President's Letter

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As we move forward into 2019, I would like to invite you to join us at the following PASIG events before, during, and after CSM:

2-day CSM Preconference Course

Musculoskeletal Sonography of the Lower Limb Focused in Sport & Performing Arts, Tuesday 1/22 & Wednesday 1/23, 8:00 a.m. - 5:00 p.m., Convention Center, 147A

This 2-day hands-on course will provide an introduction to the use of diagnostic ultrasound, evaluation of the lower limb, and sonoappearance of lower limb pathology with specific consideration to the sports and performing arts population. Day 1 content will be suitable for those with no ultrasound experience, or as a revision for intermediate users. Day 2 will discuss in depth musculotendinous and bony pathologies and their sonoanatomy as it pertains to the hip, foot, and ankle. Attendees will learn how to integrate the information obtained through musculoskeletal sonography to enhance their clinical examination and overall improved patient satisfaction and outcomes. At the completion of this course, attendees will demonstrate understanding of the use of diagnostic ultrasound in a clinical physical therapy setting, including a basic knowledge of lower limb ultrasound evaluation and a comprehensive understanding of the sonoappearance and examination of musculotendinous and bony lower limb pathologies. Presenters will include *Megan Poll, Doug White, Marika Molnar,* and *Scott Epsley*, who have extensive experience in the use of real time ultrasound imagery in augmenting the clinical examination of athletes and performing artists.

PASIG Membership Meeting

Thursday, 1/24, 6:45 a.m. - 7:30 a.m., Convention Center, 146A

You do not need to be a member to join us at this early meeting. We would LOVE for you to become a PASIG member, but all are welcome. Please contact me if you have any questions.

PASIG Educational Session

Olympian to Novice: Using Evidenced-based Screening for the Performing Artist, Thursday, 1/24, 8:00 a.m. - 10:00 a.m., Convention Center, 146A

The importance of primary prevention for injuries in performing artists is necessary, as most injuries are related to overuse. The Performing Arts Rehabilitation group is developing and adapting current screening tools to provide a comprehensive approach to working with all performing artists, such as dancers, musicians, theater performers, vocalists, figure skaters, and gymnasts. Disseminating information found in screenings from the clinicians to the performers is integral to creating change and assisting with injury prevention. Development of home programs and educational tools, including videos, websites, and other instructional aids such as mobile applications, is helping physical therapists to reach patients and create better adherence to prescribed exercise. Presenters will be *Kristen Schuyten*, PT, DPT, MS, Board-certified Sports Clinical Specialist who was the physical therapist who traveled to PyeongChang for the 2018 Olympics with Team USA for Figure Skating, and C*orey Snyder*, PT, DPT, Board-certified Orthopaedic and Sports Clinical Specialist.

The following meetings will be held in our AOPT bonus room. Please note the time change.

PASIG Fellowship Taskforce Q&A Thursday 1/24 12:00 p.m. -1:00 p.m. (If interested, contact Laurel Abbruzzese, Fellowship Taskforce Chair)

PASIG Outreach Committee Thursday, 1/24 1:00 p.m. - 2:00 p.m. (If interested, contact Marissa Schaeffer, Outreach Chair)

PASIG Dancer Screening Networking/Q&A Thursday, 1/24 2:00 p.m. - 3:00 p.m. (If interested, contact Mandy Blackmon, Dancer Screening Chair)

PASIG Committees and Interested Volunteers Thursday 1/24 3:00 p.m. - 5:00 p.m. (Please contact the chair of the committee you are interested in)

2-day Post-conference Course, (AOPT-PASIG and University of Delaware co-sponsored)

Emergency Medical Response Full Course (2 days) Sunday, 1/27, 8:00 a.m. - 5:00 p.m. and Monday, January 28th, 8:00 a.m. - 4:00 p.m. (CEU Hours: 45)

Re-certification (1 day only for those expired ≤ 3 months) Sunday, 1/27 9:00 a.m. - 2:00 p.m. (CEU Hours: 7) https://sites.udel.edu/ptclinic/2019-emergency-medical-response-course-2/

Please contact Rosie Canizares, our Vice President and Education Chair, if you are interested in attending this post-conference off-site course: rcc4@duke.edu

A shout out to our PASIG members and OSU Performing Arts Fellows Tessa Kasmar and Tiffany Marulli presenting "Special Considerations for the Dancer: Meeting the Needs of an Athlete and Artist" at the 2019 NEXT conference in June.

