

SUBTALAR JOINT ARTHRODESIS — REFINEMENTS IN TECHNIQUE

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Subtalar joint arthrodesis has been performed for many years, as an isolated procedure, or as part of a triple or pantalar arthrodesis. While the indications for this procedure have not changed significantly, notable refinements have been made in the methods of joint resection, joint repositioning, and joint stabilization or fixation. The purpose of this paper is to update the current technique of the subtalar arthrodesis with emphasis on the method of resection and proper positioning of the calcaneus beneath the talus. Finally, the standard Podiatry Institute technique of fixation will be reviewed as well as several newer devices which provide rigid internal compression fixation.

INCISIONAL APPROACHES

The standard approach to the subtalar joint involves two incisions, one medial and one lateral. The primary lateral incision provides exposure to the entire subtalar joint complex. This includes the posterior facet as well as the middle and anterior facets deep within the sinus tarsi area. Resection of the joint surfaces is readily achieved through this approach.

The lateral incision extends from the tip of the fibular malleolus distally over the sinus tarsi area to terminate at the level of the calcaneocuboid joint. The incision is deepened through the subcutaneous tissue to the level of the deep fascia which can be seen covering the extensor digitorum brevis muscle belly. Care should be exercised in identifying the sural nerve (lateral dorsal cutaneous nerve) inferiorly, and the intermediate dorsal cutaneous nerve superiorly. A "T" or "L" type arthrotomy provides access to the subtalar joint surfaces. The vertical arm is placed just anterior and medial to the fibular malleolus and provides immediate exposure not only to the posterior facet of the subtalar joint, but to the lateral aspect of the ankle joint as well. The horizontal arm runs distally from the vertical arm just beneath the extensor digitorum brevis muscle belly and superior to the peroneal tendons. In some cases it is preferable to incise the deep fascia separately, retract the peroneal tendons inferiorly, and then incise the periosteum and capsular tissues as a

distinct layer. Dissection is carried across the floor of the sinus tarsi and its contents are reflected dorsally and distally along with the muscle belly.

The ligaments of the subtalar joint may be visualized within the sinus tarsi and should be released. The entire contents of the sinus tarsi should be evacuated to provide complete appreciation of the posterior and middle facets. A Crego elevator is then introduced at the anterior lateral border of the ankle, just inferior to the fibula. The instrument is then passed around the posterior aspect of the posterior facet. It may be necessary to transect the calcaneo fibular ligament to gain exposure. If this is performed, the ligament may be tagged with suture for later re-approximation. A needle-nosed rongeur is frequently used to remove all of the remaining soft tissues adhering to the floor or the roof of the sinus tarsi.

The medial incision provides exposure to the head and neck of the talus to allow insertion of the fixation screw, most commonly a large cancellous bone screw. The incision runs from the anterior border of the medial malleolus and courses dorsally and distally to the level of the talonavicular joint. Subcutaneous dissection is accomplished with blunt technique with particular care taken to avoid damage and trauma to the saphenous nerve and vein, which routinely course this area. The vital structures should be retracted laterally and superiorly. The periosteum and capsular tissues are then incised in a similar manner and subperiosteal dissection completed, exposing the head and neck of talus, the ankle joint, and the talonavicular joint. With experience, only the head and neck of the talus need to be identified. Visualization of both the ankle joint and talonavicular joint ensure accurate placement and positioning of the internal fixation devices and can be accomplished through a small incision measuring only 2-3cm in length. (Fig. 1A & 1B)

JOINT MANIPULATION AND INSPECTION

At this point, the subtalar joint is manipulated and inspected. Complete visualization of the posterior and

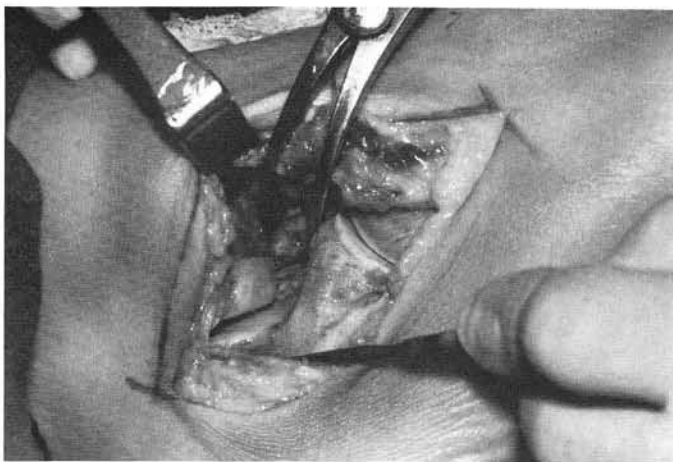


Fig. 1A. Visualization of the posterior facet of the subtalar joint through a lateral incision. The middle and anterior facets are deep within the sinus tarsi region. (Right Foot)

