residency or fellowship in every town.

Thank you!
Matt Haberl
President, ORF-SIG

REFERENCES

1. Hartley GW, Rapport MJ, Osborne R, Briggs MS, Jensen GM. Residency education: is it now or never? *Phys Ther*. 2021;101(4):1–4. doi: 10.1093/ptj/pzaa225
2. 2020 Aggregate Program Data: Fact Sheet- Physical Therapist Residency and Fellowship Education Programs. ABPTRFE.

Here is an update of what our current Committees and Subcommittees are working on. If you would like to Get Involved within the SIG make sure to reach out to mhaberl@orthopt.org.

ORF SIG 2021 CALL FOR CANDIDATES

We are seeking qualified applicants to continue what the ORF-SIG has started!

President

- Work with AOPT Leadership in meeting their strategic goals and initiatives
- Effectively collaborate with the VP and Committees on ORF SIG updates
- Lead Membership and Committee Meetings
- Meet Amazing People!
- Requirements: must be an AOPT Member, serve a 3-year term

Nominating Committee Member

- Identify qualified members of our ORF SIG to serve in one of three elected positions: President, VP and Nominating Committee
- Assist in Sub Committee Positions
- Gain invaluable experience with ORF SIG leadership
- Requirements: must be an AOPT Member, serve a 3-year term

For more information, contact Bob Schroedter at bob@movethrurehab.com

COMMITTEE UPDATES

Research: Kathleen Geist, Mary Kate McDonnell

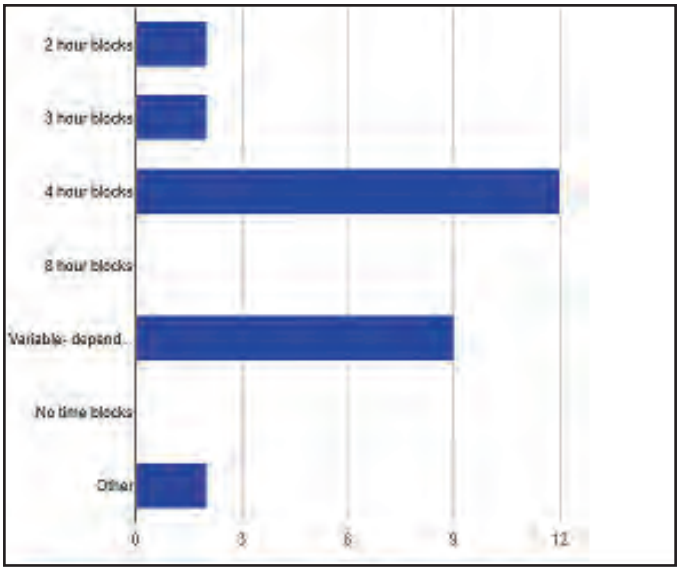
We would like to thank the residents and fellows who participated in the virtual ORF-SIG poster presentations during CSM. The research committee enjoyed the presentations and seeing the level of quality research opportunities that are occurring in residency and fellowship programs across the country. The winners of the $250 prize were to Dr. Jonathan Goldfarb from the Sacred Heart University Orthopaedic Residency Program and Dr. Mackenzie Garreth from the University of South Florida's Orthopedic Residency Program. Dr. Goldfarb's presentation was entitled" Utilizing Scapular Stabilization Exercises in a Patient with Medial Epicondylalgia: A Case Report. Dr. Garreth's presentation was entitled," Rehabilitation of Failed Forefoot Surgery in an Adolescent Female." Both winners will have the formal write up of their presentations in an upcoming *OPTP* publication.

We look forward to poster submissions by residency and fellowship ORF-SIG members for CSM 2022. The abstract submission dates will be provided on the ORF-SIG website.

