When a child or adolescent presents to your office with vague complaints of stiffness or pain in the foot and ankle, recent altered foot shape, muscle spasm, or protective gait abnormalities, you must consider peroneal spastic flatfoot as the cause. The onset of symptoms in this condition is often insidious, precipitated by minor trauma or change in activity, but the consequences could be debilitating to your patient.

Peroneal spastic flat foot is a term used to describe rigid valgus feet developing from widely different causes. Peroneal spasm is defined as 3- to 4-beat unsustained clonus initiated by a gentle passive inversion force placed on an externally rotated, everted foot. Tarsal coalitions are the most common cause of peroneal spastic flatfoot.

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seronegative spondyloarthropathies, ankylosing spondylitis, Reiter syndrome, psoriatic arthropathy, occult perilatal and articular subtalar joint fractures, tumors or tumorous conditions extending into subchondral bone adjacent to the subtalar joint or invading the subtalar joint, and infection. Post-operative subtalar arthrodesis and synovial irritation created by altered biomechanics of the foot have also been credited with causing a peroneal spastic flatfoot.

Etiology

Although tarsal coalition was initially reported in 1769, its association with severe flatfoot, reduced or absent subtalar joint motion, peroneal muscle “spasm”, and pain was not recognized until the early part of the 20th century, when calcaneonavicular coalition, and then talocalcaneal coalition, was first associated with spastic rigid pes planovalgus or peroneal spastic flatfoot. The etiology of tarsal coalition is probably due, in many cases, to failure of segmentation and differentiation of primitive mesenchymal tissue. Although most coalitions are congenital, as the consequence of autosomal dominant inheritance, coalitions also can be acquired by degenerative joint disease, inflammatory arthritis, infection, and clubfoot deformities.

The coalitions may be completely osseous (synostosis), or the bones may be divided by a fissure of varying depth consisting of cartilage (synchondrosis) or fibrous tissue (synodesmosis). Talocalcaneal middle facet and calcaneonavicular coalitions are the most important clinically and account for approximately 92% of all tarsal coalitions; the remaining 8% includes talonavicular and calcaneocuboid coalitions (3%) and all other coalitions (5%). Talonavicular tarsal coalitions are much more common than calcaneocuboid coalitions. Bilateral coalitions are present in approximately 50% of patients and may be present in as many as 68% of patients with calcaneonavicular bars.

The literature suggests a male preponderance of 60% to 80%. The exact incidence of tarsal coalition in the general population is unknown because the reported studies have been based on selected populations, and the fact that tarsal coalition can occur in asymptomatic feet. Current studies find the incidence of tarsal coalition range between 0.4% and 6%.

Pathomechanics

When one of the components of the talocalcaneonavicular joint complex is blocked or loses its elasticity, the movement of the foot around the talar head is interrupted or limited. This restriction of motion is especially pronounced in cases of talocalcaneal coalition and to a lesser degree in calcaneonavicular coalition. Restriction of subtalar motion by the coalition both limits the distal gliding of the calcaneus, forcing the heel bone into valgus, and blocks the navicular from gliding dorsally over the convex talar head.

To compensate for the limited movement of the joint, a compensatory movement is required at the nearest joint. This explains the association of tarsal coalition with a ball and socket ankle joint. Other attempts at compensation can also be observed at the Chopart joint which can develop a spherical profile, converting it into a ball and socket joint to overcome the limitation of movements.

Presenting Symptoms

Tarsal coalition should be considered in any patient who has intermittent, elusive, vague, hindfoot and ankle pain, a history of repeat-
incomplete bony coalition, between the ages of 8 and 12 years, and talocalcaneal coalitions between the ages of 12 and 16 years. Patients who reach young adulthood (20 to 30 years) without symptoms from their tarsal coalitions may never develop symptoms unless a traumatic event causes the coalition to become symptomatic. An adolescent will often present with a chief complaint of ankle pain. He says he had the pain right after an athletic activity. The patient and parents both conclude that the pain is the result of a sprained ankle. However, despite treatment consisting of rest, ice and the use of an Ace wrap, the patient's pain continues for months. He has pain in his ankle when standing and walking, and is not able to run or return to play. Upon further questioning, you find out that neither his foot nor his ankle was ever swollen or ecchymotic, and he cannot recall an exact instance of twisting his ankle.

**Physical Examination**

Detailed physical examination should include both feet with the patient sitting, standing, and walking. Although comparing the symptomatic to the asymptomatic foot is important, the normal posture of the foot must be kept in mind, because tarsal coalitions are bilateral in approximately 50% of patients and comparison may be misleading. With the patient sitting on the examining table with legs dangling over the side, the posture of normal relaxed feet in this dependent dangling position is in equinus, mild varus, and slight supination with a reasonably well-formed longitudinal arch.

