0008-3194/2010/293–300/$2.00/©JCCA 2010

Posterior tibialis tendonopathy in an adolescent soccer player: a case report

Erik A. Yuill DC, MSc, BSc, BPHE*
Ian G. MacIntyre DC, FCCSS(C), BSc**

Objective: *Detail the progress of an adolescent soccer player with right-sided chronic medial foot pain due to striking an opponent's leg while kicking the ball. The patient underwent diagnostic ultrasound and a conservative treatment plan.*

Clinical Features: *The most important features were hindfoot varus, forefoot abduction, flatfoot deformity, and inability to single leg heel raise due to pain. Conventional treatment was aimed at decreasing hypertonicity and improving function of the posterior tibialis muscle and tendon.*

Intervention and Outcome: *Conservative treatment approach utilized soft tissue therapy in the form of Active Release Technique®, and eccentric exercises designed to focus on the posterior tibial muscle and lower limb stability. Outcome measures included subjective pain ratings, and resisted muscle testing.*

Conclusion: *A patient with posterior tibialis tendonopathy due to injury while playing soccer was relieved of his pain after 4 treatments over 4 weeks of soft tissue therapy and rehabilitative exercises focusing on the lower limb, specifically the posterior tibialis muscle.*
(JCCA 2010; 54(4):293–300)

KEY WORDS: foot, adolescent, soccer, injury, tendonopathy

Objectif : *Détailler la progression d'un joueur de soccer adolescent souffrant d'une douleur chronique interne au pied après avoir frappé un adversaire en donnant un coup de pied sur le ballon. Le patient a subi une ultrasonoscopie et un traitement conservateur.*

Particularités cliniques : *Les plus importantes particularités étaient le varus de l'arrière-pied, l'adduction de l'avant-pied, la difformité du pied plat, et l'incapacité de soulever le talon en raison de la douleur. Le traitement conventionnel avait pour but de diminuer l'hypertonicité et d'améliorer la fonction du tendon du muscle tibial postérieur.*

Intervention et résultat : *Le traitement conservateur comprenait la thérapie des tissus mous sous la forme d'Active Release Technique®, et des exercices excentriques axés sur le muscle tibial postérieur et la stabilité du membre inférieur. La liste des indicateurs de résultats comprenait l'évaluation subjective de la douleur et le test du muscle contrarié.*

Conclusion : *Un patient souffrant de tendonopathie tibiale postérieure suite à une blessure subie en jouant au soccer fut soulagé de sa douleur après 4 traitements durant 4 semaines de thérapie des tissus mous et d'exercices de réhabilitation axés sur le membre inférieur, particulièrement le muscle tibial postérieur.*
(JCCA 2010; 54(4):293–300)

MOTS CLÉS : pied, adolescent, soccer, blessure, tendonopathie

* Sports Science Resident, Canadian Memorial Chiropractic College, 6100 Leslie St., Toronto, Ontario, M2H 3J1. Phone: (416) 482-2340 x287. Fax: (416) 646-1114. Email: eyuill@cmcc.ca
** Assistant Professor, CMCC

Introduction

Injuries are an unfortunate part of any sporting activity and soccer is no exception. Due to the nature of the sport the majority of soccer injuries occur in the lower limb, especially the ankle.[1,2] It should come as no surprise that lower limb injuries are a common complaint that present to a chiropractic sports clinic. Injuries in soccer typically occur because of tackling, being tackled, running, shooting, twisting and turning, jumping and landing.[2] A suggested reason for the higher incidences of ankle injuries is its close approximation to the ball, which is the main object of control in the sport. The chances of sustaining an ankle injury are highest when a player is tackling, shooting, or dribbling.[2] Risk factors for soccer related injuries include age, gender, skill level, environment, and surface type.[1] Epidemiological evidence indicates that approximately 10–15 injuries occur in soccer per 1000 playing hours.[1] Older age players appear to be more prone to injury than younger ones, as do higher skill level athletes.[2] Environment can also play a role in increased incidence, as playing indoors or on artificial turf has been linked with an increase in injury. Males are more susceptible to ankle injuries while it is reported that knees are the most frequent injury for females.[2]

