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Differential Diagnosis of Tarsal Coalition Versus Cuboid Syndrome in an Adolescent Athlete

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BACKGROUND

Patients may be referred to physical therapy with a nonspecific diagnosis, an incorrect diagnosis, or no diagnosis at all.[2] Physical therapists are responsible for thoroughly evaluating each patient and then either treating the patient according to established guidelines or referring the patient elsewhere.

This case report involves a patient with lateral foot pain, which was diagnosed by a primary care physician as myalgia and diagnosed by an orthopaedic surgeon as a neuroma. There can be multiple causes of foot and ankle pain,[14] including ankle sprain, tendinitis, neuroma, tarsal tunnel syndrome, reflex sympathetic dystrophy, rheumatoid arthritis, stress fracture, plantar fasciitis, metatarsalgia, cuboid syndrome, and tarsal coalition. The patient's history and the objective evaluation findings led me to rule out some of these conditions as the cause of her foot pain. Two conditions remained as possible diagnoses: tarsal coalition and cuboid syndrome.

This report describes the process by which I determined the differential diagnosis and decided to refer this patient to another health care provider outside of physical therapy for additional diagnostic testing.

Tarsal Coalitions

A tarsal coalition is an abnormal condition involving a bridging between any 2 adjacent tarsal bones.[5,9,14,17] The etiology is not completely understood.[4,16] A tarsal coalition may occur between true anatomical joints, such as a talocalcaneal coalition (intra-articular), or between adjacent bones, which normally do not share a true joint (extra-articular), such as the calcaneonavicular coalition.[4,9] Tarsal coalitions may be osseous, cartilaginous (synchondrosis), fibrous (syndesmosis), or a combination.[5,9,16,17] A cartilaginous or fibrous coalition may be referred to as an incomplete coalition, and an osseous coalition as a complete coalition.[4]

Tarsal coalitions are relatively uncommon, with an incidence at or less than 1%.[3,9,16,17] The exact occurrence is difficult to assess because many people with tarsal coalitions are asymptomatic.[17] Tarsal coalitions are often unrecognized or misdiagnosed.[17] Approximately 90% of tarsal coalitions occur either at the calcaneonavicular joint or the talocalcaneal joint, with the distribution of these 2 types being equal.[3,9,13,16,17]

Tarsal coalitions can be described as being either congenital or acquired, with congenital coalitions being more prevalent.[3,4,16,17] Fifty to 60 percent of calcaneonavicular coalitions occur bilaterally.[4,13,17] Congenital coalitions have an autosomal dominant pattern of inheritance.[16,17] Symptoms of a congenital tarsal coalition generally appear as the coalitions ossify, usually between the ages of 8 and 16.[4,5,9,18] An adolescent patient puts added stress on the foot complex through increased body weight or participation in athletic activities. This increase in mechanical loading may contribute to the symptoms surfacing at this point in life.[13,18] A patient may be asymptomatic until a simple sprain or other minor trauma occurs.[3,9,17]

A fibrous coalition is relatively mobile and, therefore, may not cause any pain or limited motion.[16] As fibrous or cartilaginous coalitions ossify during adolescence,[4,9,14,16] rearfoot or midfoot joint range of motion decreases.[16,17] As the rearfoot or midfoot mobility decreases, additional stress is placed on the talocrural joint, increasing joint laxity at the ankle.[9,16] A

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patient with a tarsal coalition may report a history of repeated ankle sprains[3,13,16,17] or a history of aggravating episodes in preadolescence or adolescence.[3,16]

The most common complaint of a symptomatic patient with a tarsal coalition is pain.[9,10] Pain is usually aggravated by physical activity and eased with rest.[3,9,10,14,16] The aching pain is usually located over the region of the coalition,[9,16] but may be present at an adjacent joint or be reported as a vague rearfoot pain.[3,14,17] Calcaneonavicular coalitions may cause pain over the region of the sinus tarsi[10,13] or over the lateral plantar midfoot.[3,9,10] Once ossified, the pain may not be at the site of the coalition, but at adjacent joints which bear increased stress and strain.[18] A coalition's hypomobility may cause relative hypermobility and pain at an adjacent joint.[5,13] The patient usually has no symptoms of numbness or tingling.[13]

