

SURGICAL PLANNING IN MIDDLE FACET TALOCALCANEAL COALITION

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There are many factors that must be considered in determining the appropriate surgical treatment to gain the best and optimal postoperative outcome. There has been a constant debate regarding the surgical treatment of middle facet coalition. The primary treatment option for middle facet coalition remains resection of the coalition and rearfoot arthrodesis. The purpose of this paper is to present and evaluate various treatment options for the management of middle facet tarsal coalitions.

ETIOLOGY

A middle facet coalition is an intra-articular bridge between the talus and calcaneus that often leads to the restriction or elimination of motion at the subtalar joint. Tarsal coalition is a union between 2 or more tarsal bones that may be an osseous, cartilaginous, or a fibrous connection.^{1,2} The incidence of tarsal coalition is 1-2%.^{3,4} Tarsal coalition is an autosomal dominant inheritance pattern with variable penetrance. One proposed theory suggests that accessory ossicles that are near the articular surface of tarsal bones prematurely fuse to limit and inhibit joint motion.² Another theory suggests during the early developmental stages of growth, mesenchymal stem cells fail to distinctly differentiate appropriately, thus leading to the congenital form of tarsal coalition.⁵ Post traumatic arthritis, systemic arthritis, and infection are conditions that all have been linked to the development of the acquired form of tarsal coalition.^{1,2}

CLINICAL PRESENTATION

Tarsal coalitions can frequently go unrecognized because symptoms tend not to appear until mid to late adolescence.¹ Symptoms of tarsal coalition most commonly present in preadolescents or adolescents who suddenly gain weight and who take on physical activities.⁶ When symptoms are present, pain is often localized at the site of the coalition. Middle facet coalitions present with local tenderness within the sinus tarsi, along the anterior lateral aspect of the ankle joint, that with time progress to a dull aching pain of the entire subtalar joint. Discomfort, along with lower extremity fatigue becomes unbearable with any level of activity.

The onset of symptoms may be insidious, precipitated

be recurrent foot or ankle injury often termed “awakening trauma.”⁶ Some authors correlate the onset of pain to the ossification of the coalition. As the coalition continues to ossify and harden, the involved joints begin to stiffen, limiting the joint’s natural motion thus causing pain. When ossification is complete, the mechanical stress and repeated microfractures occurring at the site of the coalition become symptomatic.² Talocalcaneal coalitions tend to ossify between the ages of 12 and 16 years.⁵

On clinical evaluation, both feet should be evaluated with and without weight bearing, which will help determine the presence of any compensatory mechanisms. Usually a pes plano valgus deformity is present displaying any of the following characteristics: an everted or valgus heel in the relaxed stance, abduction of the forefoot relative to the rearfoot, and a certain degree of ankle equinus.⁶ Evaluation of the midtarsal and subtalar joint range of motion can determine if the deformity is flexible or rigid. Depending on the anatomic type of the middle facet coalition (osseous, cartilaginous, or fibrous) range of motion of the subtalar joint inversion is decreased.

The reducibility of the calcaneus should be evaluated. If the calcaneus maintains an everted position, with no change in the medial longitudinal arch, during range of motion, this may suggest a non-reducible deformity. Range of motion of the affected foot should be compared with the contralateral foot.

Tarsal coalitions may be associated with peroneal muscle spasms. This tonic muscle spasm most often involves the peroneus brevis muscle.² As the calcaneus continues to pronate, the degree of pain and instability progressively worsen within the subtalar joint. In an attempt to stabilize and negate the pronatory forces, the peroneal tendon contracts and tries to limit and restrict subtalar joint motion. Prolonged contracture of the peroneal tendon maintains the calcaneus in an everted position. The prolonged instability of the hindfoot position can cause adaptive changes to the surrounding joints causing a “rigid peroneal spastic flatfoot.”^{1,7-10}

Diagnostic injections can be used to evaluate pes plano valgus with peroneal spasm. The use of a local anesthetic reduces the pain and rigidity of the joint and allows the examiner to evaluate the true flexibility of the subtalar joint.