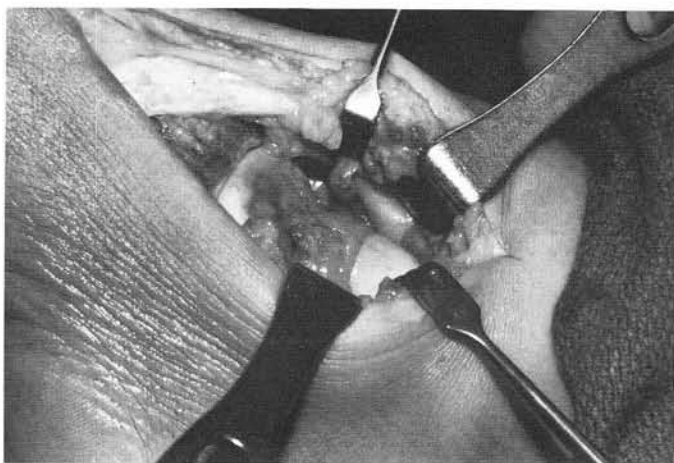


Fig. 1B. Medial dissection completed, exposing the head and neck of the talus for insertion of the fixation device. (Right Foot)

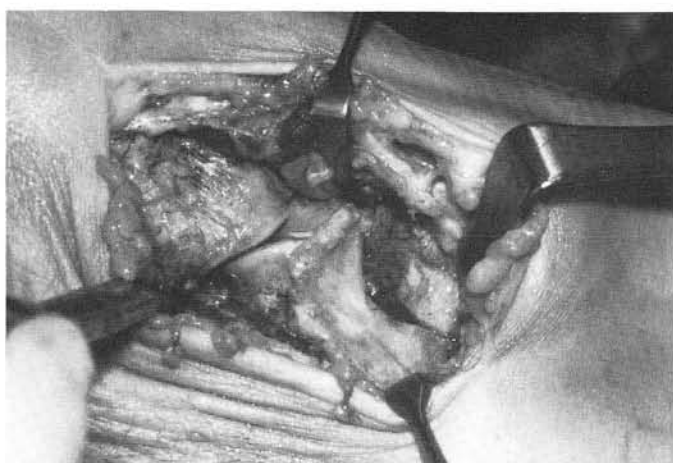


Fig. 2. Visualization of a "pseudo-facet" along the lateral wall of the calcaneus as a result of long term dislocation of the calcaneus from beneath the talus. This has resulted from chronic pressure against the fibula. (Left Foot)

middle facets is critical. In cases of tarsal coalition or severe degenerative arthritis, identification and visualization of the joint may be difficult to accomplish. Careful probing with a Sayer elevator or small osteotome and aggressive manipulation will usually help identify the posterior facet. The joint may be physically pried open if necessary. In cases of a middle facet coalition, it may be necessary to open the medial side of the joint. Accurate placement of the medial incision is accomplished by insertion of a blunt probe through the sinus tarsi area (through the joint space itself). This probe can then be palpated medially and the appropriate skin incision executed. The coalition can then be resected, allowing improved mobilization and visualization of the subtalar joint complex.