Please get connected. The PASIG is you, me, and everyone we can grab along the way to create something new. Reach out to one of us! Stay tuned for updates on PASIG programming, dancer screening, fellowship, and membership in the monthly citation blasts and in our social media leading up to CSM. To belong to our Facebook page, contact Dawn (Muci) Doran, and please tweet about performing arts with us @PT4PERFORMERS

It is with great pleasure that I introduce Megin Sabo John, PT, DPT, OCS, author of the following study. Thank you, Megin, for your contribution to our profession.

Ischial Tuberosity Avulsion Fracture in an Adolescent Dancer: A Case Report

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INTRODUCTION

Adolescent and young adult athletes suffer apophysitis and avulsion fractures in various lower extremity locations, including the metatarsals, tarsals, tibia, fibula, femur, and pelvis.[1] Reportedly, these injuries are most common during a growth spurt,[2-4] and are associated with increasing tension force through the musculotendinous unit, thus placing increased pull at ossification centers.[4] An ischial tuberosity avulsion fracture is a disruption of the open apophysis at the hamstring insertion to the pelvis.[5,6] When placing the hamstring in extreme range of motion, increased tensile force through the musculotendinous unit often causes this injury.[5]

When adolescent dancers increase participation in athletic activities,[4] overuse injuries often occur at their tendons and apophyses.[4,7,8] Bowerman et al reports lower extremity injuries as the most common injury in young elite ballet dancers but found a lack of evidence clearly isolating growth, maturation, and poor lower extremity alignment as risk factors to the onset of overuse injuries in this population.[9]

Pediatric athletes are at risk of injury to their ossification centers, with ischial tuberosity (IT) cases reported most frequently.[9,10] Rossi and Dragoni[10] collected 203 cases of acute avulsion fractures in the pediatric athlete, over 50% of the incidents (109), reported to be IT injuries. In a systematic review of avulsion fractures in the pelvis, Porr et al[11] found the mechanism of injury poorly reported among the 66 case reports reviewed, making it difficult to link primary causes of injury to eccentric loading. However, they confirmed that 88% of those cases were associated with physical activity, most frequently with kicking and running.[11]

Diagnosis of IT avulsion fractures is typically done with a series of anterior-posterior (AP) radiographs and physical examination.[5,11-15] Tenderness to palpation over the IT and pain at the IT with manual muscle testing are common findings.[5,6,12,13,15] The literature offers limited protocols for conservative rehabilitation of IT avulsion, but describes common themes[5,6,16,17]: limiting stress at the injury site during the initial stage of nonsurgical rehabilitation[5,11-13,16-18] and avoiding vigorous or dynamic stretching until weight bearing is painfree and range of motion is restored.[5,6,12,14] Some authors advocate for a period of reduced or nonweight bearing on the affected side to minimize tension[6,17,18] while others advocate bed rest for the first 72 hours.[5] After painfree activity has been achieved, return to sport may be initiated.[5,6,12,16,17]

When evaluating hamstring injuries in adolescent dancers, apophyseal injuries are an important differential diagnosis.[5,6,17] These injuries can result from stretch-type passive movements, such as anterior-posterior splits, as well as forceful contraction-type movements, such as kicks and leaps.[5,17,19] Individuals frequently report a "pop" with associated pain near the IT, similar to athletes diagnosed with hamstring strains,[19] underlining the importance of early diagnosis with physical examination and radiographs, especially in management of the skeletally immature patient.[14] The purpose of this retrospective case report is to describe the interventions used during a progressive, full weight-bearing physical therapy rehabilitation program for an IT avulsion fracture in an adolescent dancer.

CASE REPORT

Evaluation

The patient was a 14-year-old female dancer participating in multiple dance genres in a Minnesota dance studio. She came as a referral from a local sports and orthopedics walk-in clinic with a right adductor/hamstring strain. She reported pain at her right ischial tuberosity that had subsided only minimally since the injury two weeks prior to the evaluation. She was not taking anti-inflammatory medications and had not participated in dance since the injury. She reported feeling a painful pull during her stretches, followed the next day by an audible pop and pain while doing anterior-posterior splits with the right leg forward. She reported no relevant medical history. During the evaluation she rated her pain as high as 6/10 intermittently with walking, sitting, lifting her leg into flexion, squatting, and bending forward. Her self-reported functional limitations also included dancing and running.