The proximal and distal joints must also be evaluated for the presence of any secondary degenerative joint disease. Gait analysis may display wide base of gait with delayed or decreased propulsion.¹ Extrapedal manifestations may include genu valgum, shin splints, short Achilles with calf tenderness, medial knee tenderness, and leg-length discrepancy.¹

IMAGING

Plain film radiographs remain the steadfast protocol in the initial assessment of tarsal coalition. The middle and posterior facet joint lines can be well visualized on a lateral view. On a lateral view of middle facet coalition, if the joint line is obscured with shortening of the talar neck, this is suggestive of a talocalcaneal coalition. Important radiograph markers used to identify middle facet coalitions are a positive halo “C” sign indicating the absence of the middle facet with sclerotic margin along the sustentaculum tali (C-shaped line formed by the medial outline of the talar dome and the sustentaculum tali; joint space narrowing along with diminished clarity of the posterior facet; and flattening of the lateral talar process (Figure 1).^{5,11,12}

Harris-Beath views allow for proper assessment of the middle and posterior facets. Normally the middle and posterior facets are parallel to one another and to the weight bearing surface.¹¹ With a partial or complete middle facet coalition, the middle and posterior facets are obliquely orientated with the middle facet angulated 25 degrees (Figure 2).^{4,5,11,13} Stressed views like the Hebscher maneuver can also be performed to assess the reducibility of the hind foot.

Patients with middle facet coalition and severe pes plano valgus may present with calcaneal fibular remodeling.⁹ This concept proposed by Kernbach et al is best visualized on coronal computed tomography (CT) images and shows the fibula abutting against the calcaneus and possibly creating a pseudo-articulation.

CT and magnetic resonance imaging (MRI) are beneficial when coalitions on plain radiographs are unrecognizable.¹¹ Middle facet coalitions are best visualized

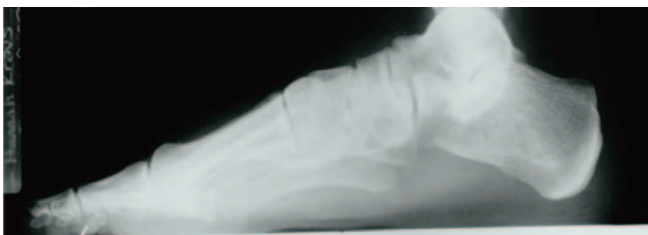


Figure 1. Middle facet coalition with irregularity or complete obliteration of the middle facet.

on coronal views with attention focused on the posterior portion of the subtalar joint to the distal portion of the midtarsal joints.⁵ The presence of joint irregularity (consistent with fibrous coalition) or trabecular bridging at the middle facet (consistent with an osseous coalition) from the talus to the calcaneus can be detected.¹² The presence of any adaptive changes to the proximal and distal joints can also be visualized. MRIs are also valuable tools especially in cases where differentiating between a fibrous or cartilaginous coalition seem indistinguishable radiographically.

CONSERVATIVE TREATMENT

The goal with conservative therapy is to decrease and limit the amount of discomfort associated with the coalition. Patients with mild to moderate symptoms may respond well to shoe modifications. Over-the-counter or custom molded orthotics can help control motion or prevent motion of the subtalar joint, which will in turn minimize pain. Some additional adjunctive treatments include anti-inflammatory medications, and steroid injections into the coalition site coupled with complete immobilization in a below knee cast. In severe pain, 4-6 weeks of complete immobilization may be warranted. Casting is reported to produce symptomatic relief in 25-33% of patients.⁸ If symptoms resolve during the casting period, the patient may resume full activity as tolerated. If symptoms reoccur and persist, the patient should be reevaluated for surgical intervention.



Figure 2. Harris-Beath view: middle facet is obliquely orientated and poorly visualized. The middle and posterior facet should be parallel to the weight-bearing surface.

SURGICAL TREATMENT

Traditionally, surgical management of middle facet tarsal coalition involves either resection of the coalition or rearfoot arthrodesis.¹² The main surgical reference tool to date is Downey's classification of tarsal coalitions, which correlates the patient's age, articular involvement, and secondary arthritic changes to the recommended surgical procedure.¹⁴ Other adjunctive procedures should also be considered depending on the overall alignment of the rearfoot and forefoot, and the need to counter-balance or negate any pronatory forces. However, one must still determine which particular procedure to perform and when.

