CHAPTER **22**

ISOLATED SUBTALAR JOINT ARTHRODESIS: Indications, Evaluation, and Surgical Technique

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Isolated subtalar joint (STJ) fusions are performed routinely by many foot and ankle surgeons for various hindfoot pathologies, but were historically avoided due to their potential complications on the adjacent joints (1). Since the inception of this isolated arthrodesis, multiple studies have been undertaken to demonstrate the effects on the surrounding joints. Jouveniaux et al concluded with their retrospective study of 37 isolated fusions that radiographic changes suggesting arthritis in the adjacent joints were common, but were moderate and asymptomatic in the majority of cases (2). Additionally, this technique is preferred instead of a triple arthrodesis in cases where the calcaneal-cuboid joint and talo-navicular joints are intact without arthritic changes. This preserves the overall function of the hindfoot with the perceived joint stiffness that the triple arthrodesis offers (3,4).

ANATOMY OF THE STJ

The STJ or talo-calcaneal joint is a diarhrodial joint composed of 3 main facets; the anterior, middle, and posterior, located on the inferior aspect of the talus and on the superior aspect of the calcaneus. The posterior facet is completely separated from the others, with its own capsule and ligaments. Just anteriorly to the posterior facet, there is a groove on the talus and the calcaneus, called respectively the sulcus tali and sulcus calcanei (5). They form the tarsal canal, which is a funnel that has a large lateral opening known as the sinus tarsi. This canal contains multiple vascular structures. The sinus tarsi artery is the principal blood supply for the sinus tarsi and the talus, which anastomoses with the canalis tarsi artery. Also, there is a venous plexus draining venous outflow from the talus and part of the posterior STJ capsule (6). The stabilizing ligamentous structures in this funnel are the cervical ligament, the interosseous talo-calcaneal ligament and the trilayered inferior extensor retinaculum (7) .

Many studies have been made to try to determine the axis of the STJ as well as its motion. A comprehensive review of the literature made by Piazza found that the average inclination angle is 41-42 degrees in the sagittal plane and the declination angle is 17-20 degrees in the transverse plane. These values were found throughout many cadaver and in vivo studies (8). The STJ motion is triplanar, as described by Sarraffian. The talus and calcaneus move in opposite directions: as the calcaneus abducts, everts and extends, the talus will adduct, invert and plantarflex (9).

INDICATIONS

Isolated STJ arthrodesis is indicated for the following: Stage II flexible flatfoot deformity, isolated arthritis, both traumatic and non-traumatic, coalition, and neuromuscular disease affecting hindfoot motion (10). The literature has reported good results for stage II posterior tendon dysfunction, but patient selection is the key to success (11). Forefoot varus can be a contra-indication for this isolated procedure unless it is addressed surgically (12). Taylor and Sammarco recommend isolated STJ arthrodesis in patients with arthritic disease of the STJ and normal talo-navicular and calcaneo-cuboid joints. In order to preserve the ankle joint and protect it from secondary arthritic changes, they recommend deltoid repair with adjunctive procedures if the STJ is greater than 7 degrees of valgus after isolated fusion. The forefoot and midfoot should be balanced through osteotomy or soft tissue procedures in an attempt to preserve the remaining joint functions (13).

For treatment of talo-calcaneal coalitions; once conservative treatment has failed, coalition resection and isolated fusion have proven highly successful in the literature. A hindfoot of greater than 21 degrees and a coalition of greater that 50% of the size of the posterior facet is associated with poor outcomes with coalition resection only (14, 15). Thorpe and Wukich recommended isolated STJ arthrodesis for hindfoot <15 valgus and no arthritic changes. They concluded that a triple may be indicated for hindfoot valgus >15 degrees with arthritic changes present (15). Calcaneo-navicular bars are typically treated by resection, but in some instances, further misalignment and deterioration of the STJ can occur postoperatively, necessitating joint destructive procedures (16).

Post-traumatic arthritis following calcaneal fracture is a common occurrence, which may necessitate isolated STJ fusion (17). Care must be taken to restore the radiographic relationships of the hindfoot. A study by Holm et al determined that the outcomes are markedly improved if the radiographic parameters are restored with the original repair (18).

