THE CURETTAGE TECHNIQUE FOR MAJOR REARFOOT FUSIONS

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Single, double or triple joint fusions are commonly performed for a variety of pathological conditions. Numerous articles have been published describing the surgical technique. While the indications for major arthrodesing procedures have not changed significantly, notable refinements have been made in the surgical technique. These refinements include incisional approaches, dissection techniques, joint resection techniques, joint repositioning, and finally, joint stabilization and fixation.

The importance of shifting, rotating, and wedging of joints to correct for multiplanar deformities has been well described. A number of techniques have been described for removal of joint surfaces, most of which involve removal of large portions of bone. Resection of large portions of bone, when performing a triple arthrodesis, will result in loss of height, increase in width, and shortening of the foot. In 1990, a refinement in the technique of joint resection was introduced, namely that of curettage removal of cartilage for fusion of the subtalar joint. The author has used the curettage technique in major midfoot and rearfoot arthrodesis numerous times, both prior to and subsequent to this publication. This article will further describe the use of the curettage technique when performing isolated or combined arthrodesis of the subtalar, talonavicular or calcaneocuboid joints.

INCISIONAL APPROACHES

A standard collateral incisional approach is used for exposure of the subtalar joint and calcaneocuboid joints. A standard medial incisional approach is used for exposure of the talonavicular joint and other medial column joints as well. The reader is referred to prior publications for further detail.

When utilizing this technique, it is important that all ligaments and periarticular structures are released to provide maximum mobilization of the joint. In the dissection of a subtalar joint, all of the ligaments within the sinus tarsi should be excised *in toto*. More commonly than not, it will be necessary to transect the calcaneofibular ligament in order to provide adequate exposure to the posterior facet of the subtalar joint. Complete dissection around the dorsal, medial, and plantar aspects of the talonavicular and calcaneocuboid joints will be necessary to achieve distraction of these joints when utilizing the curettage technique. Complete exposure of the joint is the first critical step in the successful execution of this technique.

INDICATIONS

The indications and prerequisites for the use of a curettage technique in major midfoot and rearfoot arthrodesis is the ability to manipulate and reposition the joint. This can be confirmed preoperatively by the use of neutral position x-rays. While the technique may also be useful in cases of a tarsal coalition, it may be necessary to resect the coalition to allow for manipulation of the joints. In cases where significant wedging will be necessary to accomplish realignment of the foot, the curettage technique may have limited application. Experience has shown, however, that the curettage technique can be used for a vast majority of

patients with severe deformity, providing the ability to manipulate the foot into the corrected position exists.

The concept of the curettage technique is to remove the cartilage to the level of the subchondral bone plate. This preserves the normal contour of the joint and enhances bone-to-bone contact without causing significant changes in height, width or length. After all of the cartilage has been removed from the joint to be fused, the foot can be manipulated into its desired and corrected position, and then stabilized with an appropriate technique. The repositioning and realignment of the foot is similar to capturing neutral position when casting for an orthotic device.

INSTRUMENTATION

Proper instrumentation is critical in successfully performing the curettage technique. Specific instruments required include:

1. Army/Navy elevators
2. Crego elevators
3. Bone curettes, straight and angled
4. Ring curettes
5. Lamina spreaders, small and large
6. Codman distractor
7. Bone rongeurs, varying sizes straight and curved
8. Power burrs round, oval, and side cutting

Perhaps the most important instruments are the curettes and distractors. The lamina spreader is most frequently used to distract the subtalar and midtarsal joints. In certain instances, large Steinmann pins are driven parallel to each other on opposite sides of a joint to facilitate distraction of a joint. This is particularly true with both the talonavicular and calcaneocuboid joints. Only after adequate exposure and distraction of the joint is achieved, is the joint ready for cartilage removal.