Avulsion injuries for soccer players are rare. They can present as groin pain from a sports hernia (tear of the abdominal muscles attachments to the pubic tubercle), or rectus femoris injury (tear of proximal attachment from the anterior inferior iliac spine avulsion).[3,4] In younger athletes consideration must also be given to apophyseal injuries. These injuries typically occur between 8 and 15 years of age and are associated with skeletal immaturity, muscle-tendon imbalance, and repetitive microtrauma. Common apophyseal injuries in young athletes include Osgood-Schlatter disease (tibial tuberosity), Sever's disease (posterior calcaneus), Sindig-Larsen-Johansson syndrome (inferior patella), and medial epicondylitis (medial humeral epicondyle).[5] Navicular fractures can also occur in athletes though they are far less common in soccer players.[6,7] As well to-date there have been few avulsion injuries reported with the navicular bone (main distal attachment site of the posterior tibialis muscle) and not a single navicular apophsyeal injury in a young athlete.[8,9]

A common tendon injury associated with soccer however is the posterior tibial tendon (PTT).[1] The prevalence of PPT dysfunction in the general population is approximately 3.3% and often results in adult acquired flatfoot deformity.[10] In soccer athletes injuries to this tendon result from repetitive kicking of the ball. During a ball strike the ankle is forced into excessive plantar-flexion and the foot into extreme pronation. Consequently the PTT can become irritated due to friction against the medial malleolus and subject to a number of pathological changes such as avulsion, longitudinal tear, or rupture of the mid tendon substance.[1,11] The medial malleolus acts to change the direction of pull by the tendon. This is believed to cause increased stress on the tendon as ruptures typically occur in this location.[12]

The mechanism of injury is theorized to be a degenerative process of the PTT caused by decreased blood supply. This then results in a tendon dysfunction with possible rupture and gradual collapse of the medial longitudinal arch of the foot. Other common findings associated with PTT dysfunction include hindfoot valgus deformity and forefoot abduction. Mechanically the PTT is stressed during gait immediately after heel strike as the hindfoot moves from eversion into inversion. As the angulation of the hindfoot increases the forefoot compensates by progressively moving into an abducted position. Cutting sports such as soccer are known to place increased stress on the PTT.[13,14] Additionally, as the PTT becomes dysfunctional there is an imbalance with its antagonist muscle the fibularis brevis. The dominating unopposed action of the fibularis brevis also contributes to the deformities mentioned above (medial longitudinal arch collapse, hindfoot valgus, and forefoot abduction).[15,16] Finally, the presence of a prominent navicular tuberosity or an accessory navicular have been linked to PTT tears. Again the proposed mechanism of injury is chronic irritation of the tendon. However, the location of the tear is now at the navicular insertion, not at the level of the medial malleolus.[17]

The purpose of this case report was to describe an adolescent soccer player who experienced medial foot pain after attempting to strike the ball. The patient underwent a simple non-invasive chiropractic treatment plan using manual soft tissue procedures and rehabilitative training on the lower limb musculature.

Case Report

This case report involves a 14-year old male competitive soccer player who developed right medial foot pain after striking an opponent in the leg while trying to kick the