The patient had a slight antalgic gait with decreased stance phase on the right lower extremity. Her pelvis was level in standing, and she could bend and reach the floor but reported pain over her right ischial tuberosity. She had no pain with adductor stretching or with resisted adduction. Measured with a single inclinometer placed mid-tibia (Figure 1) and allowing the hip to abduct slightly at end range, her uninjured left leg had hamstring flexibility during

Figure 1. Inclinometer placement for straight leg raise measurement.

a straight leg raise (SLR) of 130°. She had limited range of motion during the right involved SLR of 90° due to increased pain at the IT. Supine passive hip and knee flexion and active hip flexion during seated psoas manual muscle testing produced pain. She reported pain with prone right hip extension with the knee flexed but was able to hold against approximately 50% maximal contraction with 4-/5 strength during manual muscle testing (MMT) as compared to the uninvolved side. She had 4/5 strength on the right hamstring with prone MMT but with reported IT pain. She had tenderness to the musculotendinous unit of the hamstring and over the IT. All other hip, sacroiliac, and lumbar special tests were negative bilaterally including hip scour, FABER, FADIR, sacroiliac provocative tests, neural tensioning, and lumbar central posterior to anterior mobilizations.

The patient had signs and symptoms consistent with an avulsion fracture at the right IT with a possible hamstring strain. Positive findings included her age,[6] a "pop" during her stretching routine,[6,18] pain at the IT with active and passive hip flexion,[6] and tenderness over the IT.[5,6,12,13,15] She was referred back to her referring provider for additional work-up including plain radiographs.[6] The patient and parent were educated on the pathology findings and the referring medical provider was contacted to discuss findings of the physical examination.

Her plan of care recommended that she be seen twice a week for 6 weeks, then once a week for 4 weeks. Emphasis would be placed on neuromuscular re-education; therapeutic exercise; proprioception; balance; strengthening; and manual therapy to increase tissue extensibility, decrease muscle tension, and increase range of motion (ROM).

Differential diagnosis of an avulsion fracture could not be ruled out until review of radiograph results; therefore, aggressive stretching of the right hamstring was avoided. The referring provider ordered initial AP radiographs 19 days after the initial injury, resulting in confirmation of a 1 mm avulsion fracture of the right tuberosity growth plate at the hamstring insertion. Conservative nonsurgical treatment was recommended since the avulsion was minimally displaced.[6]

Interventions

Direct interventions during her initial examination (Table 1) included cross friction soft tissue mobilization of the right proximal hamstring musculotendinous unit. This approach reduces tension at the IT while maintaining mobility of the hamstring musculotendinous unit[20] and preventing adhesions.[20,21] This was followed by very gentle stretching of the right hamstring in supine and ice massage[22] over the ischial tuberosity and proximal hamstring. Furthermore, prone hamstring curls with independent concentric movements and assisted eccentric lowering with the other foot due to pain with independent lowering were initiated.

Initial interventions (weeks 2 to 7) implemented a period of relative (active) rest to prevent atrophy[23] and to encourage patient compliance with activity modification.[24] These interventions included Pilates, floor barre, and core strengthening[24] with full weight bearing as tolerated. In terms of tissue loading, active rest, and restoring ROM principles of progressive loading guided intervention planning.[25]

Approximately 4 weeks after the injury at her fourth visit, treatment progressed to partial loading with supine hooklying bridging using a posterior pelvic tilt[26] to reduce hamstring tension (Figure 2). Calf and adductor strengthening was initiated in standing barre exercises, including heel raises and ball squeezes between knees. Neuromuscular re-education was incorporated during week 4 with Pilates based small leg circles in supine with the injured leg at 90° of hip flexion. Hamstring stretching and bridges with alternating march were included at this phase due to 0/10 pain reported during these activities.