The lateral and medial aspects of the ankle joint should be inspected. A critical area is the articulation of the lateral aspect of the talus with the medial aspect of the fibula. On occasion, one will encounter degenerative changes and small exostoses which can be readily removed and remodeled. In cases involving serious deformity of the subtalar joint, especially with heel valgus, the fibula may undergo adaptation as the calcaneus abuts and then impacts against the fibula. The bone changes here are in accordance with those of Wolff's Law. In extreme cases a "pseudo-facet" may be seen on the lateral wall of the calcaneus. (Fig. 2)

The joint resection technique involves the removal of cartilage by the use of bone currettes, rongeurs, or power burrs. This technique maximizes preservation of the normal contour and shape of the curved posterior facet surfaces, and allows the surgeon to take advantage of the simple maneuvers of pronation and supination to position the calcaneus beneath the talus in optimum alignment. Sharp bone currettes of varying sizes are critical to accomplish this technique. The cartilage of the posterior facet of the calcaneus is "scraped" to its subchondral bone plate. Firm pressure is placed on the curette to create a gouge from where to progress. The cartilage of both joint surfaces are removed by this "scrapping" or "chipping" technique. Distraction of the subtalar joint is accomplished using a baby Laminar spreader. It is critical to remove all cartilage, not only from the easily visualized central portions, but also from the entire circumference and periphery to ensure that one does not create "high spots" which will prevent uniform compression of the arthrodesis site. A small power burr and needle-nose rongeur are valuable instruments in performing this task. There should be no remaining cartilage visualized. (Fig. 3 A, B)

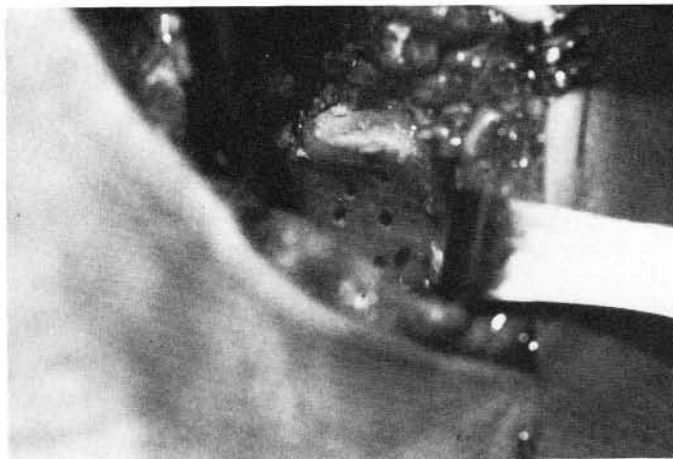
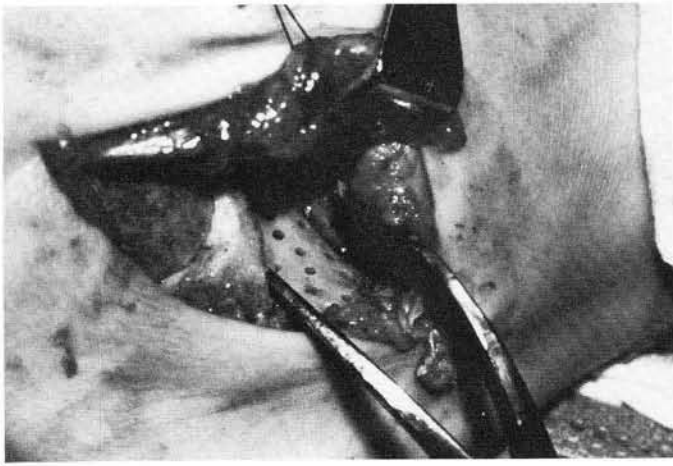


Fig. 3A, B. Appearance of the subtalar joint posterior facet surfaces & following a complete resection of the cartilage utilizing the described technique. (Left Foot)

The middle and anterior facets are then denuded of their corresponding cartilaginous surfaces. A power burr or side-cutting burr is very effective in facilitating the resection of cartilage in these areas.

The wound is irrigated aggressively with copious amounts of normal sterile saline to remove all remaining loose cartilaginous fragments and debris.

The next step is to determine the "ideal" or "desired" position of the calcaneus with respect to the talus. The subtalar joint is manipulated through its entire range of motion while observing the sinus tarsi area. The surgeon supports the heel within the palm of his hand and manipulates the calcaneus through the motions of supination and pronation. Close observation will show that with the subtalar joint maximally pronated, the lateral

process of the talus is in intimate contact with the floor of the sinus tarsi. The heel is everted and externally rotated with respect to the talus, therefore, the sinus tarsi is totally obliterated. This corresponds to what is often observed on a lateral x-ray in the maximally pronated foot.