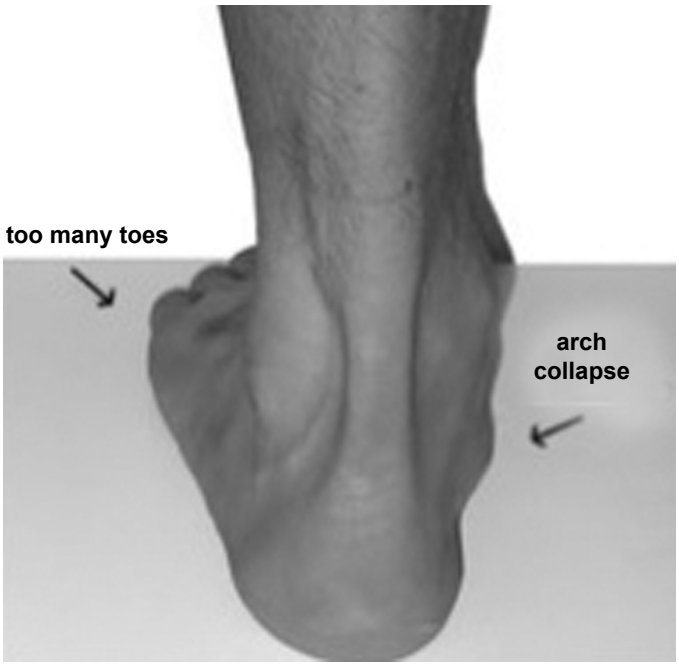

Figure 1 *Posterior view of foot and ankle showing "too many toes" sign and pes planus via collapse of the medial longitudinal arch.*

ball. The initial incident occurred 4 months prior to the patient's first visit. He recalls the injury as a direct impact of his right medial foot against the opponent's leg. This created a forced external rotation of the foot on the tibia. The athlete reported immediate pain and swelling of the medial foot and ankle. He had to be helped off of the field and was unable to return to play for the remainder of the game. The next day the subject saw a sports medical doctor who diagnosed him with a "bone bruise" and told the patient to rest for 4 to 6 weeks. No imaging was ordered at this time. After 6 weeks the patient reports that he was pain free with his activities of daily living. However, when he attempted to return to sport he was unable to continue due to sharp pain in his right medial foot. Jumping and landing particularly exacerbated his pain, which he rated as 8/10 on a Visual Analog Scale (VAS). Running was reported as normal. It was not until 4 months after his initial injury that the patient presented to a chiropractic sports clinic for treatment. The patient reported no previous history of injury and a systems review was unremarkable.

On physical examination postural observation of the subject revealed pes planus of his right foot when viewed

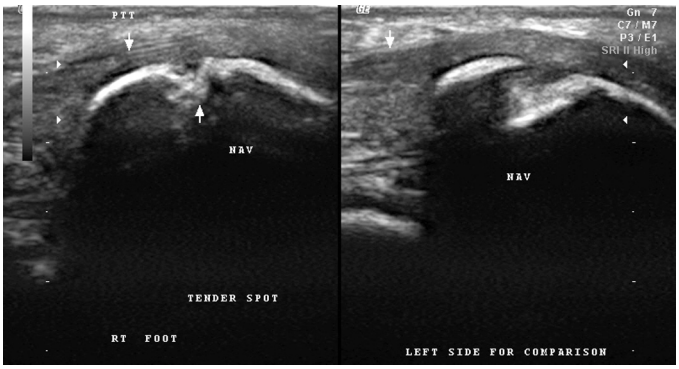

Figure 2 *Diagnostic ultrasound results showing thickening of the right tibialis posterior tendon at the navicular insertion and irregularity of the bone at the right navicular tuberosity.*

from the front and "too many toes" sign when observed from behind (Figure 1). Moderate pronation of the right foot was also observed with gait analysis. Palpation reproduced pain over the right navicular tuberosity, which appeared to be mildly swollen. Orthopedic testing found ankle range of motion to be normal and tuning fork test over the navicular to be negative. Hop test was positive due to pain on the right side. Functional testing also reproduced weakness due to pain (6/10 VAS score) with single leg heel raises. One legged squat revealed severe foot pronation, internal femoral and tibial rotation, and valgus knee deviation on the right side. Muscle testing of the posterior tibialis found weakness with resisted foot inversion (Score of 4/5 due to pain).

The patient was diagnosed with a suspected posterior tibialis tendonopathy. Due to the length of time the patient had been experiencing pain (4 months) and mild visual deformity over the right navicular tuberosity he was referred for ultrasound imaging to rule out an avulsion fracture, tendon tear, or accessory navicular ossicle. Diagnostic ultrasound showed thickening of the right posterior tibial tendon and irregularity of the navicular tuberosity bone (indicating an old avulsion fracture or apophyseal injury given the patient's age) (Figure 2).