Inflammatory diseases of the STJ such as rheumatoid arthritis or seronegative arthritities are also good indications for isolated STJ fusions. A French retrospective study on patients affected with RA and AS demonstrated a 100% satisfaction rate with isolated STJ on 14 patients (19). Other conditions such as spastic flatfoot deformity and neuromuscular disease affecting hindfoot motion can also be treated with isolated STJ arthrodesis; however care should be taken to evaluate the global positioning of the remaining joints (20-22).

CLINICAL EXAMINATION

STJ pain is typically described by patients as dull or stiff, and they may describe it as ankle pain. The pain progresses throughout the day and is aggravated by walking on uneven surfaces. Muscle cramps are also a common finding. Depending on the etiology of the STJ pain, patients may present with edema or ecchymosis. Palpation of the sinus tarsi is typically uncomfortable. A complete biomechanical examination should be performed by the clinician. Physical examination should include range of motion evaluation of the STJ, which should have twice the degree of inversion as eversion (22). Decreased range of motion or instability can be noticed, as well as crepitation. The forefoot to rearfoot relationship should also be assessed. It is crucial to compare both lower extremities, especially if the deformity or symptoms are unilateral. If a coalition is suspected, circumduction of the foot should be done bilaterally simultaneously in order to see if there is an obvious difference in the possible range of motion. When peroneal spasticity is present, a high index of suspicion should be held for tarsal coalition. (23, 24) .

Stance examination should also be performed. Varus or valgus position should be noted, and single and double heel raise tests should be performed to evaluate the rigidity of the deformity especially in cases of pes valgus deformity. If hindfoot varus is noted, then the Coleman block test should be performed to determine if the varus is forefoot driven or rigid. Heel height and width should be assessed, especially if the patient has a history of calcaneal fracture. Heel position and rearfoot motion should be evaluated in the gait examination as well. If the symptoms are diffuse and the source of the pain is hard to clearly identify, diagnostic intraarticular local anesthetic blocks can be performed and the symptoms reassessed (25) (Figures 1-3).

IMAGING

For an adequate procedure selection, imaging modalities combined with clinical examination are necessary. Plain-film radiographs will demonstrate the state of the posterior and middle facets, as well as the position of the heel and the changes

Figure 1. Pes plano valgus secondary to tarsal coalition.

Figure 2. Increased calcaneal width secondary to previous calcaneal fracture.

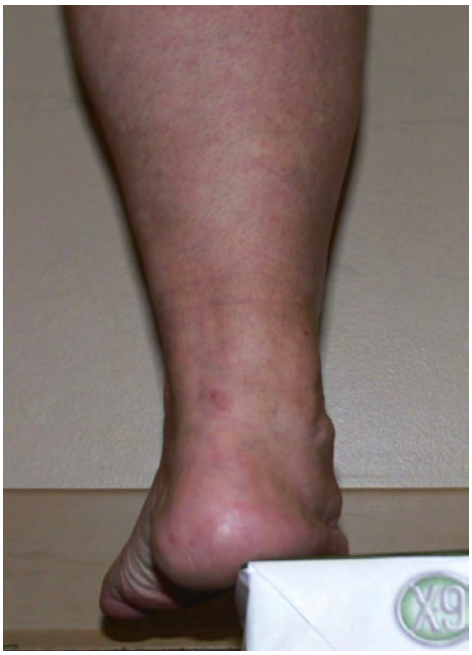

Figure 3. Coleman block test, utilized in the evaluation of cavus feet.

suggestive of a tarsal coalition. Weightbearing radiographs are preferred, in order to have a better visualization of the position of the foot. Arthritic changes including subchondral sclerosis, irregular joint space narrowing, osteophytes and subchondral cysts can be identified at the STJ. Care should also be taken to evaluate the surrounding joints, as their integrity will dictate which procedure is the best for the patient. A full series of radiographs should include lateral, oblique, calcaneal axial, and anterior-posterior of the foot. Neutral position anterior-posterior and lateral views are also helpful for delineating the reducibility of the deformity, which may influence procedural selection. The Brodens view can also be helpful for cases where a subtalar coalition is suspected (Figures 4, 5).

