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case report

Bilateral Tarsal Coalition in a National Collegiate Athletic Association Division I Basketball Player: A Case Report

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Objective: To present a case of bilateral subtalar joint coalition in a National Collegiate Athletic Association Division I basketball player and the treatment plan that was used to manage the coalition from the beginning of conference play through the postseason.

Background: A 20-year-old male basketball athlete (height = 182.8 cm, mass = 83.4 kg) presented with bilateral subtalar joint tarsal coalition that became symptomatic in 2006 and resulted in constant pain with any form of activity.

Differential Diagnosis: Traumatic injury of the talocalcaneal joint.

Treatment: Nonsurgical intervention of conservative therapy was elected.

Uniqueness: Less than 13% of the overall population is affected with tarsal coalition, so it is safe to assume that very few athletes competing at the collegiate or elite level suffer from this condition. This is the first report in the literature to document conservative manual therapies used to manage the symptoms of subtalar joint tarsal coalition in a Division I basketball player.

Conclusions: After the intensive treatment program for tarsal coalition was implemented, the patient experienced pain relief and was able to continue to compete at a competitive level. This case represents the need to further explore and document a conservative treatment protocol for tarsal coalition.

Key Words: rearfoot pain, peroneal spastic flatfoot, pes planus, talar beak

Tarsal coalition is a condition in which 2 or more tarsal bones have developed an abnormal union, resulting in restricted range of motion (ROM).[1,2] Although tarsal coalition has been primarily reported as a congenital condition due to an inherited autosomal dominant disorder, the coalition has also been acquired as a result of degenerative joint disease or arthritis.[2–4] The prevalence of tarsal coalition has been estimated from less than 1% to 13% of the population, with 50% of the cases occurring bilaterally.[1–3,5–9] The 2 most common locations of tarsal coalition are the talocalcaneal and calcaneonavicular joints.[1,4,5,8,9] Tarsal coalitions are described based on the progressive morphology of the coalition, from fibrous (syndesmosis) to cartilaginous (synchondrosis) and finally to osseous (synostosis). A fibrous or cartilaginous coalition is considered an incomplete coalition, whereas an osseous union is a complete coalition.[1]

Until 10 years ago, the literature referred to tarsal coalition as *peroneal spastic flatfoot* (PSF). The PSF term was coined from the peroneal muscle group being placed in a shortened and contracted state as a result of excessive pes planus.[1,5,10] However, upon further evaluation, PSF was defined as a splinting mechanism that occurs because of subtalar joint pain and is not synonymous with tarsal coalition. Thus, PSF (and the resultant subtalar joint pain) is secondary to tarsal coalition.[3,5,8] Individuals with tarsal coalition become symptomatic during the second decade of life because of the progressive ossification that occurs at the site.[1,6,9–11] Increased activity and the increased body mass index that naturally occurs with adolescence disturb the syndesmosis, progressing to synchondrosis, which results in pain.[2,5] The symptoms of subtalar joint tarsal coalition are vague rearfoot pain, stiffness in the foot (including the peroneal muscles and tendons and the medial longitudinal arch), and subtalar joint line tenderness.[1,9,10] The symptoms are exacerbated by walking, running, and increased duration of weight bearing. Ankle sprains are considered a noncongenital, traumatic contributing factor to tarsal coalition.[3,7] Tarsal coalition is a static condition and is not itself the cause of pain; however, the progressive ossifications that occur at the site of the coalition limit the normal joint ROM and cause pain. Based on the progressive nature of the ossifications at the coalition, foot mobility and ambulation become painful and are mechanically altered based on the severity of pain.[12] Other associated symptoms of tarsal coalition include painful pes planus, limited subtalar ROM, and a fallen longitudinal arch.[1,6]