With a tarsal coalition, the foot rests in slightly more external rotation, slightly less equinus, neutral or valgus rather than varus, with less or no supination of the forefoot (Figure 1). The longitudinal arch, compared with the normal foot, is flatter. When the patient is asked to invert both heels and adduct the forefeet, which also adducts the

**Talocalcaneal middle facet and calcaneonavicular coalitions are the most important clinically, and account for approximately 92% of all tarsal coalitions.**

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**Figure 4:** (a) and (b) Medial oblique radiographic view of a normal foot (4a) and a foot with a calcaneonavicular coalition (4b)

**Figure 5:** (a) and (b) Axial calcaneal radiographic view of a normal foot (5a) and a foot with a middle facet talocalcaneal coalition (5b)

**Figure 6:** Lateral radiographic view demonstrating talar beaking common in tarsal coalition...
While the patient is standing, inspect the feet, ankles, calves posteriorly with heels toward the examiner and toes straight ahead and finally with weight on the balls of the feet (toe stand). The examiner looks for calf atrophy (resulting from prolonged apropulsive, guarded gait), pes planus, heel valgus, and prominence of the peroneal tendons at the posterior border of the lateral malleolus, which can result from a symptomatic tarsal coalition (Figures 2 and 3). During toe stand, both heels should be observed for varus positioning, which is not present in a peroneal spastic flatfoot. In severe cases, an antalgic gait and a significant limp may be noted when observing the patient ambulating.

Roentgenographic Evaluation

Radiographs and CT scans are necessary to determine the exact anatomic site and extent of a coalition, whether it is bony or fibrocartilaginous, and if associated degenerative or congenital conditions are present. The primary radiographic views for diagnosis of tarsal coalition are the medial oblique (standard oblique view of the foot), and the axial calcaneal and lateral views. The medial oblique view profiles the calcaneonavicular bar and shows even incomplete coalitions, the most common presentation (Figures 4a and 4b).

Talocalcaneal bars frequently can be identified on an axial calcaneal view, but this is a more demanding radiographic technique than the medial oblique view, is vulnerable to the nuances of subtalar joint topography, and is more difficult to interpret. If the axial view unequivocally indicates a middle facet tarsal coalition, further radiographic tests are unnecessary unless surgery is planned (Figures 5a and 5b); however, if the axial calcaneal view in various angles (35, 40, and 45 degrees, if necessary) does not verify a clinically suspected talocalcaneal coalition, CT scanning is indicated.

The weight-bearing lateral view can be useful in identifying a...
middle facet talocalcaneal tarsal coalition and detecting talar beaking. In a patient with a middle facet tarsal coalition, the posterior facet appears to be narrowed and often is hardly visible, the lateral process of the talus as it reaches the lateral margin of the sinus tarsi appears rounded and sclerotic, and the middle facet is absent. Because of valgus posturing of most feet with talocalcaneal coalitions, the sustentaculum tali of the calcaneus and adjacent talus overlap. In a talocalcaneal middle facet coalition, this overlap is osseous or osteofibrocartilaginous, producing a sclerotic half-moon or inverted eyebrow in the region of the middle facet (Figure 6).

Bony beaking of the superior margin of the talar head may be the strongest indication of a middle facet tarsal coalition. Talar beaking has been found in 70% of valgus feet with tarsal coalition. Beaking on the anterior aspect of the talus is the result of limited subtalar and midtarsal motion. Without mobility of these joints, the dorsi-flexion forces on the midfoot during the mid- and terminal stance phases of gait are not dissipated. As the navicular attempts to glide anterolaterally on the head of the talus, it is restrained by loss of motion of the midtarsal and subtalar joint complex. In each gait cycle, the capsular ligament supports on the anterior surface of the talonavicular joint apply repeated stress to the periosteum of the subchondral bone anteriorly on the talar head in a futile attempt to allow dorsi-flexion. This repeated stress results in fibrocartilaginous and bone metaplasias that produce a traction spur. Beaking may be less prominent and may occur less frequently with fibrocartilaginous calcaneonavicular bars, because some subtalar motion remains and dorsi-flexion of the navicular on the talus is not completely inhibited.

CT scanning is considered the gold standard of diagnostic radiography for tarsal coalition. The CT scan defines the extent of the coalition within 3-mm. limits, reveals complete or incomplete (osteofibrocartilaginous) structural components of the bar, and reveals mild degenerative joint changes, which may be invaluable in treatment recommendations.

Other imaging techniques reported for diagnosis of tarsal coalitions include plain lateral tomography, arthrography of the subtalar joint, bone scintigraphy, and magnetic resonance (MR) imaging. In a symptomatic child with a suspected coalition, a purely cartilaginous bar and the extent of the bar may be demonstrated with MR evaluation. Otherwise, MR imaging seldom is useful in the diagnosis or planning of surgical treatment of tarsal coalition.