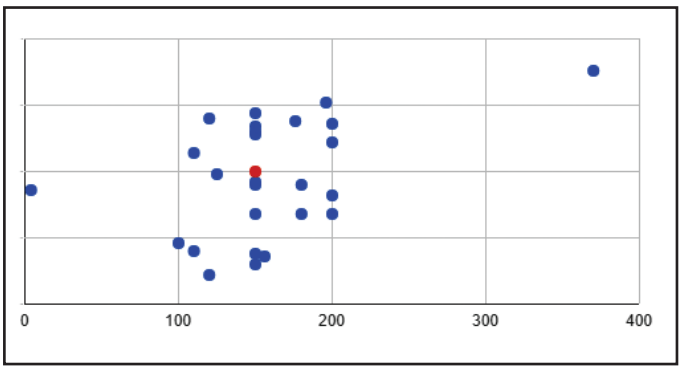
Practice/Reimbursement: Darren Calley and Kirk Bentzen

A mentorship survey to identify how mentoring is delivered across orthopaedic residency and fellowship programs has been sent and completed by 32 program directors. Thank you to the members of the Practice/Reimbursement committee for their efforts with developing this survey and to all who have participated. With this survey data, we have better identified how mentoring is currently implemented across programs, which will give ORF-SIG programs ideas for how others are delivering mentoring and provide comparisons for future mentor development. Some examples of data collected include:

1. What blocks of time are scheduled for 1:1 mentoring? 4-hour blocks (n=12), Variable (n=9)



How many total hours of 1:1 resident/fellow mentoring does your program schedule during the length of the program? mean hours = 157.6 (60.3 SD)



The ORF-SIG Practice/Reimbursement committee is pursuing dissemination of the results from the mentor survey.

Additionally, Dr. Bentzen would like to thank all members of ORF-SIG that participated in his dissertation data collection over the past six weeks. Across all residency programs, over 200 responses were recorded thereby providing a robust data set with which he can begin his analysis. The dissertation is looking at the site visit rubric accreditation reviewers utilize when observing the onsite mentoring session.

Communication: Kirk Bentzen, Kathleen Geist, Darren Calley, Megan Frazee, Sarah Nonaka, Chrysta Lloyd, Steve Kareha

ABPTRFE Frequently Asked Questions Documents: Recently the American Board of Physical Therapy Residency and Fellowship Education (ABTPRFE) released updates to their Policies and Procedures including some changes to the Primary Health conditions and CoVid-19 accreditation recommendations. The ORF-SIG was able to work with the Chair of ABPTRFE, Mark Weber and the Lead Accreditation Specialist, Linda Csiza where they provided some further elaboration on several Frequently Asked Questions.

Check out these documents here:

- Policy 13.5
- Medical Condition List FAQ
- RF-PTCAS/Program Sustainability
- CoVid-19 Modifications

Membership: Bob Schroedter, Tyrees Marcy

Some of you may have received emails regarding your membership status with the ORF-SIG and AOPT. Please make sure to renew your AOPT and ORF-SIG status when you renew your APTA membership as this does not automatically occur unless you are set up for auto renewal. Moving forward in 2021 we will be creating more member only access to several of our great resources. We are reaching out to congratulate new and developing programs and to increase awareness of the membership benefits and to highlight that membership is included to all Orthopaedic Academy members. Please make sure to share the benefits of the ORF-SIG with your colleagues!

- Communication of up-to-date changes and developments in Residency and Fellowship Education
- Access to Collaborate with other ORF-SIG Members engaged in Residency and fellowship Education on our Facebook group page
- Program Resources for members including program directors and coordinators, faculty, mentors, and prospective residents/fellows
- Scholarship Awards for residents and fellows in training
- Grant Funding and Curricular options for programs and faculty
- Opportunities to Get Involved with various leadership roles within the SIG

Additionally, we are working with the AOPT PR Committee to deploy several new social media initiatives that can help orient the newcomer to the realm of residency/fellowship education. Look for these on Facebook, Instagram, and Twitter pages of AOPT. Take advantage of our member only communication forums to share and develop ideas.

AOPT ORF-SIG Communities HUB

ORF-SIG Facebook group
bit.ly/orfsig-fbgroup

bit.ly/orsig-communityhub

Nominating: Bob Schroedter, Tyrees Marcy, Molly Malloy

A big welcome to the new ORF-SIG Vice President, Kirk Bentzen, Nominating Committee Member, Molly Malloy and our new AOPT Board Liaison Derrick Sueki. We are excited to have these wonderful individuals in pivotal positions of the ORF-SIG, building our community of excellence in residency and fellowship education. For more information on the board, committee, and subcommittee members, go to https://www.orthopt.org/content/special-interest-groups/residency-fellowship/get-involved.

The ORF-SIG has been successfully implementing Microsoft Teams to enhance our committee and subcommittee communication for project development. From online meetings to real-time chats to file repository organization this platform has greatly improved the efficiency of the SIG's productivity in a short timeframe.