Week 5 progressed to Pilates based sidelying strengthening exercises (clamshell, bent knee abduction, and high clamshell) as well as prone knee-straight hip extension exercises with a focus on gluteus maximus activation. At this point she had increased passive ROM to 105° SLR on the right and decreasing levels of pain. At this time, her mother reported that at her yearly physical she presented with 5 inches of height growth in one year. A dramatic growth spurt such as this could result in increased tensile

Table 1. Intervention Progression

Weeks postinjury and visit count	2-3 weeks 3 visits	4-5 weeks 3 visits	6-7 weeks 3 visits	8 weeks 2 visits
Right SLR ROM	90°	90°	98°-120°	133°
Intervention	Hamstring frictions at MTJ, Gentle Seated HS stretching, Ice Massage, Active-assisted ROM for prone hamstring curls	Hamstring frictions at MTJ, Bridging floor and ball, Heel raises, Adductor ball squeezes, Pilates leg circles in supine, Sidelying hip strengthening	Week 6: Hamstring frictions, Continuation of previous exercises Week 7: No manual treatment, Bridge walkouts, Pilates supine leg scissors, Hamstring curls on ball	Airplane balance, Balance with passé and developpé, Roman dead lifts, Single leg hip extension knee bent to 90°, Nordic curls, Pilates: rollover, jackknife, scissors, & leg circles
Pain Rating	6/10	4/10 sitting	Not rated	2/10 end range and grand plié
Posttreatment SLR ROM	Not tested	Week 5: 105° Right 125° Left	105° - 125° Right	Not tested
Abbreviations: SLR, straight leg raise; ROM, range of motion; MTJ, musculotendinous junction				

Figure 2. Bridge with posterior pelvic tilt cuing.

force at the apophysis making her more susceptible to an avulsion injury.[27]

At 7 weeks postinjury, she reported low levels of pain; while stretching she rated her discomfort at 2/10. Her SLR measured 120° on the right and 130° on the left. Manual muscle testing of the hamstring in prone with knee bent at 90°, revealed 5/5 static strength with no pain during eccentric loading. Strengthening was progressed at this point with bridge walkouts, core stability training with Pilates supine leg scissoring, and hamstring curls using a Swiss ball. Her SLR was near normal posttreatment measuring 125°.

Two months postinjury she measured 133° SLR on the right with 2/10 pain at the IT and 135° SLR on the left (Table 2). Exercise progression during weeks 8 and 9 included tall kneeling Nordic hamstring strengthening, Pilates core strengthening including jackknife and rollover exercises to incorporate hamstrings, end-range hamstring contraction with small ball squeezes in standing (Figure 3), "Airplane" balance,[28-30] (Figures 4 and 5) and single-leg dead lifts[31] for eccentric hamstring loading. Dance specific techniques were incorporated in balance exercises with passé développé movements into flexion, abduction, and extension. Return to dance progression was discussed with the patient and her mother, and she was encouraged to complete a daily 30-minute strengthening program for her core, hip rotators, and hamstring strengthening per initiated exercises. She was asked to rotate hamstring strengthening exercises every other day choosing among Swiss ball hamstring curls, single-leg dead lifts, end-range hamstring contraction with small ball squeezes in standing, Nordic curls, and bridge walkouts.

She had no pain with leaps or splits during week 9; therefore, progressive strengthening (Figures 6 and 7) and balance interventions continued. The following week she measured arabesque ROM (hip extension in standing) on the right leg at 70° of extension and 82° of extension on the left leg. The patient completed all stretching without pain and reported no pain with her home exercise program.

She had a setback at 11 weeks postinjury reporting increased pain to 3/10, primarily after completing her home exercise program. Her hamstring strength was 4+/5 with MMT in prone and knee bent to 90°; she reported ischial tuberosity pain with SLR and continued to have decreased SLR ROM at approximately 100° on the right during the 12th week. She was referred at 13 weeks for follow-up radiographs, which showed a small line present at the ischial tuberosity but no distinguished fracture. Manual therapy was introduced again at 11 to 14 weeks with emphasis on soft tissue release of the hamstring muscle belly and cross friction to adhesions within the musculotendinous unit.