Treatment Considerations and Goals

Because most symptomatic coalitions occur in young patients and many adults have asymptomatic coalitions, an effort at non-operative management should be attempted. When treating a young patient with a peroneal spastic flatfoot, it is very important to clearly define treatment goals with both the patient and parents, since the eventual return to all activity may not be attainable, especially if certain tarsal coalitions are involved. The progression of the treatment program should be as follows:

1) Eliminate pain;
2) Enable the youth to return to school and participate in all non-athletic school functions;
3) Limit participation in athletic school functions, such as physical education classes;
4) Return to previous sports activities; and
5) Decrease calf muscle atrophy.

Approach to Treatment

Initial symptomatic relief in a young patient with mild symptoms includes non-steroidal anti-inflammatory drugs, paraffin baths, heat, warm soaks, and whirlpool. When a patient has moderate to severe pain on ambulation, using a below-the-knee cast is recommended for four to six weeks (Figure 7). This can be combined with a common peroneal nerve block and an injection of steroid and anesthetic into the sinus tarsi, which are effective in both relieving pain and muscle spasm (Figure 8 and 9).

Upon removing the cast, the patient should be placed in orthotic devices and modified shoes that increase the support to the medial side of the foot. Use of a leather laminate foot orthosis with a deep heel seat and high medial and lateral flange is recommended (Figure 10). This type of device offers good support but will deform to allow for foot pressure areas. The function of the foot orthoses is to decrease STJ motion during gait, and may have

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to be adjusted several times upon use to accomplish maximum efficiency in accomplishing this task. Be aware that patients with peroneal spastic flatfoot often cannot tolerate hard, rigid orthoses.

The footwear that is used in conjunction with the orthoses can be modified with 1/8- to 3/8-inch inner heel to sole wedging to prevent medial shoe breakdown (Figures 11a and 11b). Physical therapy should be considered for ankle strengthening, as well as range of motion exercises to increase inversion and re-store calf muscle girth, if atrophic.

Between 30 and 90 percent of patients have been reported to respond to non-operative conservative treatment of tarsal coalitions. Many authors believe in exhausting non-operative treatment should not be so persistent, because the efficacy of resection has been proved. The best candidate for resection of calcaneonaviclar and talocalcaneal bars is a child between the ages of 9 and 12 years with an incomplete coalition, minimal to mild pes planus, no fixed hindfoot valgus and no arthritic changes. A patient, regardless of age, with fixed hindfoot valgus, markedly reduced midtarsal motion, convexity on the medial border of the foot with corresponding concavity laterally, and a contracted heel cord is a poor candidate for resection.

Surgical Management

The surgical management of talocalcaneal coalitions remains controversial. Some authors say the degenerative changes in the talocalcaneal coalition are often present at the time of the initial diagnosis. In addition, resecting these bars often requires you to surgically excise the medial facet of the talocalcaneal joint, which results in considerable stress to the anterior and posterior facets. Some believe that this procedure leads to further degenerative arthritis. The advocates of arthrodesis list stabilization, pain relief, and adequate function as advantages and warn that the middle facet assumes too much weight-bearing load to sacrifice by resection.

On the other hand, the proponents of resection of the coalition cite as advantages pain relief, restoration of subtalar (and therefore increased midtarsal and talocrural) motion, and improved function. Currently, resection of the coalition is the treatment of choice, but this is not indicated for every patient with a talocalcaneal coalition. The patient most likely to benefit from resection has a small (<3.0 cm. in length and 2 cm. in width), difficult to define bar, is not morbidly obese or precociously large framed, is young (preferably before skeletal maturity), has no degenerative radiographic changes in the posterior facet of the subtalar joint or the talonaviclar articulation, and has at least 50% normal midtarsal motion. If, however, there is pes planus with marked heel valgus, convexity of the medial border of the foot, and either fixed or difficult-to-correct forefoot varus (supination), a triple arthrodesis is recommended. In a patient with a calcaneonavicular tarsal coalition, severe deformity, and degenerative changes at the talonavicular, calcaneocuboid, or talocalcanean joints, a triple arthrodesis is also recommended.

The surgical management of talocalcaneal coalitions remains controversial.

References


CT scanning is considered the gold standard of diagnostic radiography for tarsal coalition.