Treatment for subtalar joint tarsal coalition consists of 2 options: nonsurgical and surgical. Conservative treatment is the first choice to address the pain, with the surgical option pursued if nonsurgical treatment is unsuccessful. Conservative treatment includes the use of a medial heel wedge or medial longitudinal arch support.[13] Other authors[14,15] have reported success from foot supports, ankle foot orthoses, or 6 weeks of casting. Casting was reported as the most effective conservative method of care, but none of the options provided lasting relief.[14,15] In a study of 20 athletes (26 feet), conservative methods failed and all patients required surgery.[16]

Surgical options used in the treatment of tarsal coalition are limited to excision of the coalition or arthrodesis of the subtalar joint.[17] Pain relief and return to activity from both surgical options have been reported.[3–5,8,11,18–21] The litera-

Figure 1. Photograph of the patient demonstrating pes planus.

Figure 2. Magnetic resonance imaging scan of the right foot showing moderate peroneal tendinopathy distal to the tip of the lateral malleolus, moderate posterior tibialis tenosynovitis, and trace fluid in the retrocalcaneal bursa.

ture[4] suggests that nonsurgical treatment does not typically allow individuals to return to their previous activity level. However, in 2 elite track runners who used foot orthoses, nonsurgical management allowed for return to activity at the previous level.[4]

The literature provides very few examples of rehabilitation regimens for conservative treatment of tarsal coalition. We were able to locate only 1 such case, which included ultrasound, joint mobilization, and a foot orthosis. After 5 days of the conservative care plan failed to relieve the patient's symptoms, surgery was undertaken.[5] Although tarsal coalition affects less than 13% of the population,[3] adequate data are presented in the literature concerning the condition. Much of the literature examines the surgical outcomes of tarsal coalition,[3–5,8,11,18–21] with few reports of nonsurgical treatment[4,19] and limited data available regarding rehabilitative measures used in conjunction with nonoperative care. Saxena and Erickson[4] noted that most individuals who present with tarsal coalition and elect the nonsurgical approach never return to their previous injury activity level. In the descriptions of the 2 individuals who were able to return to their previous activity level, foot orthoses were the basis of the rehabilitative approach.[4]

The purpose of our paper is to present the unique case of a National Collegiate Athletic Association Division I basketball athlete who was diagnosed with tarsal coalition and how that condition was managed conservatively. The conservative care program allowed the athlete the ability to complete the competitive basketball season, starting 30 of 31 games and averaging 34.1 minutes per game while maintaining pain at a tolerable level.

CASE HISTORY

The patient was a 20-year-old male basketball athlete (height = 182.8 cm, mass = 83.4 kg) who presented with bilateral tarsal coalition. When the tarsal coalition first became symptomatic in 2006, the patient was actively participating in high school basketball. He reported persistent bilateral foot pain while remaining extremely active in competitive basketball and opted for nonsurgical conservative treatment. The conservative regimen included nonsteroidal anti-inflammatory medication (NSAID) and foot orthotics and allowed the patient to complete his high school basketball season. His symptoms become more severe and physically limiting once he intensified his training regimen at the National Collegiate Athletic Association Division I level.

During the patient's first collegiate basketball season, he presented with bilateral foot pes planus and abduction (Figure 1). No swelling or inflammation was evident. Chief complaints described by the patient included vague bilateral rearfoot pain (8 of 10 on a visual analog pain scale (VAS; 0 = *no pain*, 10 = *most extreme pain*) with significant joint stiffness (ie, he could not walk without displaying an antalgic gait). During activity, the pain and restricted joint ROM would decrease (6 of 10 on the VAS and less pronounced antalgic gait) once the patient had been weight bearing and performing cardiovascular activities for at least 30 minutes. Pain would then escalate and ROM would become restricted, as noted by worsening of the antalgic gait once the activity subsided. During this period, the patient's treatment regimen consisted of NSAID, foot orthotics, and warm hydrotherapy.