SUBCOMMITTEE UPDATES:

RF-PTCAS: Kirk Bentzen, Steve Kareha, Megan Frazee, Carrie Schwoerer, Christina Gomez

Spring is winding down and summer is upon us. A couple of deadlines related to RF-PTCAS occur during the summer. Generally, program updates on the pre-launch website need to be completed in July or August. You should receive notification of this about a month prior to the deadline. Secondly, final decisions for the 2021 admission cycle will likely be due in early August. Please watch your e-mail and the APTA Hub Communication for these important announcements. Please contact Carrie Schwoerer (cschwoerer@uwhealth.org) with questions.

Program Sustainability: Steve Kareha, Matt Haberl, Kirk Bentzen, Carrie Schwoerer

One big problem facing programs over the years is the ability to sustain consistent applicant bases despite using, or not using, RF-PTCAS. Based upon your feedback, we have created two surveys to aid in this effort.

1. The first is to become a contact list library for our member programs of physical therapists and physical therapist students interested in learning more about orthopaedic residency and fellowship programs.
2. The second is specifically for those qualified applicants who are good and have already been vetted but applied to a program that does not have any additional spots available. The program denying admission may then provide the applicant with a flyer explaining the database and providing them the option to participate. Member programs may then access these qualified, vetted applicants as needed by contacting Steve Kareha (stephen.kareha@sluhn.org) and updates on numbers of candidates in this list will be provided quarterly to the membership.

Residency & Fellowship Interest

http://bit.ly/2OH6zdX

Residency & Fellowship Qualified Applicants

http://bit.ly/3u0JR0s

LIAISON UPDATES:

ORF-SIG-AAOMPT Updates: Bob Schroedter

ORF-SIG and AAOMPT are joining forces to brainstorm potential avenues for collaboration in the future. Be on the lookout for innovative ideas to bring together these two organizations and engage both memberships. More to come!

OTHER RESOURCES:

bit.ly/orfsig-covidresourcemanual

If you have not already done so, please make sure to review the continually evolving ORF-SIG **CoVid-19 Resource Manual**. This manual provides further information in how residency and fellowship programs are overcoming accreditation challenges, ensuring patient participation, and program sustainability.

aptaeducation.org/special-interest-group/RFESIG/

You can also find more great information from the Academy of Education's Residency and Fellowship SIG (RFESIG). Here you will find a variety of Podcasts they have completed for Residency and Program Directors. Please make sure to check these out as well as the Think Tank resources.

Rehabilitation of Failed Forefoot Surgery in an Adolescent Female

Mackenzie Garreth, PT, DPT
Aimee Klein, PT, DPT
Craig Vecchiarelli, PT, DPT
Matt Lazinski, PT, DPT

University of South Florida, Tampa, FL

INTRODUCTION

Forefoot disorders are a common pathology encountered in physical therapy practice. These pathologies include deformities such as metatarsalgia, hallux valgus or rigidus, claw or hammer toes, or sesamoiditis may cause impairments as well as activity limitations or participation restrictions. For some patients, the clinical presentation may be mild and go untreated. However, these disorders often have a progressive nature that can lead to severe pain, mobility loss, gait restrictions, and even disability. Patients can improve with conservative management, including physical therapy and/or shoe modification, but may require surgical intervention depending on severity, patient preference, and medical expertise.[1,2] All of the above health conditions, the impairments identified, and their respective interventions have one thing in common: research on the role of physical therapy and effective interventions is limited.

Hallux valgus (HV) is the most common foot deformity with an incidence of 35% in elderly adults and may result in pain, particularly with weight-bearing. While less common, HV may also be present in adolescents and younger adults. Conservative treatment for HV traditionally includes footwear modification such as a wider toe box, toe spreaders, or bunion shields to improve alignment and reduce pain. Surgery is considered when conservative treatment fails to alleviate symptoms or functional limitations.[1,3-5] Many surgical options exist, but evidence for physical therapy intervention following surgery is scarce. Schuh et al[6] demonstrated that multi-modal physical therapy intervention can reduce disability and improve plantar pressure following surgical osteotomy for HV correction.