Outcomes

She began modified dancing at 14 weeks postinjury with restrictions to the barre portion of ballet and tap dance classes. She began to independently manage her strengthening at 15 weeks with one

Table 2. Intervention Progression

Weeks postinjury and visit count	9-10 weeks 2 visits	11-12 weeks 2 visits	14 weeks 1 visit	15 weeks 1 visit	27 weeks (6 months) 1 visit
Right SLR ROM	Week 9: 135° Week 10: not tested	Week 11: 90° Week 12: 100°	Not tested	110°	122° Bilaterally no pain
Intervention	Roman dead lifts, Airplanes, Standing hamstring exercise with ball squeezes at variable speeds, Nordic curls, Single leg bridge, Ball Hamstring curls, Ball bridges, Down dog arabesque, Plank arabesque	Hamstring frictions, Ice massage, Stretch hamstring manually	Hamstring frictions, Contract/relax right hamstring	Airplane, Roman Dead Lifts, Swiss ball hamstring curls, bridges (all progressed with dynamic surfaces) Pilates: superman, rolldown, leg circles, leg pull up/down	Hamstring frictions, Hamstring stretch, reviewed hamstring curls on ball and bridges at various angles
Pain Rating	0/10	Week 11: 3/10 in muscle Week 12: 0-2/10	Not rated	0/10	0/10
Post treatment SLR ROM	Not tested	Slight increase	122° Right 137° Left	Not tested	Not tested

Abbreviations: SLR, straight leg raise; ROM, range of motion

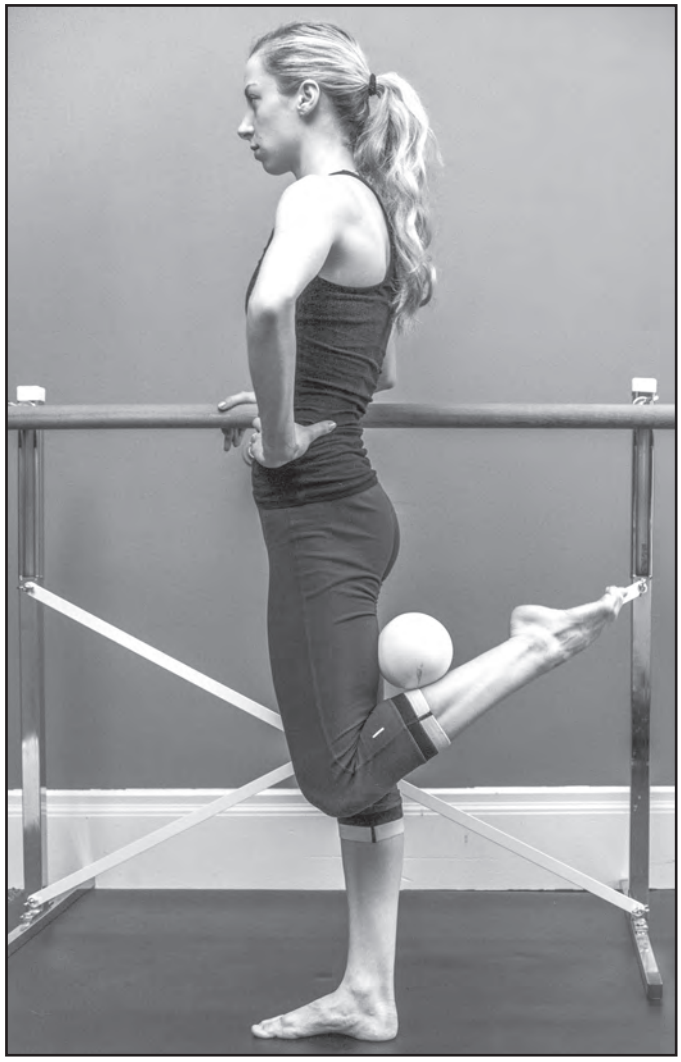

Figure 3. End-range hamstring contraction with small ball squeezes in standing.

Figure 4. Airplane balance.

returning follow-up visit at 6 months. She was still slightly limited to 122° of ROM during SLR on the right, but she reported no pain. She had decreased hamstring strength on the right in prone testing 4/5 and reported some hamstring soreness and fatigue with dance.

Discharge planning discussions with her and her mother

Figure 5. Airplane balance into plié.