Treatment

The patient was treated with 4 sessions over 4 weeks. Passive treatment consisted of Active Release Technique® (ART®) therapy to the posterior tibialis tendon insertion

Figure 3 *"Tib post heel-ups" exercise for the posterior tibials muscle, done while squeezing the tennis ball between the medial malleoli.*

and muscle. ART® is used by conservative care practitioners (chiropractors, physiotherapists, and message therapists) with an understanding that anatomical structures throughout the body have traversing tissues located at oblique angles to one another. Areas of tissue overlap are prone to negative changes with trauma producing local swelling, fibrosis and adhesions that can result in pain and tenderness at the location of injury.[12] During ART® therapy the practitioner applies digital tension along the tissue fibers at tender areas of adhesion. The patient is then instructed to actively move the tissue fibers of the injury site from a shortened to a lengthened position.[12,13]

Additionally active care consisted of the patient being prescribed 3 types of rehabilitative exercises. Posterior tibials muscle exercises of "tib post heel-ups" while squeezing a tennis ball between the medial malleoli were given (Figure 3). Lower limb stability exercises consisted of single leg supine bridges on a physioball, single leg squats, and "clock squats" (Figure 4). As well, gluteus medius muscle exercises consisted of hip hikes, side lying abduction, and lateral theraband walking (Figure 5). All exercise programs were done 2 times per day, 6 days per week.

After 4 weeks of treatment the patient was able to finally return to playing soccer relatively pain free (1/10 VAS score with jumping and landing). Functional muscle testing of the posterior tibialis showed decreased weakness and improvement (score of 5/5). This patient was not considered a surgical candidate as his injury was no longer acute at the time of presentation and a trial course of conservative care was successful in allowing him to return to play pain free.

Discussion

Soccer is one of the most popular sports on the planet with hundreds of millions of players throughout the world.[19] In North America its popularity is continuing to rise and soccer is starting to emerge as a major amateur and professional sport.[1] It is a unique sport that involves walking, jogging, running, and sprinting at various times in play. The characteristics of the game along with a high demand for functional activities place significant demands on the athlete's physical and technical skills while playing. Thus many of the injuries and medical problems that arise can be distinct to the sport.[1] Previous studies have demonstrated a high injury rate associated with soccer. In fact more injuries are found in soccer than such contact sports as judo, boxing, and rugby. The most commonly reported injuries among soccer players are the ankle, knee, thigh, groin, and hip.[2] The anatomical dominance of injury to the lower limb region is not surprising when one considers the repetitive forces required from weight-bearing activities such as running, sprinting, jumping, and landing.

The patient in this case report was an adolescent male who sustained a medial foot and ankle injury while attempting to kick the ball, a mechanism of injury all too common to soccer athletes. As previously mentioned the ankle's close approximation to the ball is a possible explanation for the increased incidence of injury in soccer players and the chances of sustaining this type of injury are highest when performing such kicking actions as shooting or dribbling.[2]

The posterior tibialis muscle has proximal attachments on the posterior tibia, interosseous membrane, and proximal third of the fibula. It travels medially around the ankle and inserts distally on the navicular bone in the area

Figure 4 *"Clock squats" exercise for lower limb stability. Flex the knee of the weight bearing leg to 15–20° while reaching the non-weight bearing leg toward each of the four clock positions as shown below. Return to the start position after reaching each clock number.*