In November 2009, the patient presented with bilateral foot pain and extreme pain in his left calcaneus. Magnetic resonance imaging of the right foot demonstrated moderate peroneal tendinopathy distal to the tip of the lateral malleolus, moderate posterior tibialis tenosynovitis, and trace fluid in the retrocalcaneal bursa (Figure 2). A stress reaction of the calcaneus was reported, but no fracture line was present. Talocalcaneal coalition of the middle subtalar facet was confirmed as cartilaginous with possible osseous union. Secondary findings included degenerative changes with bone marrow edema around the talocalcaneal joint. Magnetic resonance imaging of the left foot demonstrated peroneal tendinopathy at the distal tip of the fibula with no stress fracture along the calcaneus. The talocalcaneal coalition of the left middle facet was confirmed as cartilaginous without definite osseous union. Secondary findings included degenerative changes with marrow

Table 1. Joint-Mobilization Protocol

Talocrural joint in a loose packed position
Perform grade I joint mobilizations[a] for 30 s (approximately 40–45 small-amplitude oscillations)
Perform 10 passive dorsiflexion stretches (hold each for 20 s)
Perform grade II joint mobilizations[b] for 30–45 s (approximately 21 to 38 large-amplitude oscillations)
Perform 10 passive dorsiflexion stretches (hold each for 20 s)
Perform grade II joint mobilizations[b] for 45 s (approximately 38 large-amplitude oscillations)
Perform 10 passive dorsiflexion stretches (hold each for 20 s)

[a] Grade I joint mobilizations were replaced by grade III mobilizations after week 4.

[b] Grade II joint mobilizations were replaced by grade IV mobilizations after week 4.

Table 2. Conservative Care Program

Exercises
Warm whirlpool (15 min)
Actively move ankle by drawing letters, numbers, or shapes with foot.
Slant-board stretches
Both feet (3 × 30 s)
Single foot (3 × 30 s)
Foam rolling (5 min)
Roll up and down lateral, medial, and posterior musculature of the lower leg and foot (plantar fascia). For the plantar fascia, the athlete held the roller at a tender point and moved the foot around in circles 4–5 times to release the tense area. Repeat if needed.
Massage (5 min)
Using an analgesic balm, massage was performed to increase blood flow and relax the surrounding musculature, focusing on the lower leg and plantar fascia.
Joint mobilizations and passive range of motion (see Table 1)
After practice
Ice-water soak (15 min)

edema. The referring orthopaedic surgeon recommended the continued use of rigid orthotics and prescribed the NSAID nabumetone (Relafen 1000 mg per day; GlaxoSmithKline LLC, Philadelphia, PA). In addition to the NSAID, the therapeutic treatment regimen consisted of warm hydrotherapy, in an attempt to increase ROM, and foot orthotics. Postactivity, an ice-water soak was used to address the patient's pain. After activity, the patient would typically report pain as high as 10 of 10 on the VAS.

In January 2010, an athletic training student was assigned to the patient under the direction of the clinical coordinator of the entry-level graduate athletic training education program and the head athletic trainer for basketball. The student was instructed by the clinical coordinator, a certified athletic trainer, on manual therapies such as joint and soft tissue mobilizations. After the student demonstrated clinical proficiency, she was allowed to perform some of the learned therapies under the direction of the athletic trainer.

The conservative care program focused on joint mobilization and soft tissue massage and mobilization. Active and passive ROM were performed in an attempt to increase mobility and decrease pain at the subtalar and talocrural joints. Initial daily treatment focused on increasing plantar flexion, dorsiflexion, inversion, and eversion bilaterally with 15 minutes of hydrotherapy in a warm whirlpool. During hydrotherapy the patient performed active ROM movements with his feet submerged in the warm whirlpool. Hydrotherapy has been documented as a viable treatment for decreasing pain, increasing ROM, and restoring joint mobility to gain neuromuscular functional improvement.[22–24] After hydrotherapy, effleurage massage was performed bilaterally using an analgesic balm on the foot and ankle, focusing primarily on the Achilles tendon and plantar fascia. The topical analgesic was incorporated with the massage based on evidence that the agent can temporarily relieve pain by blocking the peripheral nerve signal to allow for altered pain perception.[25,26] The effleurage massage was implemented for its ability to decrease pain and anxiety as well as increase ROM.[27–32]