CURETTAGE TECHNIQUE

Subtalar Joint Arthrodesis

Once adequate exposure and distraction of the joint is achieved, the cartilage of the joint is resected primarily with the use of bone curettes. The cartilage is literally "scraped" from the subchondral bone plate, and the subchondral bone plate preserved. Both standard and ring curettes are the most commonly used instruments to resect the cartilage. The periphery of the subtalar, talonavicular or calcaneocuboid joints can be removed by utilizing a small needle-nosed rongeur. Small power burrs are used only to remove any small portions of cartilage which have not been resected by the curettes.

In "scraping" the cartilage from the joint, firm pressure is placed on the curette to create a gouge as the initial starting point. The cartilage of both joint surfaces is removed by this technique. It is critical that the cartilage from the entire joint is resected and not only the cartilage which is easily visualized. Failure to remove all cartilage from the opposing joint surfaces will result in difficulty with repositioning and realigning the foot and, thus, compromise the ultimate correction.

After the cartilage has been completely removed by the curettage technique, the wound is aggressively irrigated with normal saline to remove any remaining loose cartilaginous fragments and debris. The wound is dried thoroughly and inspected for any remaining loose portions of cartilage. Special emphasis should be placed on inspecting the periphery of the joint. Any osteophytic projections of bone or irregularities in the joint surfaces are remodeled to ensure the best reciprocal fit when the foot is placed in corrected position.

After all of the cartilage of the joint has been removed, a series of 1.5 mm drill holes are placed through the subchondral bone plate of the opposing joint surfaces. For example, when performing a subtalar joint arthrodesis, typically, 20 holes are placed through the under side of the talus and the dorsal side of the calcaneus in the area of the posterior facet. Similarly, ten to twenty holes would be drilled into the opposite subchondral plates of both the talonavicular and calcaneocuboid joints. The resulting "bone paste" from the drill holes is left in place to serve as autogenous bone. These drill holes are believed to help facilitate revascularization and osseous bridging across the fusion site.

Joint Manipulation and Positioning

The next step is to determine the "ideal" or "desired" position of the joint. In the case of the subtalar joint, one must position the calcaneus properly with respect to the talus. The subtalar joint is manipulated through its entire range of motion while observing the sinus tarsi area. Manipulation of the subtalar joint is identical to

the in-office technique used when examining the subtalar joint or casting for orthotic devices. The surgeon supports the heel in the palm of his/her hand and manipulates the calcaneus through the motions of supination and pronation. Close observation will show that with the subtalar joint in a maximally pronated position, 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, and therefore, the sinus tarsi is totally obliterated. This corresponds to what is observed on a lateral x-ray in a maximally-pronated foot.

With intraoperative supination of the subtalar joint, one also 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 within the sinus tarsi area. Deep within the sinus tarsi, the medial or middle facet joint space (which has also been denuded of its cartilage) is also visualized. The sinus tarsi is now a large void cavity. This corresponds to what is often observed on the lateral radiograph in a maximally supinated foot (i.e., cavus foot).

While performing these manipulations, one will observe that the adjacent surfaces of the posterior facet of the subtalar joint maintain contact with each other throughout the process. This occurs in spite of resection of the cartilage because the overall architecture and joint contour have been preserved. Cadaveric specimens will show that the posterior facet consists of a convex dorsal calcaneal component and a concave talar component. Maintenance of the overall contour of each of these bones allows one to manipulate and reposition the calcaneus to its desired position while still maintaining contact between adjacent joint surfaces. Once the desired position is obtained, it must be maintained, fixated, and allowed to progress to a complete fusion.