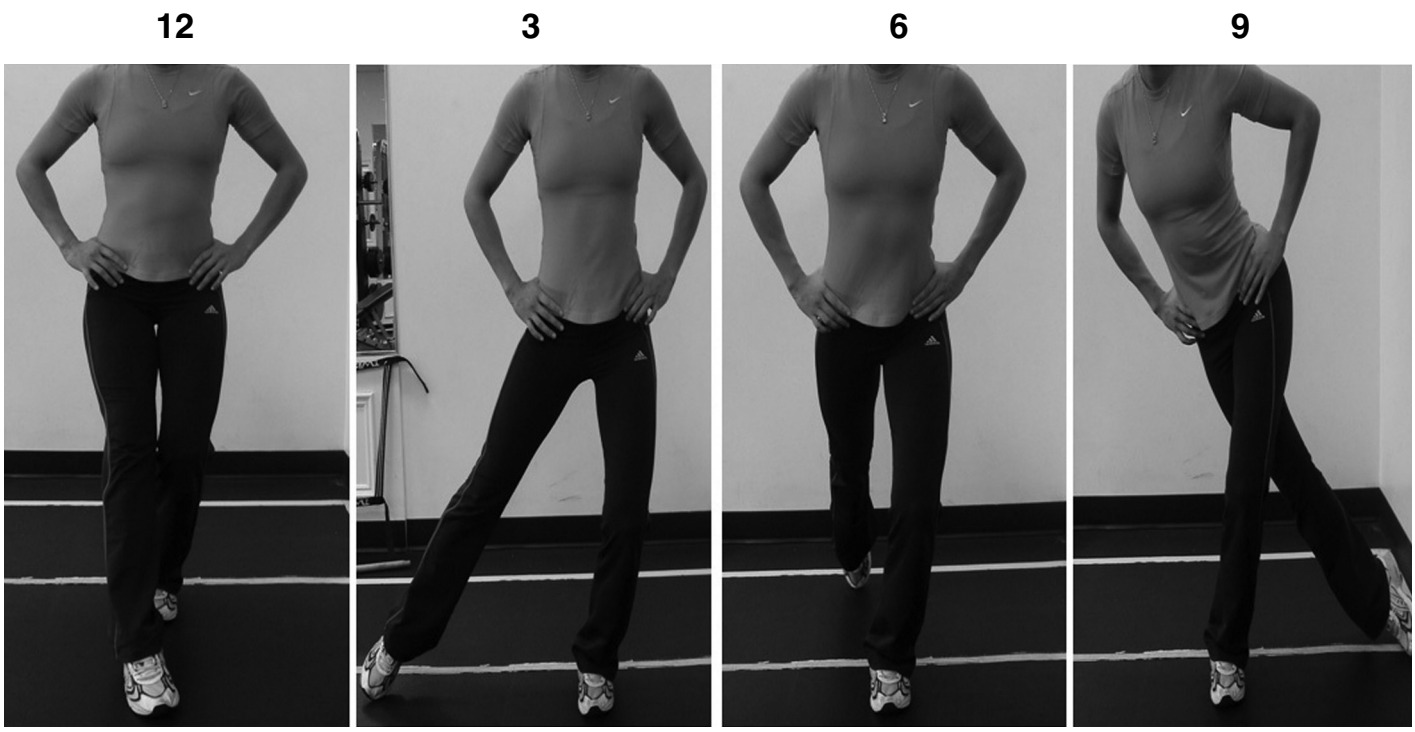

Figure 5 *Lateral theraband walking exercise for gluteus medius muscle rehab. Perform a slow and controlled lateral shuffle to one side (8–10 steps), then repeat to the opposite side.*