Hammertoe, mallet toe, and claw toe may be seen in isolation or in patients with HV as the 1st metatarsalphalangeal (MTP) position may impede on the lesser toe's mobility and function. Similar conservative interventions to those described for HV, such as footwear modification, may be beneficial in reducing the impairments due to a hammertoe deformity.[1,7] Surgical management includes the sequential release of the MTP joints and toes affected with or without pin fixation with physical therapy addressing range of motion (ROM) and foot intrinsic strength post-operatively.[8]

The sesamoid bones function to transmit load during weight-bearing activities, act as a mechanical lever for foot intrinsic musculature during gait, and stabilize the 1st ray. Sesamoids are at risk for pathology including fracture, chondromalacia, and osteonecrosis from trauma or overuse due to the continuous demands and suboptimal blood supply.[9,10] The focus of conservative treatment is to reduce pain and/or mitigate external stress on the sesamoid complex through a trial of reduced or non-weight-bearing gait, footwear modification or padding, taping, use of non-steroidal anti-inflammatory drugs, injection, or any combination of these interventions.[9] However, excision of one or both sesamoid bones may be necessary in severe cases when necrosis occurs or conservative treatment fails. The primary research question regarding intervention has been whether removal of sesamoids will alter the mechanics of the foot in gait.[10,11,12] A cadaver study by Aper et al[11] concluded that partial or complete removal of the medial sesamoid had minimal effect on the flexor hallucis brevis while removal of both the medial and lateral sesamoids may cause profound deficits. Similarly, studies by Saxena and Krisdakumtorn,[13] Bichara et al,[14] and Biedert and Hintermann[15] have shown high return to pre-operative daily or sport activities following removal of a single sesamoid, but these studies provided limited guidance on the role of physical therapy post-operatively.

Forefoot pathologies are commonly encountered in physical therapy practice, and often do not appear in isolation. Rather, these pathologies may occur simultaneously or in accompaniment to a proximal chain pathology. Physical therapists are frequently involved in conservative care, but they may also play a large role in post-operative management. However, there is a paucity of evidence for physical therapy following surgical intervention, and available studies do not include adolescent patients, those with multiple pathologies, or desire to return to high levels of function.

The purpose of this case report was to describe the multi-modal treatment of an adolescent female following failed multi-procedure repair of idiopathic HV, hammertoes, and sesamoid avascular necrosis with a severe extension contracture of the 1st toe.

CASE DESCRIPTION

History

The patient was a 19-year-old female who reported a 6-year, complex history of right 1st MTP joint pain, which was exacerbated by standing and walking. The patient stated that physician examinations and radiographs revealed HV and hammertoe deformities in toes 2-4. The patient reported seeking treatment from several physicians including generalists, orthopedic surgeons, and podiatrists. In the spring of 2019, the patient was examined by a neurologist to rule out pathology, such as spina bifida, as the cause of pain and forefoot deformities. Patient was prescribed 2 different types of custom-fit semi-rigid orthotics without improvement before seeking surgical intervention. On May 23, 2019, the patient underwent an outpatient hammertoe release of toes 2-4. The patient continued to have limiting symptoms at 1st MTP during ambulation and a corticosteroid injection was administered to the medial 1st MTP joint on August 8, 2019; with boot immobilization post-procedure. Due to continued symptoms, the patient underwent a chevron osteotomy with distal interphalangeal fixation on December 12, 2019, to reduce the HV; at that time, it was determined that her tibial sesamoid bone was necrotic prompting removal. The most updated pre-operative x-rays were taken on December 6, 2019, while post-operative radiographs were taken on February 2, 2020 (**Figure 1**). Upon fusion of the 1st toe DIP joint, the hardware removal and scar tissue debridement of hallux extensor tendon was performed on February 21, 2020, secondary to extension contracture of extensor hallucis. Following these procedures, the patient remained in the boot for 2 additional weeks and was weight-bearing as tolerated in a Controlled Ankle Motion walker boot (United Ortho; Fort Wayne, IN) from August 8, 2019, to March 6, 2020, a total of 7 months.

Examination

The initial evaluation was 2.5 months post initial surgery after podiatrist referral to reduce great toe extension contracture and strengthen the flexor hallucis muscles. The patient reported pain under the 1st metatarsal head that increased with walking, (6/10 during evaluation, 4/10 at best, 8/10 at worst per Numeric Pain Rating Scale or NPRS). Activity of daily living (ADL) restrictions included her inability to wear a tennis shoe or sandal, walk without pain and deviation, walk on uneven surfaces, or participate in recreational activities such as playing with dog, running, or walking on the beach. Additionally, the patient noted distress about cosmetic appearance of her foot secondary to extension contracture.