Joint mobilizations followed the analgesic effleurage massage to decrease pain and increase ROM.[33–39] Using the Maitland joint-mobilization classification,[33] grades I and II were primarily for joint pain and grades III and IV were to increase joint ROM (Table 1). To manage the patient's pain, grade I and II mobilizations were implemented daily. After 3 weeks of grade I and II mobilizations, grade III and IV mobilizations were introduced 2 to 3 times per week to improve ROM.[17,33,40] During the first week of performing the joint mobilizations, the subtalar and talocalcaneal joints were noted to be extremely restricted in movement. Most of the movement was in the upward or anterior directions; however, some force was generated in the posterior direction. The direction of force was based on the patient's restriction and pain in dorsiflexion. Anterior-to-posterior talocrural joint mobilizations have been shown to increase dorsiflexion ROM and decrease pain.[33–39,41,42]

Joint mobilization was used to increase blood flow and nutrients to the subtalar and talocrural joints.[40] The patient experienced no increase in pain with the joint mobilizations and responded well to the technique. During the first 2 weeks of grade I and II mobilizations, the patient reported his pain as an average of 6. After 2 weeks of grade III and IV mobilizations, the athletic trainer detected increased movement in the joints and the patient's VAS pain level decreased. Before joint mobilization, his average VAS pain range was 8 to 10. After 2 weeks of joint mobilization, the average VAS pain range was between 4 and 6. After the joint-mobilization session, the ankle was passively stretched in dorsiflexion and plantar flexion to increase mobility and stretch the Achilles tendon, gastrocnemius, and soleus muscles (Table 2).

Throughout conference play, the patient's pain levels were monitored daily with the VAS (Figure 3). The patient complained of significant pain after games, with difficulty ambulating into the following morning. On average, pain was between 7 and 10 immediately after games for the first 6 weeks of treatment. On practice days after a game, prepractice pain averaged 4 on the VAS. Once the patient reached midseason (6 weeks of treatment), pain immediately after a game decreased from 10+ on the VAS to less than 5. Although he still reported pain at an average of 5 or greater, he was able to ambulate with a less antalgic gait pattern.

In addition to pain, the patient also reported ankle and foot stiffness after games. Soft tissue mobilizations using a foam roller were performed on the lower leg musculature and plantar fascia to release the tension and address the restrictions.[32,42–47] Soft tissue mobilizations activate the