A patient with a calcaneonavicular coalition may have a pronated foot or calcaneal valgus,[3,16] although cases of coalitions in nonpronated feet have been documented.[8,9] The foot may be a rigid flatfoot, with no change in the height of the medial longitudinal arch from a non–weight-bearing position to a weight-bearing position.[9,16] With fibrous or cartilaginous coalitions, the foot may have limited range of motion. Once ossified, rearfoot range of motion decreases significantly, and the calcaneus may assume a rigid valgus position.[3,5,10,14,16,18] However, foot position and foot range of motion vary considerably in patients with tarsal coalitions.[9]

One characteristic that may be associated with a tarsal coalition is a peroneal spastic flatfoot.[9,10] With decreased inversion range of motion, the peroneal tendons become shortened and place the foot in a pronated position.[17] Then, with attempted inversion or supination out of this shortened range, the peroneal muscles protectively spasm.[9,13,14] A spastic peroneus longus is not always present in calcaneonavicular coalitions.[5,9,17]

Thus, a patient with a tarsal coalition does not necessarily have rigid foot, a flatfoot, nor a peroneal spasm.[5,9] A physical therapist should suspect a tarsal coalition based on the history (adolescent with repeated episodes of foot pain) and clinical examination (limited range of motion, tenderness to palpation, and peroneal spasm). Diagnostic tests may then confirm the diagnosis.[18]

The diagnosis of a tarsal coalition may be made from a plain film radiograph, computerized tomography (CT) scan, magnetic resonance imaging (MRI), or bone scan.[16] Plain film radiographs are superior to other forms of imaging to identify ossified coalitions.[3,4] Nonossified coalitions may not be evident on plain radiographs; CT or MRI studies may be necessary to diagnose these types of coalitions.[4,9,17] Even without osseous bridging, plain film radiographs may demonstrate bony changes indicative of cartilaginous or fibrous coalitions, such as articular narrowing, cystic joint changes, and subchondral sclerosis.[3,4,9,10,16]

The diagnosis of an osseous calcaneonavicular coalition is usually made with oblique view (at 45 degrees) plain film radiographs.[4,9] Calcaneonavicular coalitions may be overlooked with standard anterior posterior and lateral films.[3] Oblique view radiographs are best to visualize this region and may be better than CT or MRI for diagnosing osseous calcaneonavicular coalitions.[3,9,16,17]

Conservative treatment for a tarsal coalition includes rest,[3,4] orthoses to support the medial longitudinal arch,[4,9,13] anti-inflammatory medication,[3,4,9,13,17] and immobilization with a short leg cast for 3 to 6 weeks.[14]

Some coalitions can be treated with nonsurgical measures,[13] but surgical resection is indicated with persistent pain.[3,9,14,17] Surgical intervention should be completed soon, before degenerative changes occur.[9,14] A good candidate for surgical resection is a young patient (less than 14 years of age) with pain and limited motion and without degenerative changes.[9,17] If a patient demonstrates arthritic changes, arthrodesis becomes the surgical intervention rather than just resection.[4]

Extra-articular coalitions (calcaneonavicular) usually do well with resection.[4] Outcomes postoperatively range from good to excellent, with many patients (69–95%) returning to athletics.[13,15,17]

Cuboid Syndrome

Cuboid syndrome is another cause of lateral foot pain in the adolescent athletic population and can be misdiagnosed or mistreated.[1,14] Cuboid syndrome is characterized by gradual or sudden onset of pain over the cuboid.[1] Additional contributing factors include increasing body weight, training on uneven terrain, and repeated inversion ankle sprains.[1]

The mechanism of injury consists of an inversion injury or repetitive stress.[1,12] With the foot inverted, the peroneals may contract in an attempt to get the medial foot on the ground.[1] The cuboid can sublux in a plantar direction, being pulled by the peroneus longus tendon.[11,12] If the cuboid remains subluxed, there may be a visible depression over the dorsal aspect of the cuboid.[11,12] The subluxation may irritate the joint capsule, ligaments, and the peroneus longus tendon, causing pain in these areas.[1]

Diagnostic tests, such as an MRI or plain film radiographs, may not be helpful in the diagnosis of cuboid syndrome.[11] The subluxation is often a temporary occurrence, and the cuboid may be in normal alignment on radiographs.[1,14] Instead, the diagnosis is based on the patient's history and physical exam.[1]