Maintenance of the desired position is accomplished by insertion of a 0.062-inch Kirschner wire or a 5/32-inch Steinmann pin into the calcaneus at the leading or distal edge of the lateral process of the talus. Proper placement of this wire is critical and acts to prevent the downward migration of the talus in a pronatory direction. This pin does not cross the posterior facet and, consequently, does not penetrate the talus. This pin functions similarly to an arthroereisis-type device while completing the fixation process. Placement of the pin is a precise maneuver which requires complete visualization of the subtalar joint complex. With the foot supported in the palm of the surgeon's hand, the subtalar joint is manipulated into its desired position, the Steinmann pin is inserted perpendicular to the slope of the posterior process, yet parallel to the anterior surface of the lateral process of the talus. Once the pin has been inserted, the subtalar joint can no longer be pronated. It is important to note that this pin does not replace the actual fixation device which will cross the subtalar joint; however, if a patient were permitted to stand with full-weight bearing on the extremity (an imaginary and hypothetical situation only), this pin, like a subtalar joint arthroereisis device, would deter and prevent pronation of the subtalar joint but still allow for supinatory movements. This technique is referred to as a STA-pin technique. The author has used this technique routinely over the last seven years, when performing a subtalar joint arthrodesis as an isolated procedure or as part of a triple arthrodesis, with excellent results.

Permanent fixation of the subtalar joint is then achieved. Typically, a large cancellous screw is placed through the neck of the talus from a dorsomedial approach, crossing the posterior facet of the subtalar joint, and terminating at the posterolateral body of the calcaneus. Once permanent fixation has been introduced, the previously inserted STA-pin is bent 90° and cut to allow the pin to lock against the anterior beak of the calcaneus. The bending and locking of the pin in this position will minimize potential complications, should the pin attempt to migrate further into the calcaneus. Should the pin migrate outward, retrieval of the pin would be a simple procedure and could be performed in an office setting under local anesthesia. In addition, the 90° angle of the pin provides additional support against the body of the talus.

Midtarsal Joint Arthrodesis

Positioning of the talonavicular joint for fusion as an isolated procedure or as part of a triple arthrodesis is easily performed. Articulation of 80 to 90% between the talus and navicular is recommended. Because the "ball-and-socket" joint configuration has been preserved, proper positioning of the navicular on the talus is readily achieved. Temporary or permanent fixation of this joint is

then completed utilizing an appropriate fixation technique. Medium to large cancellous bone screws are preferred, when possible. An alternative technique is the use of one or more large bone staples.

The calcaneocuboid joint is perhaps the easiest to realign and reposition. Its saddle-one architecture allows for easy positioning with nearly 100% congruity. Even cases involving a severe pes valgo planus deformity do not require bone grafting or lengthening of the lateral column. Conceivably, a foot with severe abduction would require bone grafting of this area or concomitant medial column shortening. The curettage technique, however, allows the complete restoration of normal congruity between the subtalar, talonavicular, and calcaneocuboid joints without wedge resection of bone, and without the necessity of a bone graft.

The subtalar joint, talonavicular joint, or calcaneocuboid joint can be fused alone or in combination with each other. The author has found that when utilizing the curettage technique, for example in cases following intra-articular calcaneal fractures, fusion of the subtalar joint and calcaneocuboid joint is sufficient. The curettage technique permits ready repositioning of these two joints and precludes the necessity of sacrificing the talonavicular joint. Traditionally, when a calcaneal fracture has involved the calcaneocuboid joint, a triple arthrodesis has been performed routinely, rather than fusion of the subtalar and calcaneocuboid joints only. Interestingly, in such cases, the talonavicular joint is usually spared of any significant arthritis and, thus, does not necessarily require concomitant fusion.