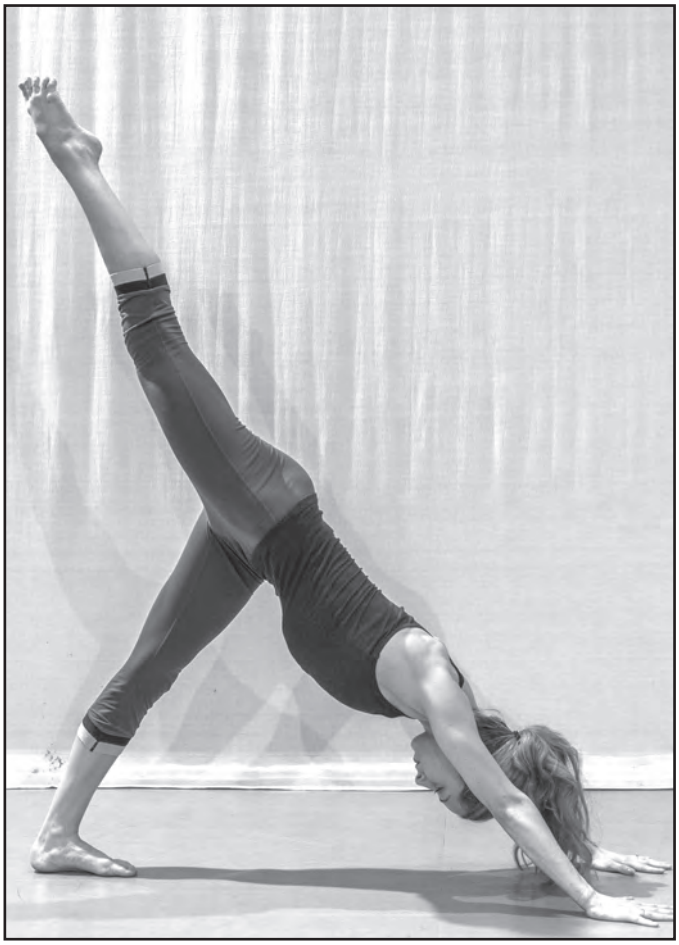

Figure 6. Downdog arabesque.

emphasized ongoing hamstring and core strengthening as previously prescribed. She did not require any additional visits although a follow-up visit was completed at 6 months.

DISCUSSION

Throughout the rehabilitation program the patient's mother reported financial concerns. This consideration impacted the treatment plan, resulting in reduced attendance, as the original recommendation was therapy twice a week for 6 weeks followed by once a week for 4 weeks. This change in frequency—despite patient education aimed to ensure the dancer followed guidelines for return to

Figure 7. Plank arabesque.

dance that included maintaining low level pain during stretching and strengthening—resulted in less guidance during more challenging exercise progressions. This could account for the dancer's increased pain and weakness at approximately 10 weeks postinjury as the dancer increased load on the hamstring by incorporating more dance-based movements at home. She reported compliance with the strengthening program but likely accelerated her home program too quickly due to lack of skilled supervision. Jumps and leaps were not introduced in the clinic, which may have been a contributing factor as well. More comprehensive neuromuscular re-education of her lower extremities, such as the dance specific jump protocol from the Harkness Center for Dance Injuries, as well as dynamic exercises for strength and agility could have been emphasized more toward the end of her rehabilitation. This case report demonstrates a progressive full weight-bearing conservative approach to IT avulsions in the skeletally immature patient, which could assist with further studies as well as clinical management of similar patients.

CONCLUSION

Progressive treatment of adolescent patients with IT avulsion fractures has been scantily outlined in the literature. While we know that athletes across various sports present with IT avulsions, we have no clear parameters for return to sport. We do know that stretch-type hamstring injuries in dancers tend to have longer healing time frames than sprinters,[32,33] which could be significant when treating an adolescent athlete with a stretch-type avulsion at the IT. The literature discusses eccentric loading for hamstring injuries, but there is still a lack of guidance concerning full weight-bearing physical therapy rehabilitation for an avulsion fracture with associated hamstring strain. This case report presents a conservative treatment for a 1mm avulsion fracture at the IT growth plate with return to dance at 14 weeks and full recovery reported at a 6-month follow-up. The progression of treatment and relative rest effectively returned this adolescent athlete to full athletic activity without reoccurring pain or injury and should be considered in patients with similar diagnoses.

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