In the physical examination, the patient may demonstrate pain located over the lateral midfoot and tenderness to palpation over the plantar surface of the cuboid.[1,12,14] Range of motion may be decreased over the lateral foot.[12] The foot may likely be pronated, as cuboid syndrome occurs more often in pronated feet.[1,12,14] Overall, the symptoms of cuboid syndrome are nonspecific and subtle.[1] The recommended treatment for cuboid syndrome includes manual reduction (if necessary), rest, arch supports, or arch taping with a cuboid pad.[1,14]

Tarsal coalitions and cuboid syndrome can be present in adolescent athletes with similar, nonspecific symptoms.[1,9,14] A patient with either of these 2 conditions does not generally have a history of a macrotrauma. Symptoms are usually increased with activity and relieved with rest.[9,14,16] The patient usually has a pronated foot type,[1,3,16] and may report pain localized over the lateral midfoot. Diagnostic tests may be normal.[3,11]

In both cases, the lateral midfoot may be tender to palpation. There may not be any bony deformity or range of motion deficit.[12,14] Conservative treatment for both a tarsal coalition and cuboid syndrome consists of rest and immobilization.[1,12,13]

SUBJECT DESCRIPTION

History

A 16-year-old female track athlete (height 157.50 cm, weight 65.38 kg) was seen in physical therapy with a prescription from her primary care physician to be evaluated and treated for left foot myalgia. An orthopaedic surgeon had previously diagnosed her with a neuroma. She received an injection earlier in the year to treat the neuroma, but she reported no decrease in her foot symptoms following the injection.

She reported a 6-month history of left lateral midfoot pain, which she first noticed at track practice after running laps around the track. She denied a specific injury or onset. She related a slight increase in training at the time of onset, increasing sprint distance from 45 to 50 meters and decreasing rest periods between sets. At the time of onset, she competed in the 100- and 200-meter races, but she was not currently able to run at all due to foot pain.

She had received multiple diagnostic tests since the time of symptom onset. The diagnostic tests ordered by the orthopaedic surgeon and the primary care physician included an MRI, a bone scan, plain film radiographs, and hematological studies. The patient was not able to state why the hematological studies were completed. All tests failed to identify pathology. She denied other health problems, fever, or additional joint pain, which may have been indicative of a systemic pathological process.

The patient's history enabled me to rule out several possible diagnoses as the cause of her foot pain. With a lack of macrotrauma or specific onset, I ruled out an acute sprain. Because the bone scan was negative, a stress fracture was also ruled out. The normal results of the hematological studies ruled out a systemic rheumatological condition. Her pain was specifically located over the lateral midfoot, not the plantar forefoot. This location of pain, along with her lack of response to the neuroma injection, contributed to ruling out the diagnosis of a neuroma.

The patient's past medical history revealed a left hamstring strain 6 months before this onset. Unlike some patients with a tarsal coalition, she did not report repeated ankle sprains. Because her history did not include a traumatic inversion ankle sprain, sinus tarsi syndrome was ruled out.[7] She reported an episode of left foot pain approximately 2 years earlier, which she thought was diagnosed as Achilles tendonitis. These symptoms resolved with rest.

Subjective

She reported pain specific to the lateral midfoot, both on the dorsal and plantar surfaces, but primarily plantar. She pointed to the base of the fifth metatarsal and cuboid region on the left foot. She rated her pain intensity as a 7 on a scale of 0 to 10. She stated that she occasionally felt a popping sensation in this area. She denied experiencing any burning, shooting pain, numbness, tingling, or weakness, so I ruled out a peripheral nerve compression or entrapment.

Physical Examination

Observation The patient sat with slight rearfoot and forefoot inversion bilaterally. Medial longitudinal arch heights in non–weight-bearing were symmetrical. The patient stood with bilaterally pronated feet in the midfoot region, with a vertical calcaneal position in resting stance (Figure 1). Her resting stance position was at the end range of available pronation and tibial internal rotation. There was no evidence of swelling, ecchymosis, or visible foot deformity. Iliac crest heights were symmetrical.

Gait Gait was antalgic and characterized by decreased stance time on the left, with the entire left lower extremity in external rotation.