Mark Caselli, DPM is a staff podiatrist at the VA Hudson Valley Healthcare System, Montrose, NY. He is an adjunct professor, New York College of Podiatric Medicine, former chairman, Division of Orthopedic Sciences and director, Department of Pediatrics at NYCPM.
1) When an adolescent patient presents with a complaint of stiffness and pain in the foot and ankle with no history of trauma and no signs of erythema or swelling, which one of the following conditions is most suspect?
  A) Acute gout  
  B) Rheumatoid arthritis  
  C) Calcaneal fracture  
  D) Tarsal coalition  

2) Peroneal spastic flatfoot is most likely not the result of which one of the following?
  A) Metatarsal fracture  
  B) Articular subtalar fracture  
  C) Ankylosing spondylitis  
  D) Rheumatoid arthritis  

3) Which one of the following tarsal coalitions is most closely associated with causing a peroneal spastic flatfoot?
  A) Talonavicular  
  B) Calcaneonavicular  
  C) Calcaneocuboid  
  D) Cubonavicular  

4) Which one of the following has not been found to be a causative factor in producing a tarsal coalition?
  A) Severe ligamentous laxity  
  B) Autosomal dominant inheritance  
  C) Degenerative joint disease  
  D) Infection  

5) A tarsal coalition that is completely osseous is termed a:
  A) Synchondrosis  
  B) Syndesmosis  
  C) Synphytosis  
  D) Synostosis  

6) The exact incidence of tarsal coalition in the general public is difficult to determine because:
  A) Many coalitions do not show on x-ray.
  B) There are only a few studies on this condition.
  C) Tarsal coalition can occur in asymptomatic feet.
  D) The tarsal coalition must be biopsied to determine its true nature.

7) The age at which symptoms of tarsal coalition first appear depends primarily on:
  A) The activity level of the patient.
  B) The stage of ossification or synchondrosis of the coalition.
  C) The weight of the patient.
  D) The type of sport engaged in.

8) Which one of the following age ranges is associated with the appearance of a symptomatic calcaneonavicular coalition?
  A) 3 to 6 years  
  B) 8 to 12 years  
  C) 13 to 16 years  
  D) 18 to 22 years  

9) Why is comparing the symptomatic and asymptomatic foot not always helpful in a patient with suspected tarsal coalition?
  A) Both feet may be symptomatic but the patient does not know it.
  B) The foot with the coalition might look like the foot without a coalition.
  C) Tarsal coalitions are bilateral in 50% of patients.
  D) There is no change of appearance in a foot with a tarsal coalition.

10) During toe stand, the heels of a normal functioning foot should be in what position?
    A) Varus  
    B) Valgus  
    C) Neutral  
    D) Varies with foot type  

11) What imaging technique should be initially used in the evaluation of a patient with suspected tarsal coalition?
    A) Tomography  
    B) Arthrography  
    C) Magnetic resonance  
    D) Radiography  

12) The calcaneonavicular bar is best visualized on which radiographic view?
    A) Lateral  
    B) Axial calcaneal  
    C) Medial oblique  
    D) Anterior-posterior  

13) The radiographic view best suited for observing talar beaking is:
    A) Lateral  
    B) Axial calcaneal  
    C) Medial oblique  
    D) Anterior-posterior  

14) The imaging technique that best defines the extent of a coalition, reveals complete or incomplete structural components of the bar, and mild degenerative joint changes is:
    A) Radiographs  
    B) CT scan  
    C) MR imaging  
    D) Tomography  

15) The most important reason to thoroughly define treatment goals with both patient and parents in cases of peroneal spastic flatfoot is:
    A) Resolution of the problem may take a long period of time.

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16) The initial goal in the progression of treatment of a patient with a tarsal coalition is:
   A) Return to sports activities.
   B) Elimination of pain.
   C) Decrease muscle atrophy.
   D) Restore joint range of motion.

17) The purpose of a common peroneal nerve block and steroid/local anesthetic sinus tarsi injection in the treatment of a painful tarsal coalition is to:
   A) Restore range of motion.
   B) Return patient to a normal gait pattern.
   C) Restore arch integrity.
   D) Relieve pain and muscle spasm.

18) Which one of the following tarsal coalitions should be most considered for surgical management in a timely manner?
   A) Talocalcaneal
   B) Calcaneonavicular
   C) Talonavicular
   D) Calcaneocuboid

19) The surgical treatment of choice for a tarsal coalition with pain, severe deformity, and multiple joint degenerative changes is:
   A) Subtalar arthrodesis.
   B) Ankle fusion.
   C) Triple arthrodesis.
   D) None of the above.

20) The importance of early recognition, evaluation, and aggressive treatment of a patient with peroneal spastic flatfoot due to a tarsal coalition is that failure to do so can:
   A) Have no consequences.
   B) Result in requiring expensive treatment.
   C) Cause the patient to lose valuable time in returning to sports activity.
   D) Reduce the possibility of permanent disability.

See answer sheet on page 177.
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Evaluation and Treatment of Peroneal Spastic Flatfoot
(Caselli)

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