CLINICALLY ILLUSTRATED TECHNIQUE

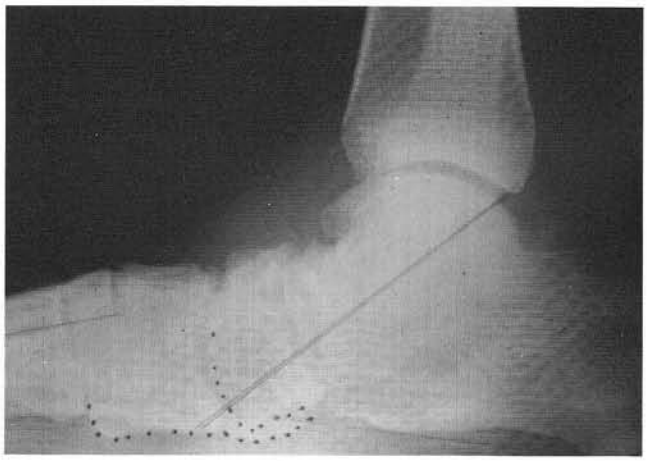

Figure 1A. Weightbearing lateral x-ray demonstrates severe pes planus deformity. Neutral position lateral radiograph demonstrates excellent restoration of alignment to the subtalar and midtarsal joint complexes.

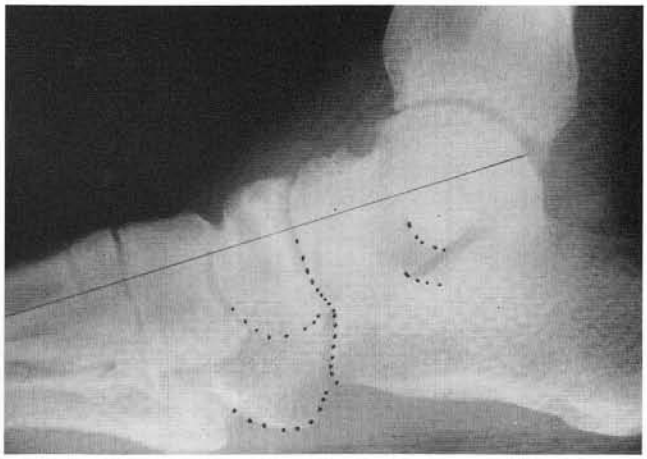

Figure 1B. Weightbearing lateral x-ray demonstrating severe pes planus deformity. Note the reduction of the medial column faulting.

Figure 2A. Cadaveric specimen showing the subtalar joint in a maximally pronated position. Note the intimate contact of the lateral process of the talus with the floor of the sinus tarsi.

Figure 2B. Cadaveric specimen showing the subtalar joint in a maximally supinated position. Note the wide opening present in the sinus tarsi area, often referred to as the "bullet hole" appearance on a lateral x-ray.

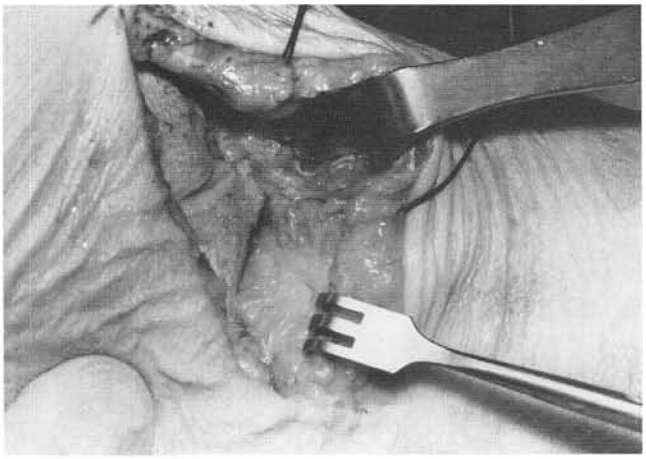

Figure 3A. Intraoperative photograph demonstrating the lateral perspective on a left foot with the subtalar joint in a pronated position. The sinus tarsi is completely obliterated and the middle facet cannot be visualized.