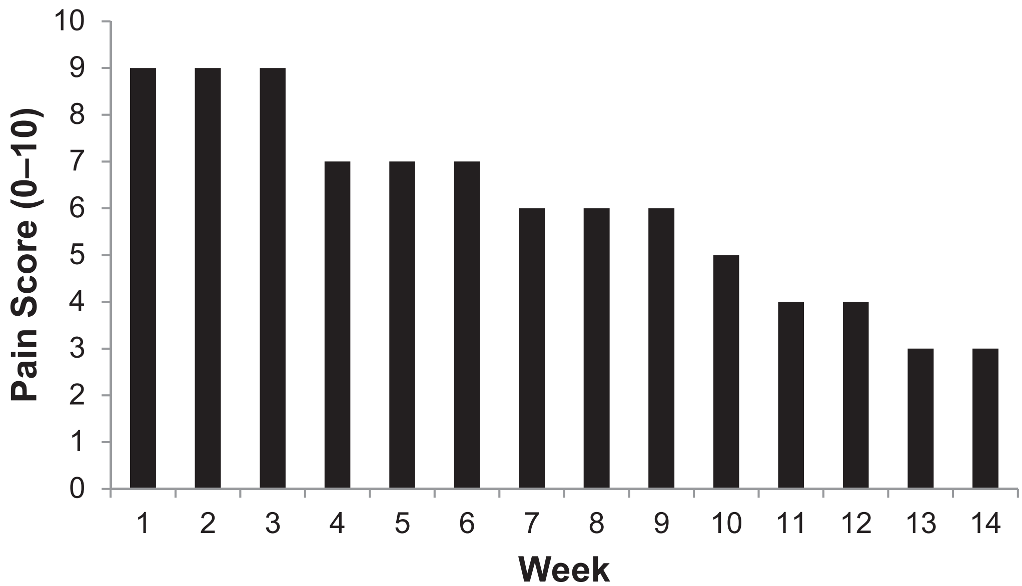

Figure 3. Average weekly pain reported on a visual analog scale of 1 to 10 (0 = *no pain*, 10 = *most extreme pain*). Values reflect 2 pain reports on game day (before and after game).

autogenic inhibition in the Golgi tendon organs, resulting in increased soft tissue extensibility.[44–46] The daily rehabilitation regimen consisted of 15 minutes of hydrotherapy treatment for ROM, analgesic massage, soft tissue mobilizations, and joint mobilizations. The 5-minute soft tissue mobilization protocol focused on the entire lower leg. After a week of soft tissue mobilizations, the patient began to feel a significant increase in ankle ROM, especially in the mornings. Before the soft tissue mobilizations, he needed assistance upon ambulation for the first 5 minutes after getting out of bed. After 5 days of soft tissue mobilizations, he was able to ambulate in the mornings without assistance. On clinical evaluation, dorsiflexion and plantar flexion increased an average of 7° to 12° and inversion and eversion increased an average of 5° to 7°.

A Functional Movement Screen (FMS; Functional Movement Systems, Danville, VA) was performed at the beginning and end of rehabilitation to document his progress. We chose the FMS because of its interrater reliability.[47] The FMS evaluated the patient's ability to perform a body-weight squat, hurdle step, and in-line lunge. Scoring is on a 0 to 3 scale, with 3 being the best possible score. The initial FMS (Table 3) resulted in an average score of 2 for the squat and hurdle but a score of 1 for the in-line lunge. At the end of postseason play, the FMS was performed again, with similar scores reported. We had postulated that FMS scores would rise because the patient demonstrated ROM improvements as evident in his gait. Although the improvements were not evident in the FMS scoring, documented observation did reveal improvements in both flexibility and body awareness.

From midseason to the end of postseason play, the conservative protocol continued, and the patient's pain was becoming manageable, with average postgame pain at 5 on the VAS scale. The conservative program allowed the patient to complete the season having started in 30 of 31 games and averaged 34.1 minutes per game with a pain level of 5 on the VAS scale. The patient reported that the 2009–2010 basketball season was his most painful because of the deterioration of his condition. However, anecdotally, he felt that the conservative care program pursued throughout the conference season and postseason allowed him to continue to perform at the desired competition level.

DISCUSSION

Few athletes competing at the collegiate or elite levels suffer from tarsal coalition. The literature suggests that a person is born with tarsal coalition and becomes symptomatic in the second decade of life.[1,4,5] A talocalcaneal coalition is thought to ossify between 12 and 16 years of age,[1,5] which explains why our patient became symptomatic at 15 to 16 years old. It has been claimed[3] that individuals

Table 3. Functional Movement Screen Results Before and After Conservative Treatment Program

Test	Leg	Score[a] Before Program	After Program	Comments
Body-weight squat		0	2	Mild pain (3 of 10 on visual analog scale) in left knee, tightness reported
Hurdle step	Right	2	2	Hip abduction to clear hurdle
	Left	2	2	Hip abduction to clear hurdle
In-line lunge	Right	1	1	Before program: fell off board (poor balance) After program: slight improvement in balance (did not fall off board)
	Left	1	1	Before program: fell off board (poor balance) After program: slight improvement in balance (did not fall off board)

[a] Lowest (worst) possible score = 1, highest (best) possible score = 3.

with tarsal coalition eventually become inactive and unable to participate in physical activities such as running, jumping, and endurance activities secondary to pain. Traditionally, bilateral tarsal coalition precludes one from reaching desired physical activity levels, much less elite performance levels.[4,13] Yet, our 21-year-old patient was able to continue competing at the Division I level.