Range of Motion Active range of motion of the right lower extremity, left hip, and left knee were normal. There were moderate limitations (approximately 50%) in left ankle active dorsiflexion and plantarflexion range of motion. Goniometric measurement was approximately 0–7 degrees for dorsiflexion and approximately 0–25 degrees for plantarflexion. Active range of motion of the foot was also limited approximately 50% for inversion and eversion, with inversion measuring 0–15 degrees and eversion measuring 0–8 degrees. Subtalar and mid-

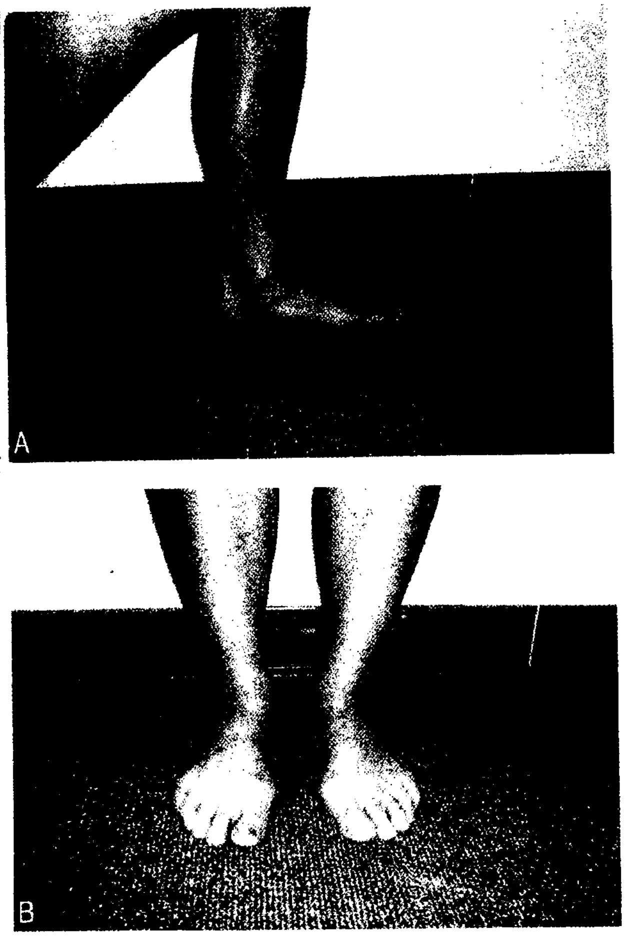

FIGURE 1. (A) Medial view of subject's left foot and (B) frontal view of subject's feet, both showing midfoot pronation.

tarsal range of motion were not differentiated. The patient reported lateral midfoot pain with all active foot and ankle motions. Passive range of motion was not assessed due to the high level of pain and hypersensitivity to palpation. An assessment of the non–weight-bearing foot in prone was not completed due to these same reasons. Sit-to-stand testing demonstrated a change in the height of her medial longitudinal arch, indicative of a mobile midfoot.[6] Thus, I did not consider this patient to have a rigid foot type or an osseous block to midfoot motion.

Strength Resisted isometric strength testing was done for muscle groups in a neutral ankle position (zero degrees of dorsiflexion/plantarflexion and zero degrees of inversion/eversion). Resisted isometric testing of ankle inversion was strong and pain-free. Resisted testing of dorsiflexion, plantarflexion, and eversion tests was strong and painful. Because plantarflexion and inversion were both strong, I did not suspect insufficiency of the tibialis posterior.

Palpation Tenderness was present locally over the cuboid and the fifth tarsal metatarsal joint on the plantar aspect and to a lesser extent over the base of the fifth metatarsal. She denied tenderness along the course of the peroneal tendons and muscle bellies. There was no tenderness over the sinus tarsi or the medial foot and ankle. Skin temperature was normal and there were no trophic changes evident. Because of her localized symptoms and these objective findings, I ruled out reflex sympathetic dystrophy as a possible cause of her pain. Even though resisted eversion testing was painful, the patient did not have tenderness over the peroneal tendons and her primary complaint of pain was not at the base of the fifth metatarsal. Thus, peroneal tendinitis was not a probable diagnosis. Specific stress tests and passive range of motion were not assessed due to the high degree of pain the patient demonstrated with active range of motion and palpation.

Intervention This active adolescent patient's history included no trauma. She demonstrated localized, lateral midfoot pain. The objective evaluation revealed highly irritable symptoms with lateral midfoot tenderness and limited active range of motion. Based on her age, history, and the physical examination, I reasoned that probable differential diagnosis included tarsal coalition and cuboid syndrome. I determined that regardless of the specific cause of the patient's foot pain, she needed to decrease the mechanical stress placed on her foot. At the time of initial evaluation she was instructed to rest her foot by discontinuing her attempts at running and to exercise on a stationary bicycle. To limit the inflammation, she was told to place ice on her foot several times each day. In an attempt to support her pronatory foot type and decrease the mechanical stresses placed on the midfoot, I issued her an over-the-counter, semirigid medial longitudinal arch support. She was to use the arch support in a supportive and comfortable athletic shoe. She was instructed to return for a follow-up appointment in 1 week.