Magnetic resonance imaging (MRI) may be used to evaluate the integrity of the joint's cartilage and the surrounding soft tissues, including the peroneal tendons and surrounding ligaments. If there is suspicion of avascular necrosis, an MRI should be taken because its severity correlates with the success of arthrodesis. Computed tomography scans are considered to be the gold standard to assess ossified tarsal coalitions. They may also offer valuable insight for preoperative planning, as they provide superior detail of bone and joint quality, with better details than might be visible on plain radiographs. For complicated cases, a 3D reconstruction can be obtained to have even better visualization of the foot that can be helpful for surgical planning (23, 25).

Figure 4. Pes plano valgus with middle facet coalition.

Figure 5. Posttraumatic arthritis from old calcaneal fracture.

SURGICAL TECHNIQUE

The authors' preferred technique is with the patient under general anesthesia, in a lateral position, with a beanbag. However, if other ancillary procedures are being performed, supine position works just as effectively. Tourniquet use is at the surgeon's discretion. The incision extends from the postero-inferior aspect of the fibula to the calcaneo-cuboid joint. The incision is carried to the subcutaneous tissue, with careful retraction of the neurovascular structures. Deep fascia is identified and incised along the inferior border of the extensor digitorum brevis muscle. Dissection is then carried inferior to the muscle belly, and it is separated from the capsular and periosteal tissues and retracted superiorly. Care is taken to maintain the peroneal tendons within their sheath and the entire layer may then be retracted inferiorly. The STJ is identified, and Hoke's tonsil is visualized at the exit of the sinus tarsi. The contents of the sinus tarsi are then evacuated. The calcaneo-fibular ligament is generally sectioned to enhance exposure and distraction of the joint. The STJ is distracted and the anterior, middle, and posterior facets are resected with hand instrumentation. Debridement is carried out until cancellous bleeding bone is exposed (Figures 6, 7).

Positioning of the fusion site is then undertaken. When good alignment is obtained, temporary fixation is inserted from a small incision at the level of the talar neck. The position is verified under fluoroscopy and if adequate, a large fragment screw is inserted from anterior talar neck crossing the posterior facet ending in the postero-lateral aspect of the calcaneus (Figure 8).

A second screw is inserted for anti-rotation purposes from the neck of the talus to the anterior lateral aspect of the calcaneus, just proximal to the calcaneo-cuboid joint. The screw size depends principally on the size of the talar neck. A 6.5 mm screw will be used if there is enough space; in cases where osseous area is limited, a smaller screw can be utilized. The purpose of the second screw in isolated STJ arthrodesis is to prevent rotation, which could occur with single screw fixation. By adding a second point of fixation that is divergent, the rotary motion around the compression screw is eliminated (Figure 9).

Following definitive fixation, proper layered closure is performed and a posterior splint or hard Jones compression cast is applied. The patient is maintained non-weightbearing in a splint for 6 weeks and subsequently progressed to a walking boot. Physical therapy may be employed as needed.

COMPLICATIONS

Complications that can occur include varus or valgus malunion, delayed union, nonunion, infection, hematoma, painful hardware, sural nerve entrapment, and wound dehiscence.

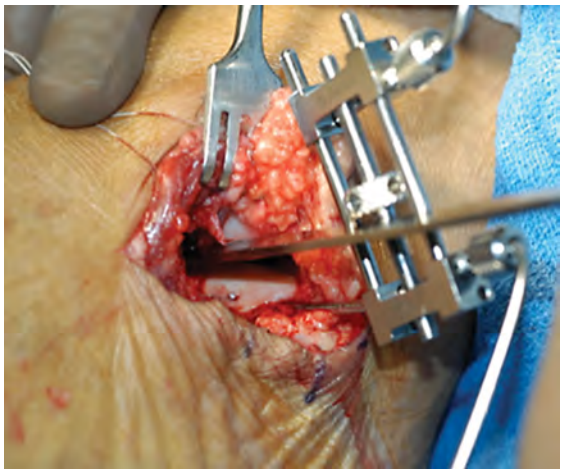

Figure 6A. Resection of anterior and middle facets.