Coalition of the talocalcaneal joint results in abnormal adhesions between the tarsal bones, altering the normal mechanical stresses by displacing them to other areas.[11,12] Some researchers[4,5,10,18] noted that before symptoms begin, flatfoot may not be observed on physical examination. Other authors[3,9,12] adamantly suggest that a significant case of pes planus is not always a precursor of tarsal coalition. Essentially, flatfoot from tarsal coalition is ridid, whereas congenital flatfoot is more flexible. Our patient, however, did present with a severe case of pes planus in the abducted position. He often reported tightness and tender points in the peroneal muscles and tendons before he applied soft tissue self-mobilization techniques. Peroneal muscle and tendon tightness was attributed to his significant pes planus, as well as his high intensity of physical activity, but the tightness could have also been from PSF. The patient's use of rigid orthotics and soft tissue mobilizations was successful in managing peroneal muscle pain and tightness. The orthotics were used to relieve some of the compressive forces due to the structural deformity and attempt to place the foot in a more neutral position[4,5,14,15]; the goal of the soft tissue mobilizations was to activate autogenic inhibition in the muscles of the lower leg.[44–46]

The joint mobilizations that were incorporated into the conservative care protocol were designed to relieve the patient's pain and improve his ROM.[33–39] The anterior-to-posterior mobilizations were intended to increase dorsiflexion ROM.[35–39] With subtalar joint mobilizations, dorsiflexion and plantar-flexion ROM as well as functional ability improved in patients with ankle fractures after 5 weeks of treatment.[35] In addition, the joint mobilizations led to decreased pain and increased pain-free dorsiflexion. Patients who received joint mobilizations had fewer absences from work than those who did not receive the treatment.[48] Short-term effects of joint mobilizations include decreased pain and increased functionality.[34,41]

When conservative treatment for tarsal coalition fails, surgical intervention is an option.[1,2,5,8] Often those who elect the nonsurgical approach are unable to continue at their previous level of activity.[4] As in any condition for which surgery is an option, the decision should be based on the individual. Our patient opted to rely on conservative treatment. While the patient was competing at the high school level, NSAIDs and foot orthotics allowed him to compete with minimal symptoms. However, once he progressed to the collegiate level, his symptoms became exacerbated, resulting in severe pain and movement limitations. The manual therapy approach of joint mobilizations, massage, and stretching allowed the patient to continue to function at his desired level. The joint mobilizations were mainly anterior to posterior, permitting increased dorsiflexion and decreasing pain. These mobilizations have previously been shown to be effective after prolonged ankle immobilization as well as for acute ankle sprains.[33–39] The rehabilitation steps used in this case were specifically intended to provide short-term comfort to enable continued competitive performance. The long-term benefits of this rehabilitation protocol require additional study.

CONCLUSIONS

This case study documents a unique condition of bilateral talocalcaneal coalition experienced by a National Collegiate Athletic Association Division I basketball player. For more than 3 years, the patient had suffered from bilateral rearfoot pain; he also sustained a right calcaneal stress fracture. His current and previous levels of athletic participation were deemed major contributing factors to his persistent symptoms. Once symptoms intensified, he was able to sustain his desired activity level through conservative treatment of orthotics, ice, and activity modification. During the 14 weeks of the conservative care program, the patient experienced significant pain relief, which permitted him to successfully complete his competitive season.

This case demonstrates the need to further explore and document conservative manual therapies that allow patients diagnosed with tarsal coalition to continue to compete at their desired levels.

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