With supination of the subtalar joint intraoperatively, one observes a predictable event. The lateral process of the talus rotates away from the floor of the sinus tarsi as the talus "rides up" on the posterior facet of the calcaneus. The sinus tarsi is totally open and this creates a rather large visual defect. Deep within the sinus tarsi, the medial middle facet joint space (which has also been denuded of its cartilage) is readily visualized. The sinus tarsi is now a void cavity. This corresponds to what is often observed on a lateral x-ray in the maximally supinated foot.

While performing these manipulations, one will observe that the adjacent surfaces of the posterior facet maintain contact with each other throughout the manipulation. This occurs in spite of resection of the cartilage because the normal gently sloped joint configuration and contour has been preserved. Maintenance of the overall contour allows one to manipulate and reposition the calcaneus to its desired position while still sustaining contact between the adjacent surfaces. Once the desired position is obtained, it must now be maintained, fixated, and allowed to progress to complete fusion. (Fig. 4A, 4B & 4C)

Maintenance of the desired position is accomplished by the insertion of a 5/32 inch Steinman pin into the calcaneus at the leading or distal edge of the lateral process of the talus (Fig. 5). Positioning of the wire at this level acts to prevent migration of the talus in a pronatory direction. This Steinman pin functions as an arthroereisis type device while completing the fixation process. Placement of the pin is a precise maneuver which requires complete visualization of the entire subtalar joint complex. With the foot supported in the palm of the surgeon's hand, and the subtalar joint now in the corrected position, the Steinman pin is inserted perpendicular to the slope of the posterior process, parallel to the anterior surface of the lateral process of the talus (Fig. 6). The pin itself does not physically pass through any portion of the talus. Rather, its strategic placement prevents the downward and forward migration of the talar body. It does not replace the fixation device which will cross the subtalar joint, however, if a patient were permitted to stand with full weight bearing on the extremity, (an imaginable and hypothetical situation only) this pin would help deter and prevent pronation of the subtalar joint, but still allow for supinatory movements.

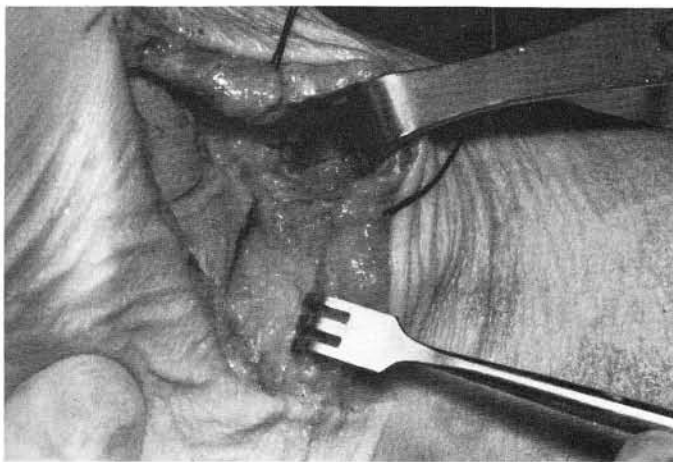


Fig. 4A. Appearance of the subtalar joint in a position of maximum pronation. Note contact at the lateral process of the talus with the floor of the sinus tarsi.

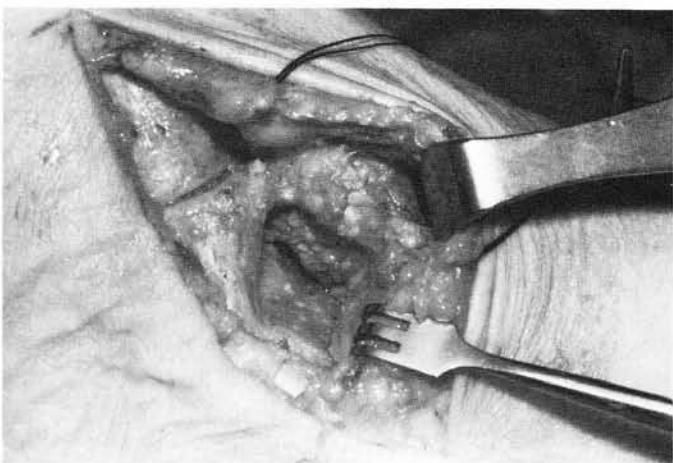


Fig. 4B. Appearance of the subtalar joint in a position of maximum supination. Notice a large void created within the sinus tarsi.