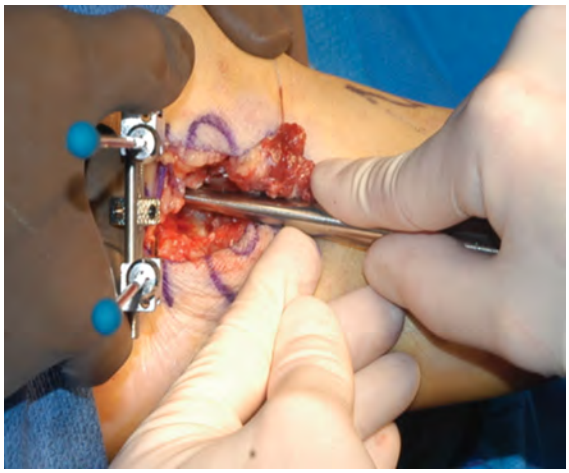

Figure 6B. Resection of posterior facet.

Figure 7. In some instances, a bone graft can be utilized to restore the height and to provide an appropriate rearfoot position.

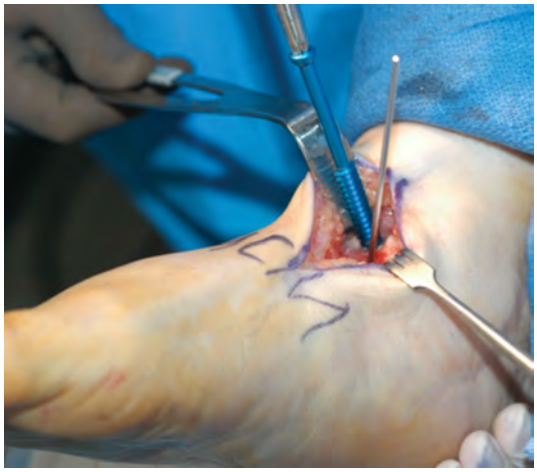

Figure 8. Screw insertion.

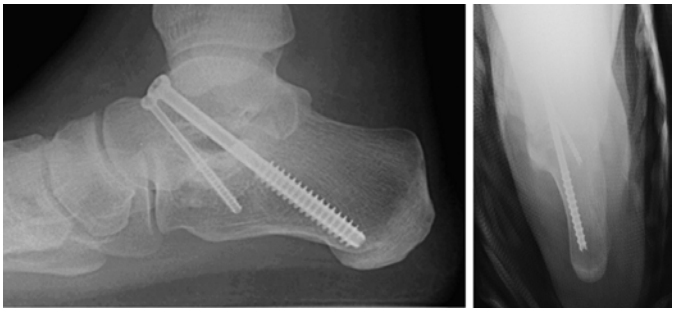

Figure 9. Immediate postoperative radiographs.

A large study by Easley et al with 184 STJ arthrodesis was made in order to identify the factors contributing to the nonunion rates of this procedure. Their results showed that smoking, the presence of more than 2 mm of avascular bone in the arthrodesis site, or the failure of a precedent STJ fusion were significantly contributing to nonunion (26).

In conclusion, the authors and the literature support isolated STJ arthrodesis in the management of pes valgus, rearfoot coalitions, severely comminuted calcaneal fractures, isolated STJ arthritis, and neuromuscular diseases. We have utilized this procedure as our preferred building block in the management of the adult acquired flatfoot deformity. It provides a definitive, lasting, and predictable result, which in our hands has resulted in high patient satisfaction and a low complication rate. As with any fusion procedure, success is highly correlated to the position of the arthrodesis. With neutral or very slight valgus, the foot will function well and place no significant torque on the ankle. It is the authors' opinion that concerns about fusion are overstated. In most patients, we are electing fusion, which is providing a favorable alternative to the previously malpositioned, painful, and/or unstable joint. This improves the patient's level of function and pain.

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