Her perceived disability was demonstrated by the Lower Extremity Functional Scale (LEFS, score 45/80, MCID = 9 points[16]) and Patient Specific Functional Scale (PSFS; 0 – running, 1 – standing, walking, stairs, hobbies; MCID not available for patient population). Patient-reported and functional outcomes measures are displayed in **Table 1**.

The patient's standing weight-bearing postures revealed symmetrical foot posture, including moderate arch height, neutral forefoot position relative to hindfoot, and mild decreased calcaneal eversion. However, the great toe remained elevated from the ground into extension in weight-bearing postures and weight was shifted to the lateral aspect of the foot (**Figure 2**). She tended to bear weight primarily on lateral aspect of foot during the stance phase of gait.

Figure 1. Pre-operative and Post-operative Radiographs of the Patient in this Case Report Taken on December 16, 2019 and February 3, 2020

Objective measures from the examination, reassessment and discharge visits are reported in **Table 2**. The patient presented with decreased active and passive great toe ROM, inability to perform active great toe flexion, hypomobility of 1st MTP, no mobility at 1st distal interphalangeal (DIP) joint (fused), and point tenderness at the plantar surface of MTP joint. Post-operative incisions on medial side of great toe and dorsal aspect of DIP joint demonstrated proper healing. The patient demonstrated an antalgic gait, specifically with a reduced stance and weight transfer to the lateral foot thus reducing toe off, as pain limited weight-bearing through the distal end of 1st metatarsal.

Proximally, the patient showed decreased strength in the bilateral hip and right ankle musculature, decreased ankle dorsiflexion ROM with talocrural and subtalar hypomobility, and decreased flexibility of gastroc-soleus complex.

Balance testing revealed impaired single leg balance as she was unable to bear weight on the medial foot at 1st MTP. Aforementioned impairments also led to altered squat and stair mechanics. The remainder of the physical examination was unremarkable.

Clinical Impression

Based on subjective and objective data, the patient's impairments were forefoot pain, mobility, and stability deficits following great toe chevron osteotomy, tibial sesamoid removal, and hammertoe release with subsequent great toe extensor contracture. Priority impairments at the time of the evaluation included restoring functional great toe ROM and improving weight-bearing tolerance. Secondary impairments were also present as a result of prolonged boot use that impacted the plan of care. The patient had moderate symptom irritability and presented in the subacute stage of healing based on incision appearance, pain levels, and ability to mobilize with pain at end range. The patient was expected to have a fair prognosis based on the positive influence of young age with no other comorbidities and high motivation. Negative factors included previous failure of conservative treatment, extensive immobilization, and post-operative complication of the extensor hallucis contracture.

INTERVENTION

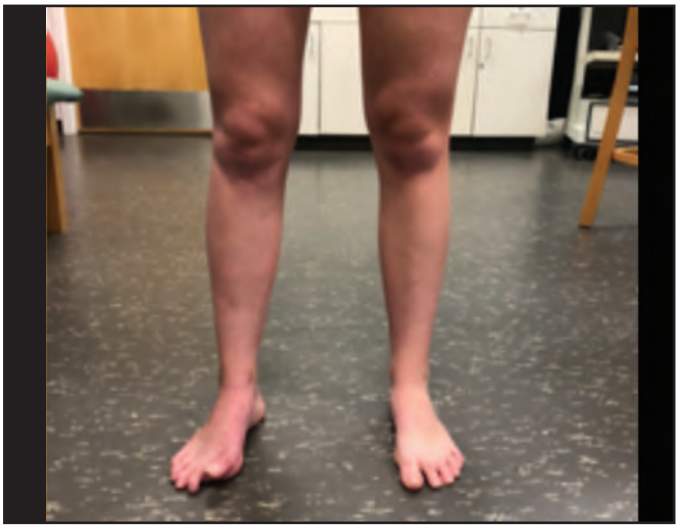
The patient was seen for 18 visits over 12 weeks. Initial physical therapy intervention focused on improving 1st MTP mobility.