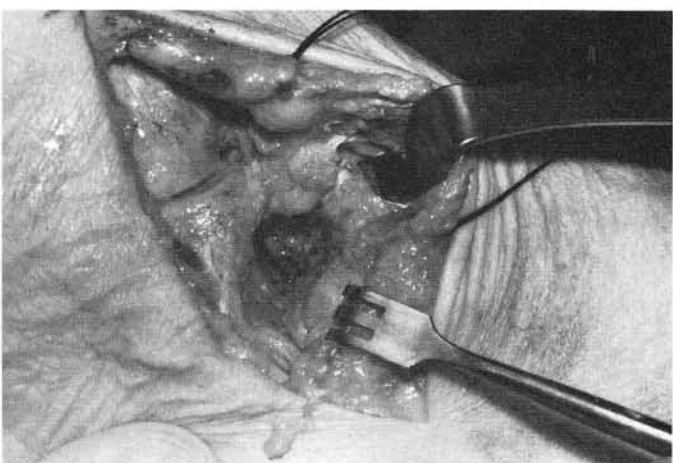


Fig. 4C. Partial obliteration of the sinus tarsi as a result of placement of the STJ in a "neutral position". This is generally the desired position of fusion. One can see that the lateral process of the talus is midway in its course of travel from the floor of the sinus tarsi to its maximum distance when in a position of maximum supination.

Fixation Using AO/ASIF 6.5mm Cancellous Screws

The wound is irrigated with copious amounts of normal sterile saline. The joint is then distracted and a series of small 1.5 or 1/8mm drill holes are placed throughout the subchondral bone plate of both the talus and calcaneus. Typically 10-15 holes are drilled through each surface. The resultant "bone dust" or "paste" is allowed to remain and is usually not irrigated from the wound.

The joint is then fixated with a 0.062 inch Kirschner wire passing through the neck of the talus and exiting through the central portion of the posterior wall of the calcaneus, just lateral to midline. The subtalar joint is held in the palm of the surgeon's hand, suspended in the air, allowing the weight of the extremity to assist in locking the subtalar joint against the previously inserted pin in the sinus tarsi area. This simple maneuver prevents joint distraction as the temporary K-wire is inserted.

Intraoperative x-rays are obtained to confirm placement of the K-wires. Most often these include a lateral and calcaneal axial view. If necessary, the K-wire is repositioned and additional x-rays obtained.

Final fixation is accomplished utilizing standard AO/ASIF techniques with a 6.5mm long thread cancellous bone screw. The screw will typically measure 80-100mm in length. The sequence of steps for insertion of a 6.5mm cancellous screw are:

1. 3.2mm drill hole
2. 4.5mm overdrill (optional)
3. Countersink
4. Depth measurement
5. Tap
6. Screw insertion

Rigid Internal Compression Fixation is Readily Achieved.

Attention is then re-directed to the lateral incision. The previously inserted pin is allowed to remain but is bent at a 90 degree angle to prevent inward migration. The pin is locked against the lateral process of the talus. It is important that the pin is positioned in a correct location to avoid hindering ankle joint dorsiflexion or plantarflexion. In rare cases, this pin can be replaced with a small, yet heavy gauge bone staple. The purpose of this pin following the insertion of the permanent fixation devices is to prevent loss of correction in the event of inadvertent weight bearing on the extremity. (Fig. 7)

Patients are usually permitted a return to full weight bearing at approximately eight weeks postoperatively. For the next four weeks progress should be monitored carefully to ensure that no shifting or complication of bone healing occurs.

Internal fixation devices may be removed between six months and one year, although this is not routinely performed. Unless there are complications relative to the internal fixation devices, the author's preference is to leave them in place undisturbed.

Results

The author has utilized this technique extensively over the last four years for both isolated subtalar joint arthrodesis, triple arthrodesis, and on less frequent occasions, pantalar arthrodesis. The results to date have been excellent. This technique has helped greatly in repositioning the subtalar joint into a proper location, especially when correcting the pronated or valgus foot deformity. There have been no cases of delayed union, non-union, or pseudoarthrosis of the subtalar joint to date. Fixation devices have been removed on rare occasions due to either protrusion of the screw beyond the cortical wall of the calcaneus, or situations of individual patient preference. The results of this technique to date have been extremely rewarding and gratifying, from both the patient's and surgeon's perspective.