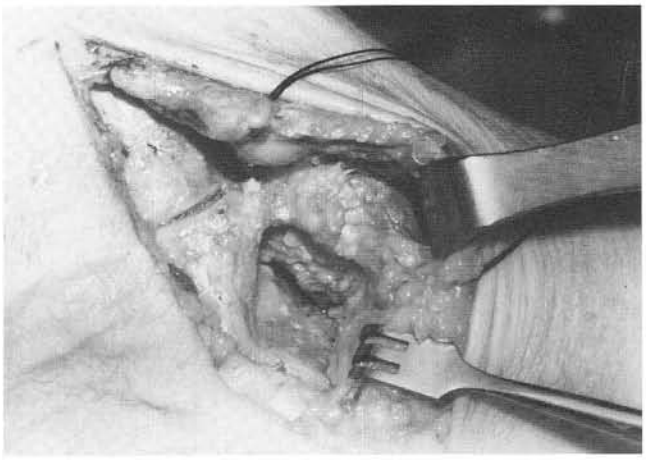

Figure 3B. Intraoperative photograph demonstrating a lateral perspective on a left foot with the subtalar joint in a supinated position. Note the wide opening present in the sinus tarsi. The medial or middle facet is seen deep within the surgical site.

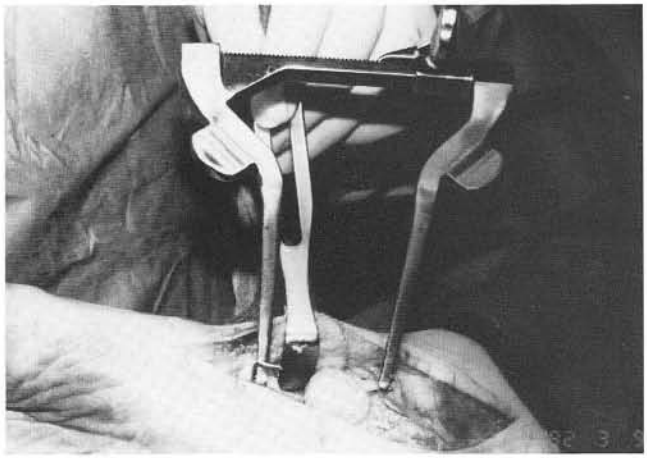

Figure 4A. Intraoperative photograph demonstrating distraction of the talonavicular joint utilizing Kirschner wires and a Codman distractor. Successful distraction utilizing this technique requires that the subtalar joint not be pinned to allow movement of the talus with respect to the calcaneus.

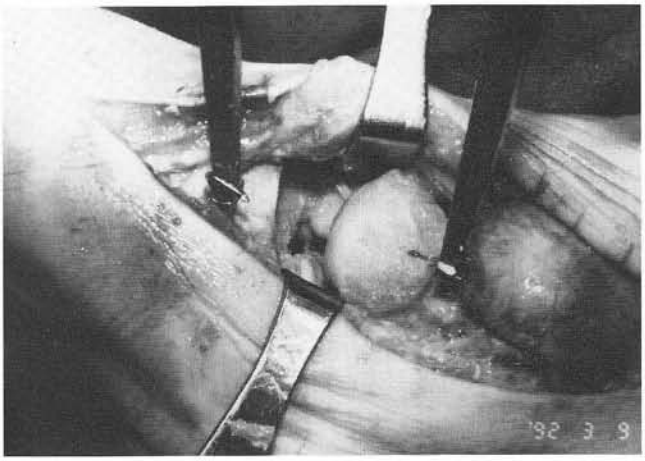

Figure 4B. Cartilage is then removed from the adjacent surfaces utilizing the curettage technique. Note the preservation of the normal architecture and shape of the talus and navicular.

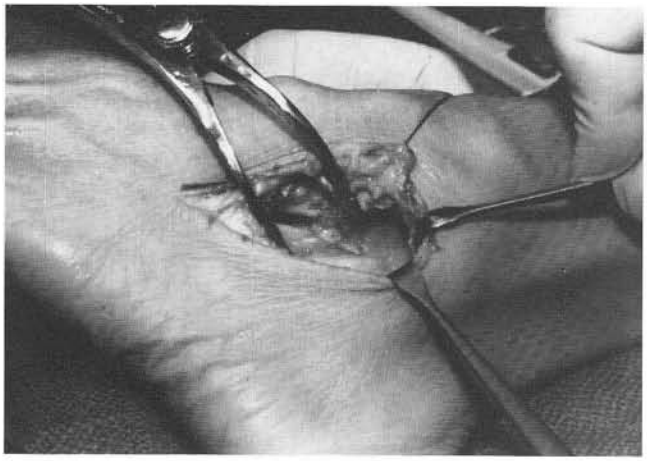

Figure 5A. Intraoperative photograph showing proper placement of a baby lamina spreader to facilitate distraction of the subtalar joint. The cartilage has already been removed to the level of the subchondral bone plate in the posterior facet.