Table 1. Functional and Self-Report Outcomes Measures

Measure	Initial Evaluation	Discharge
Lower Extremity Functional Scale	44% disabled	31% disabled
Patient-Specific Functional Scale	92% disabled	28% disabled
Comfortable 10MWT (shoes on)	Deferred	1.1 m/s
Comfortable 10MWT (shoes off)	Deferred	1.2 m/s
Fast 10MWT (shoes on)	Deferred	1.6 m/s
Fast 10MWT (shoes off)	Deferred	1.4 m/s
6MWT	Deferred	780 feet

Abbreviations: 6MWT, 6-meter walk test; 10MWT, 10-meter walk test

Figure 2. Standing Foot Posture with Right Great Toe in Extension and Increased Weight Bearing on Lateral Aspect of Right Foot (pictured April 20, 2020)



During the first 8 physical therapy sessions, instrument-assisted soft tissue mobilization at extensor hallucis muscle belly and tendon, passive ROM, low load long duration stretching, and joint mobilization at 1st MTP joint was used to decrease the extension contracture. The patient supplemented these interventions at home with passive ROM and self-stretching daily. Use of a Velcro brace, prescribed by the podiatrist, at night to promote MTP joint flexion was not successful. Additional interventions included weight-bearing activities to normalize plantar pressures and foot intrinsic strengthening focused on maximizing the mechanical advantage of the flexor hallucis muscles. Patient was cued to increase emphasis on weight-bearing through medial aspect of the foot to improve great toe push off and normalize gait as weight-bearing tolerance improved.

Mild improvements in active and passive MTP flexion were made within sessions following manual therapy and stretching, but there was no carry-over between visits. On the fifth visit, the physical therapist added the use of a Joint Active Systems (JAS) Dynamic Toe splint (JAS; Effingham, IL) to focus on low load, long duration of stretching of extensor hallucis between physical therapy sessions. The patient started the use of the splint one-month post-second surgery (**Figure 3**) and was educated to gradually increase wear time and intensity per tolerance. Once the patient was able to tolerate prolonged wearing of splint, 3 to 6 hours per day depending on schedule, the focus of physical therapy sessions shifted from manual therapy to proximal chain strengthening and improving balance/proprioception.

During the middle phase, visits 8 to 13, interventions addressed ankle mobility and strength deficits from prolonged boot use and ongoing hip weakness. Instrument-assisted and manual soft tissue mobilization was used with subsequent stretching to improve gastroc-soleus muscle flexibility. Additionally, the patient benefited from joint mobilization including grades III and IV posterior glides at talocrural joint, grades III-V combined distraction of subtalar and talocrural joints, and talocrural mobilization with movement to improve mobility, particularly dorsiflexion, during gait and squats. Calf raises were initiated in late March, progressing from sitting to standing and bilateral to unilateral as medial forefoot weight-bearing tolerance improved. Strengthening of hip musculature was initiated with specific muscle training using progressive resistance straight leg raise, clamshells, and sidelying hip abduction, and gluteal bridges with an emphasis on regular performance of home strengthening between sessions. Balance intervention included static and dynamic training on firm, uneven, and non-compliant surfaces.

The latter phase, visits 14-18, focused on return to function activities that included progressive hip and ankle strengthening. Extensive time was spent on normalizing gait and squat mechanics. Squatting was deferred at initial evaluation, but the patient was able to perform and presented with unsymmetrical weight-bearing (35% Right/65% Left) and excessive frontal plane motion secondary to ankle dorsiflexion and hip strength deficits at this time; squatting mechanics did improve with verbal and tactile cuing along with support under heels (**Figure 4**). The patient was able to jog approximately 50 feet within the clinic without pain. She demonstrated a bilateral heel strike running pattern with reduced stance time as she did not achieve full toe push off. She was educated on initiating a progressive return to jumping and running protocol. The patient was unable to continue with in-person clinic sessions to work on return to running or cueing for running mechanics due to changes in campus housing during the COVID-19 pandemic. Finally, she was educated on the importance of performing her comprehensive home exercise program (HEP) addressing mobility, stability, and functional deficits following therapy discharge. The patient was placed on hold at that time, but she was encouraged to return to the clinic once she returned to campus.

OUTCOMES

Following the first phase of physical therapy, the patient had an increased ability to actively contract the flexor hallucis muscles, but the great toe remained significantly limited both actively and passively by an extension contracture. By the fifth visit, the physical therapist requested the JAS splint to promote low load, long duration stretching at home. The focus of physical therapy interventions shifted on the eighth visit once the patient had received her splint.