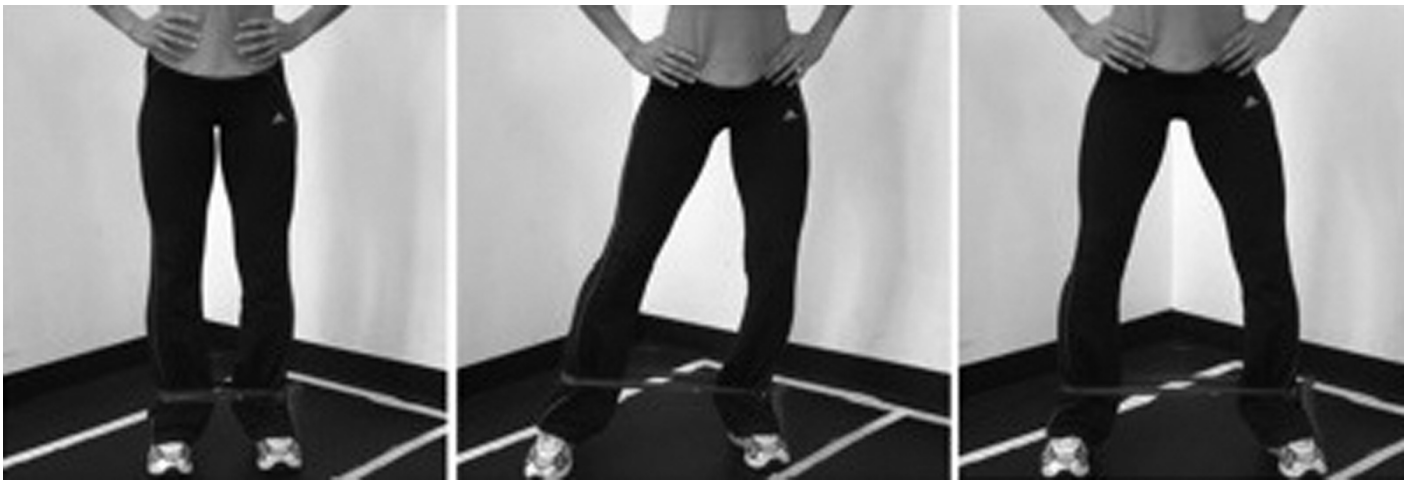

Table 1 *Progressive classification of posterior tibial tendon dysfunction stages.*[13,15,21,22]

Classification Stages	Description
Stage I	The patient has pain and swelling along the tendon, is able to perform single heel raises, flatfoot deformity is minimal, and the subtalar joint is mobile.
Stage II	The patient is unable to perform a single heel raise, flatfoot deformity is pronounced with hindfoot valgus and forefoot abduction, and the subtalar joint remains mobile.
Stage III	The patient cannot single heel raise, flatfoot deformity is more severe, and the subtalar joint becomes ridged.
Stage IV	All of the findings in Stage III as well as valgus tilt of the talus in the ankle mortise joint leading to lateral tibiotalar degeneration

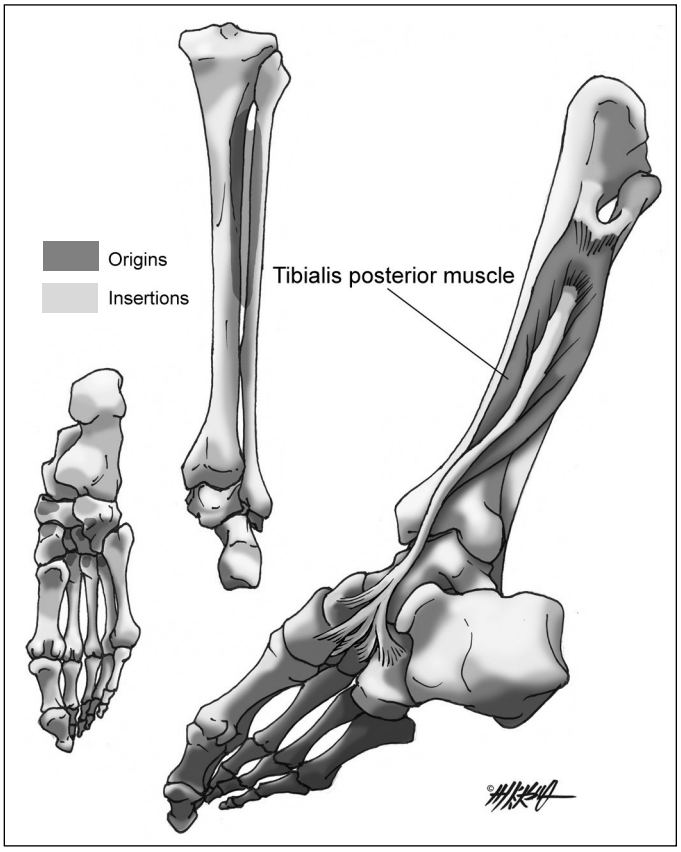

Figure 6 *Anatomical depiction of tibialis posterior muscle and tendon attachments.*

of the midfoot (Figure 6).[13,18] This muscle functions as a plantar flexor and powerful inverter of the foot, it also provides support to the medial longitudinal arch, and stabilizes against hindfoot valgus and forefoot abduction deformities.[16,20] The true etiology of PTT dysfunction still remains unclear. Vascular, metabolic, and mechanical factors have all been suggested to play a part, and conditions such as hypertension, diabetes mellitus, obesity, previous midfoot trauma, seronegative arthropathies, and enthesopathies have been identified as risk factors.[13,16,18] Johnson and Strom originally created a classification system for PTT dysfunction that was later added to by Myerson (Table 1).[21,22]