When considering resection of the coalition, the size of the coalition is important in terms of a successful outcome. Wild et al reported poor results when coalitions greater than 50% of the posterior facet were resected.³ Luhmann et al also confirmed coalitions larger than 50% of the posterior facet had poor outcomes.⁸ Surgical resection of the middle facet coalition is the preferred procedure in the preadolescent patient. Resection of the coalition is recommended if the coalition involves less than 50% of the articulating surface, and there is no evidence of arthritis or rearfoot valgus. In preadolescents, resection of the coalition will allow for increased joint motion and osseous remodeling as maturity continues.¹¹

Other adjunctive procedures can be performed to enhance the resection process with the use of interposition material. Interposition materials like bone wax, fat grafts, and tendon are placed in the coalition site in hopes of preventing re-ossification. Kumar and Rankin et al reported superior results with interposition of a portion of the flexor hallucis longus tendon.^{6,15} This study did not have any associated complications such as the flexor hallucis longus tendon rupturing or loss of motion at the hallux interphalangeal joint. Kumar later used fat grafts, bone wax, and the flexor hallucis longus in 18 feet and concluded no significant difference in the outcome.¹² However, Scranton et al and Saloman et al reported good results with the use of fat from behind the calcaneus through the same incision, but additional fat graft was needed from the gluteal region which required another incision.¹⁶

Some surgeons are doubtful about the use of interpositional material. Interpositional material placed between bones may disperse into the surrounding area under axial compression, thus limiting the efficacy on preventing any osseous regeneration of a coalition. To date, there is still no true evidence-based research that can truly justify the use of interpositional material, as well as the specific type of material that should be used.

The majority of the literature reviewed did however

focus on the outcomes after using interposition material within the resected coalition site. There was less emphasis on the overall malposition of the calcaneus.³ Simple resection of the coalition may eliminate pain and restore motion; however this does not address the associated pes plano valgus and ankle deformity.⁶ Correction of pes plano valgus deformity along with resection of the coalition has shown some promising results. Wild et al found that more than 16 degrees of rearfoot valgus correlated with a poorer outcome after resection alone.³

There are more studies illustrating the degree of failure with resection alone in the presence of pes plano valgus. Surgeons are more inclined to perform concomitant single staged soft tissue and osseous procedures.¹⁷ Kernbach et al recommends a single staged resection of a middle facet coalition in conjunction with a flatfoot reconstruction.¹² The following procedures can be performed alone or in combination depending on the degree of the deformity and skeletal maturity: subtalar arthroereisis, medial calcaneal osteotomy, Evan's calcaneal osteotomy or distraction calcaneocuboid arthrodesis, gastrocnemius recession, tendo-Achilles lengthening, and/or medial column procedure/fusion.¹

Downey performed a medial incision for resecting the coalition and a lateral incision over the sinus tarsi for insertion of the subtalar joint arthroereisis.¹¹ Placement of the arthroereisis into the created space at the sinus tarsi after resection of the coalition, prevents re-ossification of the coalition site.^{5,11} Giannini et al resected talocalcaneal coalitions in 14 adolescent patients and then corrected the hind foot valgus with a bioabsorbable subtalar joint arthroereisis implant.⁵ A total of 90% of the patients showed significant improvements in pain and motion, while 100% had improved hindfoot alignment.¹⁷

Luhmann et al also suggested a medializing calcaneal osteotomy or a lateral column lengthening after resection of the coalition to better correct the valgus position of the hindfoot.⁸ Westbery et al performed a coalition resection by completely removing the sustentaculum tali; they also combined it with a lateral column lengthening by means of calcaneocuboid distraction arthrodesis in 2 feet and tendo-Achilles lengthening.^{9,12} Westbery et al found that 11 of the 12 patients had good results, and at the 5-year follow up found no malignment of the rearfoot complex.⁹

Isolated subtalar joint, double, and triple arthrodesis remain the preferred approach to intraarticular talocalcaneal coalitions. Rearfoot arthrodesis should be avoided in skeletally immature patients, unless significant arthritic changes are present. Joint arthrodesis like subtalar and, triple arthrodesis remains the accepted form of salvage after failed excision of the tarsal coalition.⁵

Adult patients with middle facet coalitions traditionally do not perform well with coalition resection alone. Adult patients have a higher incidence of reoccurrence and postoperatively have poorer outcomes with prolonged pain at the resected site.^{5,11}

With prolonged coalition deformity, adults may display some component of joint arthritis, which is contraindicated for coalition resection alone. Joint arthrodesis is the traditional treatment for talocalcaneal coalition associated with degenerative changes in the surrounding joints.¹¹ Adjunctive procedures, as discussed above can be performed.

SUMMARY

Middle facet coalitions may or may not respond to conservative treatment. Those that do not respond are best treated with coalition resection or arthrodesis. In the presence of rearfoot valgus, adjunctive procedures can also be performed. Regardless of the surgical procedure, a thorough evaluation and understanding of the pathology will aid in the appropriate procedure selection for the management of middle facet coalitions.

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