Between the second and third phases of intervention, the patient demonstrated increased ankle mobility and mild improvements in hip strength. However, her hip strength did remain limited overall, which led to impaired squatting mechanics. The patient's tolerance to walking on level surfaces had improved, but she remained limited when ambulating quickly or on uneven surfaces.

At discharge (18th visit), the patient demonstrated improved

Table 2. Impairment Based Measures at Baseline, Midpoint, and Discharge for the Patient in this Case Report

	Initial Assessment		Mid-Plan of Care (3/30/2020)	Discharge	
	Right	Left	Right	Right	Left
Great toe MTP extension ROM	48° (54°)	WNL	50° (55°)	50° (62°)	WNL
Great toe MTP flexion ROM	Unable to actively flex (lacking 39° from neutral*)	WNL	Resting in 32° extension AROM lacking 25° from neutral (10° from neutral)	Resting in 35° extension AROM lacking 25° from neutral (10° past neutral)	WNL
Great toe DIP joint ROM	Not assessed due to fusion	WNL^	Not assessed due to fusion	Not assessed due to fusion	WNL
Toes 2-4 ROM	50% normal limits (WNL)	WNL	WNL	WNL	WNL
Ankle dorsiflexion ROM	3° (5°)	15° (20°)	5° (10°)	10° (20°)	15° (20°)
Ankle plantar flexion ROM	54° with anterior tightness (61°)	70°	65°	65°	72°
Ankle inversion ROM	32°	WNL	WNL	WNL	WNL
Ankle eversion ROM	14°	WNL	WNL	WNL	WNL
Soleus muscle length	11° with posterior tightness	24°	15°	18°	20°
Ankle dorsiflexion strength	5/5	5/5	5/5	5/5	5/5
Ankle plantar flexion strength	Unable to test functionally; 3/5 in non-weight bearing	5/5	3/5	4/5	5/5
Ankle inversion strength	4/5	5/5	4/5	4 /5	5/5
Ankle eversion strength	4-/5	5/5	4/5	4+/5	5/5
Great toe flexion strength	0/5	2-/5	Trace contraction	2-/5	2+/5
Hip flexion strength	4/5	4+/5	4/5	4+/5	4+/5
Hip extension strength	4-/5	4/5	4-/5	4/5	4+/5
Hip abduction strength	4-/5	4/5	4-/5	4/5	4+/5
Hip internal rotation strength	4-/5	4/5	4/5	4+/5	4+/5
Hip external rotation strength	4-/5	4/5	4/5	4+/5	4+/5
TTP at plantar surface of MTP joint (1st toe)	3/4	NA	2/4	1/4	NA
1st MTP joint mobility	1/6 (moderate to severe hypomobility)	3/6 (normal)	3/6 (normal)	3/6 (normal)	3/6 (normal)
Single leg stance Right LE	Unable to perform	>30 sec with eyes open	5 sec with moderate sway on flat surface	20 sec on flat surface 5 sec on compliant surface	>30 sec on flat or compliant surface
1st MTP circumferential measurement	20.3 cm	19.5 cm	20 cm	20 cm	19.4 cm

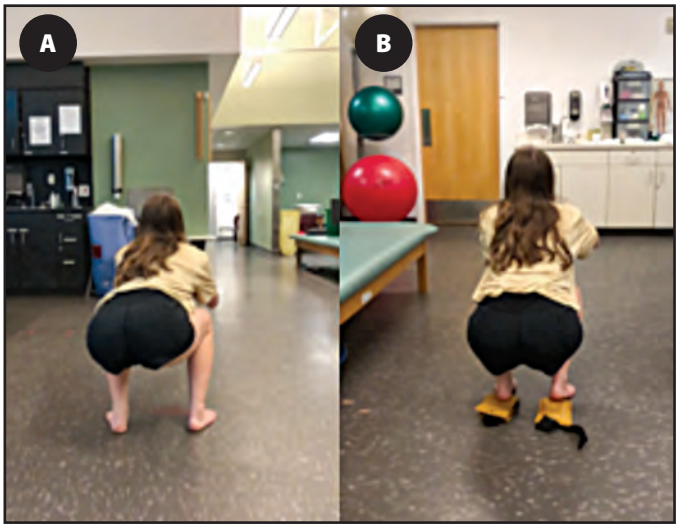
Abbreviations: DIP, distal interphalangeal joint; LE, lower extremity; ROM, range of motion; TTP, tenderness to palpation; WNL, within normal limits
Pain indicated by "*". ROM values are listed with active first followed by passive in parentheses,measured in degrees using goniometer.[19]
Muscle strength assessed per guidelines proposed by Kendall for muscle grading.[20] TTP assessed using 4 point scale.[21] Joint mobility assessed using 6-point scale.[22]