Navicular avulsions of the PTT in athletes, though rare, have been reported.[8,9] Avulsions of epiphyseal bone can occur after only slight exertion and are thus termed stress avulsions or apophyseal injuries depending on the age of the athlete. Avulsions are far less common after closure of the epiphysis.[8] Several theories have been given to explain the development of apophsyeal injuries in young athletes. The first theory suggests that a major traumatic event, such as a violent contraction, avulses part of the apophysis and inflammation ensues.[5] Theory two proposes repetitive microtrauma to an apophyseal area causes multiple tiny avulsion fractures, followed by an inflammatory cycle developed from repetitive running and jumping (as in sports such as soccer).[5] The third theory is that aphophyseal injury is due to a macrotraumatic event that either preceded or followed multiple episodes of repetitive microtrauma to the area.[5] The purposed mechanism for avulsion injury at the navicular bone involves repetitive cycling of compressive and twisting loads caused by forceful movements of the foot.[8] During maximal effort (occurring during running, jumping, or kicking) the navicular is locked be-

tween the proximal and distal tarsal bones, and subjected to bending and compressive forces from muscle and ligament attachments. Pull is suggested to be greatest at the medial aspect of the navicular, where the PTT attaches.[8] It should be noted that cortical avulsion fractures of the navicular occur most often as a result of twisting forces applied to the foot and are seen most frequently in middle aged women wearing high-heel shoes.[9]

The PTT and navicular have been implicated in overuse injuries in athletes, specifically those that have an accessory navicular bone within the tendon or close to the attachment site.[20] The distinction between an accessory navicular bone and a sesamoid bone can be confusing. Clinicians often simplify this and call any bone close the PTT attachment site a "asscessory navicular" and classify it based on size, location, and relationship to the true navicular bone. There are 2 types of accessory navicular, type I bones lie fully within the structure of the tendon proximal to the attachment, while type II bones lie very close to the navicular tuberosity and form a synovial joint with it.[20] While it has long been known that the PTT may have accessory bones within it that can be associated with foot pain, it is now also being associated with PTT tears as well. Chronic irritation of the tendon at its navicular insertion (due to the accessory bone) is the proposed mechanism of injury for the tear. Injury to the synovial joint of a type II accessory navicular combined with tension and shear forces from the tendon prevent healing and predispose the PTT to tearing.[11,18,20] It is important to remember however, that even when degenerative changes are associated with the finding of an accessory navicular bone it does not exclude the possibility of other parts of the PTT, such as behind the medial maleollus, from undergoing injury and thus causing pain.[20]

Stage I and II PTT dysfunction are rarely treated with surgery unless conservative care has failed. There are a variety of isolated soft-tissue procedures designed to compensate for these injuries. A wide variety of operative treatments have been reported for stage III and IV PTT dysfunction, navicular avulsions, and symptomatic accessory navicular bones. Reconstructive surgeries or osteotomies are employed to improve alignment of the hindfoot and forefoot and decrease pain at the site of PTT attachment. However, recovery from reconstructive surgery can be prolonged and an eventual return to pain-free unrestricted activities is variable.[13]

Summary

Foot and ankle injuries in soccer players have been widely reported, however to our knowledge this is the first case where a potential navicular apophsyeal injury has been reported and treated in a young soccer player.[1,2,19] The cause of injury is believed to be multi-factorial and include repetitive microtrauma to the navicular as well as weakness of the PTT due to the forces and mechanics involved with repetitive kicking of the ball in soccer. Conventional treatment aimed at decreasing hypertonicity and improving function of the posterior tibialis muscle and tendon through ART® soft tissue therapy, and rehabilitative exercises focusing on the lower limb stability. In this case, a patient with right chronic medial foot pain due to striking an opponent's leg while attempting to kick a soccer ball appeared to be relieved of his pain after having 4 treatments over 4 weeks.