First Follow-up Visit

Subjective Due to transportation difficulties and schedule conflicts, the patient was unable to attend her 1-week follow-up appointment. She returned to physical therapy 5 weeks after the initial evaluation. She reported no change in her foot symptoms while using the arch support. She had not obtained any relief with increased rest. She stated that for approximately the last week she had been intermittently using a hard plastic cast boot that she used 2 years earlier for what she thought was Achilles tendonitis.

Physical Examination

Range of Motion The patient demonstrated limited foot and ankle active range of motion in all directions (approximately 50%) with pain in all directions. Again, subtalar motion was not differentiated from midtarsal motion. Her foot and ankle active range of motion had not changed since the initial evaluation.

Strength Manual resistance strength testing was painful, yet strong. The most painful direction was a contraction into eversion.

Palpation The patient exhibited tenderness and hypersensitivity primarily over the cuboid and secondarily over the base of the fifth metatarsal.

Intervention Because the amount of rest incorporated over the previous 5 weeks did not decrease the patient's pain, I decided to have her increase the amount of rest. She had not been running, but had been walking with a partial weight-bearing pattern. I instructed the patient to avoid weight-bearing by using crutches, continue icing, and immobilize her foot with the plastic cast boot. She was told to wear the boot all the time, even while sleeping.

Second Follow-up Visit

Two weeks later (8 weeks after the initial physical therapy evaluation), she reported compliance with rest, crutches, and immobilization with the cast boot. However, she reported no significant changes in her symptoms and felt that the symptoms may be getting worse. She demonstrated tenderness to palpation over the cuboid. The patient and her father were instructed to pursue a follow-up appointment with a physician. They both stated that they preferred to follow-up with a podiatrist whom she had seen 2 years previously. No additional physical therapy was scheduled.

DIAGNOSIS

Podiatry Consultation The patient saw a podiatrist 2 weeks later, approximately 10 weeks after the initial physical therapy visit. The podiatry office visit notes included a review of the radiographs that revealed some possible endosteal sclerosis. The podiatrist reviewed the previous MRI and ordered a repeat MRI. The repeat MRI was completed 12 weeks after the initial physical therapy visit and was interpreted by the radiologist as normal.

Follow-up Podiatry Visit The patient followed up with the podiatrist 14 weeks after the initial physical therapy visit. At that time, the patient demonstrated tenderness to palpation along the calcaneocuboid joint and the calcaneonavicular region. Resisted strength testing of eversion was weak and painful. Ankle dorsiflexion and plantarflexion were strong and pain-free. Active range of motion into inversion and eversion was painful. There was evidence of a peroneal spasm with movement into inversion.

The podiatrist's review of the repeat MRI showed some possible abnormalities at the calcaneonavicular joint consistent with a fibrous coalition. A follow-up

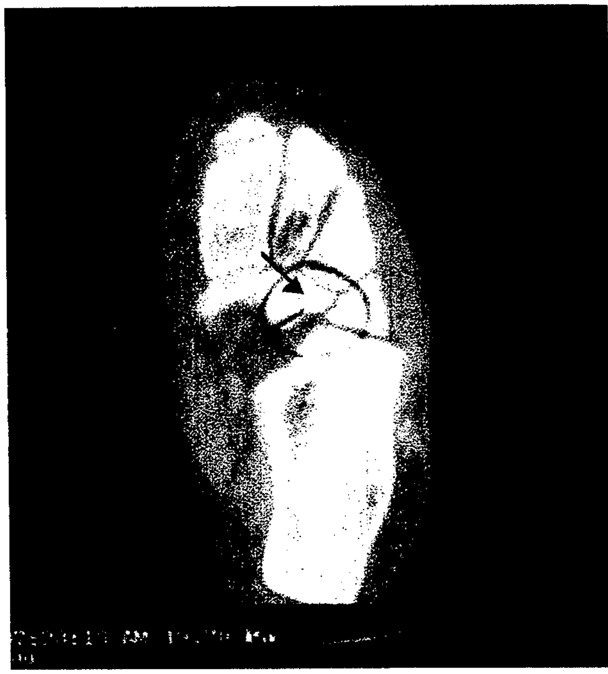

FIGURE 2. Computerized tomography scan showing an area of subtle subchondral cystic changes on the navicular bone (arrow).