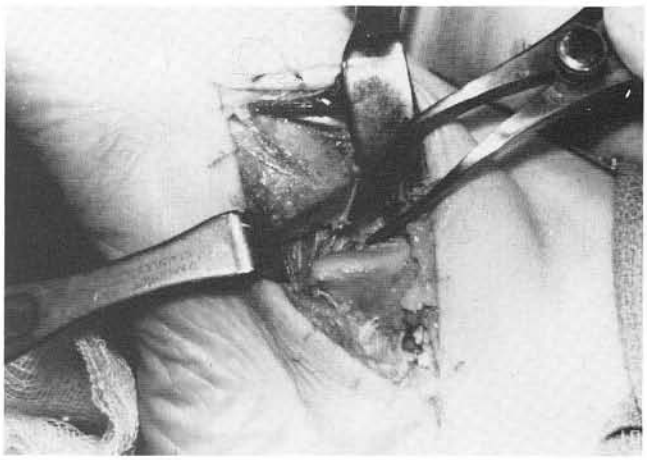

Figure 5B. Intraoperative photograph demonstrating distraction technique of the calcaneocuboid joint by use of a baby laminar spreader.

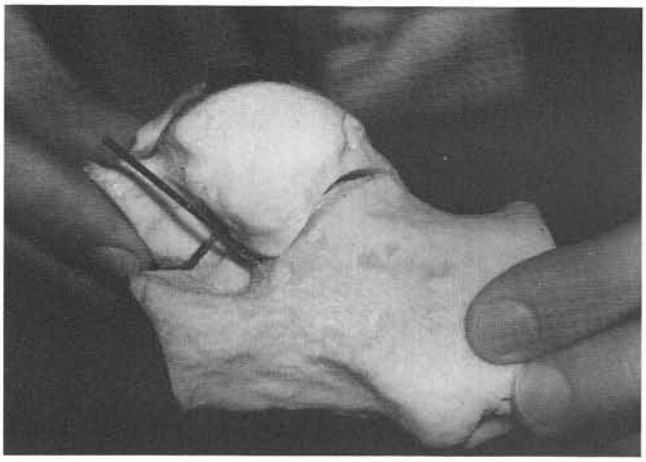

Figure 6A. Bone model demonstrating placement of the Kirschner wire for use as a STA-pin implant to maintain proper alignment during the fixation process for fusion of the subtalar joint.

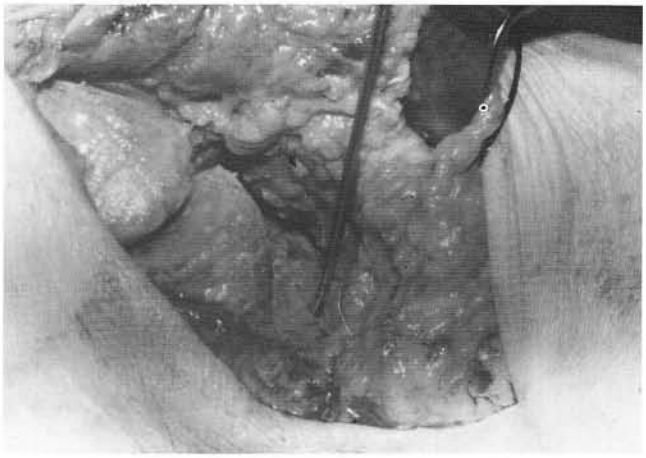

Figure 6B. Placement of the subtalar joint in neutral position with insertion of the "STA-pin" device. The pin will then be bent at a 90° angle after achieving fixation of the subtalar joint. The bent portion of the pin will be locked against the dorsal surface of the anterior beak of the calcaneus.