References

1 Manning M, Levy R. Soccer. Phys Med Rehabil Clin N Am. 2006; 17:677–695.
2 Wong P, Hong Y. Soccer injury in the lower extremities. Br J Sports Med. 2005; 39:473–482.
3 Farber A, Wilckens J. Sports Hernia: Diagnosis and Therapeutic Approach. J Am Acad Orthop Surg. 2007; 15:507–514.
4 Atalar H, Kayao E, Yavuz O, Selek H. Avulsion fracture of the anterior inferior iliac spine. Turkish J Trauma & Emergency Surgery. 2007; 13(4):322–325.
5 Peck D. Apophyseal injuries in the young athlete. American Family Physician. 1995; 51(8):1891–1895.
6 Luthje P, Nurmi I. Fracture-dislocation of the tarsal navicular in a soccer player. Scand J Med Sci Sports. 2002; 12:236–240.
7 Coris E, Lombardo J. Tarsal navicular stress fractures. American Family Physician. 2003; 67(1):85–90.
8 Orava S, Karpakka J, Hulkko A, Takala T. Stress avulsion fracture of the tarsal navicular: An uncommon sports-related overuse injury. Am J Sports Med. 1991; 19(4):392–395.
9 Bayramoğlu A, Demiryu D, Firat A, Oanznur A, Oanzsoy M. Differential diagnosis in a professional basketball player with foot pain: is it an avulsion fracture or an os supranaviculare? Joint Dis Rel Surg. 2009; 20(1):59–61.
10 Kohls-Gatzoulis J, Woods B, Angel J, Singh D. The prevalence of symptomatic posterior tibialis tendon dysfunction in women over the age of 40 in England. Foot Ankle Surg. 2009; 15(2):75–81.
11 Chen Y, Wen-Wei R, Liang S. Degeneration of the accessory navicular synchondrosis presenting as rupture

of the posterior tibial tendon. J Bone Joint Surg. 1997; 79(12):1791–1798.
12 Leahy P. Active Release Technique®, soft tissue management system for the lower extremity. Champion Health Activity. 2008
13 Howitt S, Jung S, Hammonds N. Conservative treatment of a tibialis posterior strain in a novice triathlete: a case report. JCCA. 2009; 53(1):23–31.
14 Wapner K, Chao W. Nonoperative treatment of posterior tibial tendon dysfunction. Clin Orthop Rel Res. 1999; 365:39–45.
15 Jacoby S, Slauterbeck J, Raikin S. Acute posterior tibial tendon tear in an ice-hockey player: a case report. Foot & Ankle International. 2008; 29(10):1045–1048.
16 Feighan J, Towers J, Conti S. The use of magnetic resonance imaging in posterior tibial tendon dysfunction. Clin Orthop Relat Res. 1999; 365:23–38.
17 Karasick D, Schweitzer M. Tear of the posterior tibial tendon causing asymmetric flatfoot: radiologic findings. Am J Roentgenol. 1993; 161(6):1237–40.
18 Mosier S, Pomeroy G, Manoli A. Pathoanatomy and etiology of posterior tibial tendon dysfunction. Clin Orthop Relat Res. 1999; 365:12–22.
19 Ergen E, Ulkar B. Clin Sports Med. Proprioception and ankle injuries in soccer. 2008; 27(1):195–217.
20 Moriggl B, Kumai T, Milz S, Benjamin M. The structure and histopathology of the "Enthesis Organ" at the navicular insertion of the tendon of tibialis posterior. J Rheumatol. 2003; 30:508–17.
21 Johnson K. Tibialis posterior tendon dysfunction. Clin Orthop. 1989; 239:196–206.
22 Myerson M. Adult acquired flatfoot deformity: treatment of dysfunction of the posterior tibial tendon. J Bone Joint Surg. 1996; 78A:780–792.