great toe flexion ROM, increased bilateral hip strength, increased right foot and ankle strength, ability to actively flex 1st MTP in non-weight-bearing and weight-bearing positions, improved static and dynamic balance/proprioception, and decreased pain during gait with improved toe-off. Values for clinically important change are not published for these values when used in isolation for this patient population; progress was determined by comparing baseline and discharge measurements for functional change and assessing the patient's reported satisfaction.

During the final physical therapy visit, the patient completed 10-meter walk tests at self-selected and fast speeds for 2 trials each; the average speed in meters per second is shown in **Table 2**. The 6-minute walk test was performed to assess walking endurance. Although the patient did meet age normative values for distance, her time per lap increased with each additional lap performed. The patient demonstrated a normal gait speed of 1.1 m/s and 1.2 m/s during the comfortable walk test, shoes on and off, respectively. The patient exhibited a gait speed of 1.6 m/s and 1.4 m/s during

Figure 3. Joint Active System Splint to Promote Flexion of Great Toe for the Patient

Figure 4. Squat Mechanics of the Patient



A, Before Lift Intervention. B, After heel lift intervention.

the fast walk test, shoes on and off, respectively. The patient was able to jog 50 feet in the clinic with decreased stance and minimal toe off, without pain.

The patient was able to squat to 90° with reduced hip drop and pelvic rotation but still required verbal, tactile, or external cueing in the form of a wedge under the bilateral heels for consistent performance. The patient demonstrated symmetrical weight bearing on Biodex Balance System SD (Biodex; Shirley, NY) during squatting activities by discharge.

The patient showed improvements on the PSFS (64%), and LEFS (12.5%), and Global Rating of Change ("quite a bit better") Scale indicating reduced perceived disability. The PSFS scored on items of standing, walking, stair navigation, running, and hobbies. The patient verbally noted improved function with walking, stairs, squats, and jogging in daily life.

The patient continued to report pain, rated as 3/10 on the NPRS, while ambulating after faster speeds or uneven surfaces. Additionally, she continued to have moderate deficits in proximal chain strength, specifically hip abduction and extension at 4/5, and great toe flexion of 2-/5, which prompted the need for continuing this within the HEP. The patient reported increased satisfaction with the appearance of the 1st toe compared to pre-operative status, but voiced frustration about the cosmetic appearance of the extension contracture.

DISCUSSION

This case report provides the post-operative physical therapy management for an adolescent female following surgical correction of hallux valgus, hammertoe, and sesamoid avascular necrosis with a subsequent extensor hallucis contracture. After 18 visits spanning 12 weeks, the patient showed improvements in pain, mobility, strength, gait, and function. The patient had a persistent great toe extension deformity but was able to return to functional and recreational ADLs with minimal limitation.

The patient's progress may have been limited as a result of the COVID-19 pandemic. The patient had limited access to the gym that affected her compliance with the advanced stages of her HEP. Physical therapy intervention was also discontinued earlier than planned in the latter stage of treatment as the patient was no longer near the physical therapy clinic due to a campus-mandated quarantine.

The results of this case report support prior research[1-15] that an individual can improve gait mechanics and function following HV correction, hammertoe release, tibial sesamoidectomy, and extensor hallucis debridement. This case report also provides a model of physical therapy intervention for an adolescent female with idiopathic forefoot deformities following multiple failed attempts at surgical intervention.

Future research including a larger number of adolescent patients wishing to return to high levels of activity is warranted to determine the success of surgical forefoot deformity correction with post-operative physical therapy.

CONCLUSION

A multi-modal approach for managing impairments and functional limitations in an active, adolescent female following multiple surgical interventions of idiopathic forefoot disorders with resultant deformity is provided. After a 12-week, multi-modal treatment, this patient demonstrated significant improvements in function, pain, mobility, and strength but with continued resultant 1st toe extension deformity.

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