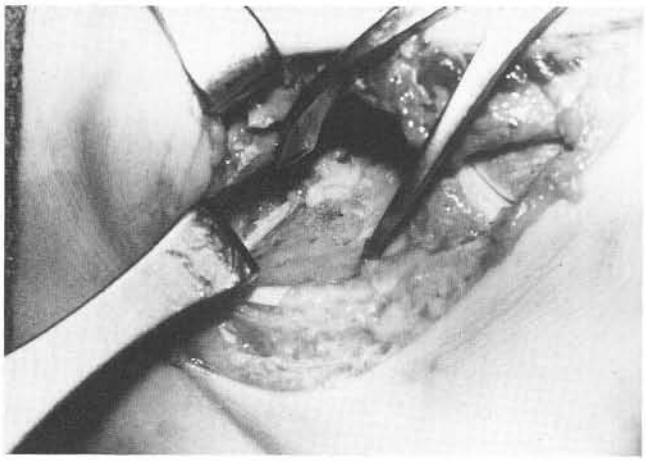

Figure 7A. Intraoperative photograph of the posterior facet of the subtalar joint of a right foot. Note that the cartilage has been removed from the adjacent surfaces with the exception of the peripheral rim which can be removed by a small needle-nosed rongeur. The cartilage has been removed to the level of the subchondral bone plate, and several drill holes have been placed in the posterior facet of the calcaneus.

Figure 7B. Intraoperative photograph from a medial perspective demonstrating complete dislocation of the talonavicular joint for exposure of the talar head. The cartilage has been removed to the level of the subchondral bone plate and multiple drill holes made.

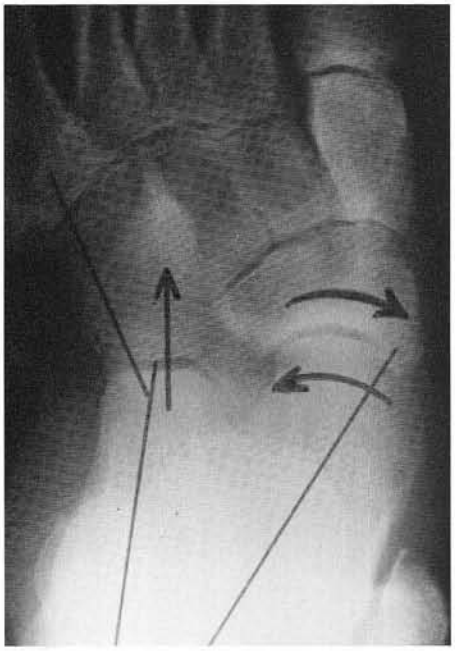

Figure 8A. Preoperative dorsoplantar x-ray in a patient with a long-standing flatfoot deformity secondary to chronic rupture of the tibialis posterior tendon.

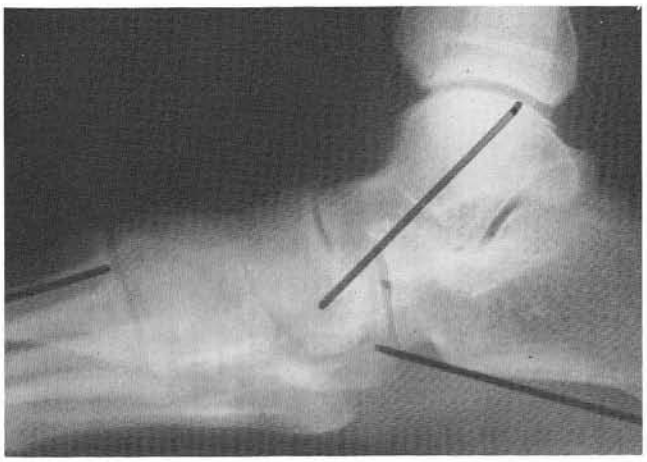

Figure 8B. Preoperative lateral x-ray in a patient with a long-standing flatfoot deformity secondary to chronic rupture of the tibialis posterior tendon.