CT scan was ordered, and the podiatrist's impression was that it revealed calcaneonavicular subchondral cystic changes also consistent with a fibrous coalition (Figure 2).

The patient had another podiatry visit 17 weeks after the initial physical therapy evaluation. At that time, the physical exam revealed tenderness at the calcaneocuboid joint and the calcaneonavicular space. Midtarsal range of motion was painful. There was no evidence of peroneal spasm.

By this time, she had been using crutches and an immobilizer for 12 weeks without symptom resolution. Because the patient had not responded to conservative measures, the podiatrist recommended surgery for resection of a probable fibrous calcaneonavicular coalition.

Twenty-two weeks after the initial physical therapy visit, surgery was performed and confirmed the diagnosis of a fibrous calcaneonavicular tarsal coalition. The coalition was resected from the calcaneonavicular region deep underneath the plantar navicular and talar head.

The patient did not have postoperative physical therapy but was instructed by the podiatrist to ice, elevate, and begin active range of motion exercises. Two weeks postoperatively, she progressed to weight-bearing as tolerated with the immobilizer and continued with the active exercises. Four weeks postoperatively, she was working out lightly at the gym and was allowed to gradually return to activities. By 2 months postoperatively, she was able to run with light exertion for short distances. At the time of the final podiatry visit, 4 months after the surgery, she was able to run without pain and had normal range of motion and motor function.

DISCUSSION

This patient had a history and physical examination consistent with either a tarsal coalition or cuboid syndrome. She was an adolescent athlete with an insidious onset of foot pain. The pain was located over the lateral midfoot, she had pronated feet, and initial diagnostic testing was unremarkable. She did not present with a rearfoot valgus or with a rigid pronated foot.

Passive range of motion and manual stress tests were not performed because the patient had tenderness to palpation and pain with active range of motion. There is a possibility that passive motion or joint mobility testing may have revealed limited midfoot range of motion, although this patient's coalition was not yet ossified. A fibrous coalition may cause some specific limitations in joint motion, but not necessarily so. This patient had a mobile midfoot, as indicated by the sit-to-stand test, so a localized limitation of joint motion may not have been present in this particular case.

Without a definitive diagnosis, the physical therapist's intervention was appropriate to treat either of these 2 diagnoses. Nonsurgical treatment included rest, arch supports, crutches, immobilization, and ice. The patient's symptoms did not improve with these measures over approximately 8 weeks; thus, a referral outside physical therapy was indicated.

By the time she visited the podiatrist, she had been immobilizing her foot for 6 weeks. According to Kulick and Clanton,[9] immobilization for 3–6 weeks is indicated as a nonsurgical treatment for a tarsal coalition. This early nonsurgical intervention enabled the patient to receive relatively prompt diagnostic testing and eventual surgical intervention once she visited the podiatrist. Because of the 6 weeks of immobilization, the podiatrist did not recommend another course of rest and immobilization but was able to recommend surgical treatment.

Unfortunately, the original radiographs and MRI were interpreted by a radiologist as being normal. The podiatrist reviewed these same films and noticed some subtle subchondral sclerotic changes. These changes were consistent with the patient's clinical presentation. Perhaps when reviewing the films, the podiatrist was specifically looking for changes that matched the patient's clinical presentation.

In this particular case, it was important to recognize a history of insidious onset of midfoot pain, a high severity of symptoms, and a lack of patient response to treatment. By encouraging a referral to a physician and the trial of appropriate nonsurgical intervention, the patient received the appropriate surgical treatment. As expected, the patient had an excellent outcome and returned to running without foot symptoms 4 months after surgery. Even with the referral to a podiatrist, the surgery was not completed until 22 weeks after the initial physical therapy visit and 40 weeks after the onset of symptoms.

Earlier recognition and treatment of her symptoms may have facilitated a positive outcome more rapidly. In this particular case, the patient was encouraged to go back to her physician on the second physical therapy visit. She did not do so at that time.

It is imperative that physical therapists be able to recognize patients who have a condition that requires referral to other specialists. This process should occur as rapidly as possible to expedite treatment and the patient's eventual return to function. In this case, recognition of the history, signs, and symptoms of a fibrous calcaneonavicular coalition, proper nonsurgical intervention, and referral to other specialists all contributed to a positive outcome for the patient.

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