Figure 9A. Postoperative dorsoplantar radiograph of the patient in Figures 8A. A triple arthrodesis was performed using the curettage technique in all three joints.

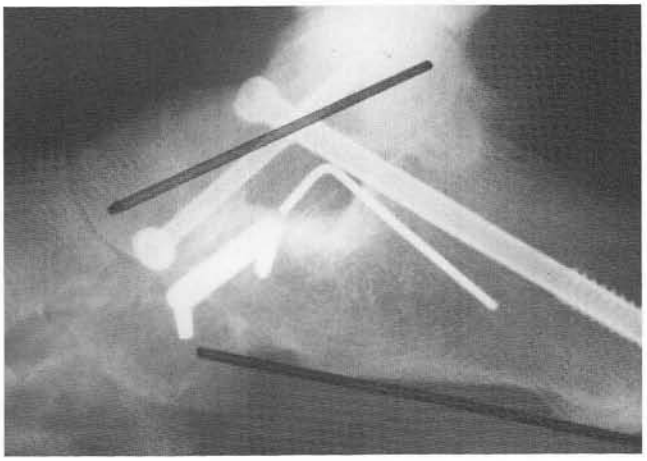

Figure 9B. Postoperative lateral radiograph joint. Repositioning has been achieved, and solid consolidation of all three joints is evident.

POSTOPERATIVE MANAGEMENT

Patients are initially placed in a Jone's compression dressing for 3 to 5 days. This initial dressing helps to control and minimize postoperative edema. Surgical drains are routinely used for the first 48 to 72 hours. At 3 to 5 days postoperatively, the wound is redressed under sterile conditions. The ankle is placed at 90° and a short leg non-weight bearing synthetic cast is applied.

Patients are maintained in a non-weight bearing status for approximately 8 to 12 weeks, depending on the type of fusion performed. Serial x-rays are obtained to monitor the consolidation process. At approximately 4 to 6 weeks, the cast is bivalved and converted to a posterior splint. The patient is then permitted to undergo aggressive physical therapy to resolve any residual edema and stiffness. This typically consists of hydrotherapy, electrical stimulation, and active and passive range of motion exercises of the ankle joint.

Patients are permitted to return to partial weight bearing between 8 and 12 weeks. There is a gradual, progressive increase in weight bearing over a 1 to 4 week period until full-weight bearing is achieved. This is a critical period which should be monitored carefully to ensure that no shifting or complications of bone healing occur.

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 themselves, the preference is to leave the devices in place, undisturbed.

RESULTS

The author has used the curettage technique extensively over the last seven years for isolated, double, and triple joint arthrodesis, with excellent success. While the technique has been attempted when performing an ankle fusion, alone or as part of a pan-talar arthrodesis, the results have been less encouraging. The curettage technique has provided a new dimension to major rearfoot and midtarsal arthrodesis, as well as Lisfranc's arthrodesing procedures. The author has found that even the most severe deformities can be readily corrected by this technique when the joints are properly repositioned. To date, the author has encountered one case of a nonunion of the subtalar joint, and one case of nonunion involving the calcaneocuboid joint, utilizing this technique.

Proper repositioning of the subtalar joint corrects for frontal plane valgus and transverse plane abduction. Proper repositioning of the talonavicular joint corrects for sagittal plane medial column faulting and assists in the correction of transverse plane abduction. In cases of a cavovarus foot, the calcaneocuboid joint is resected by wedge resection while the talonavicular joint and subtalar joint are resected utilizing the curettage technique.

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