

Tibio-talo-calcaneal Arthrodesis by a Retrograde Intramedullary Nail

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SUMMARY

Background. The paper presents the results of tibio-talo-calcaneal fusions using Retrograde Nailing System and Bone Grafting.

Material and methods. From May 2006 to January 2008, we performed 13 fusions in 11 consecutive patients with advanced ankle and hindfoot disease. Patients underwent 13 tibiototalcalcaneal fusions (2 patients had initial tibiototalcalcaneal fusion using screws and subsequently developed a non-union) and all 11 patients were available for follow up. The procedure was performed unilaterally in all cases; there were 4 males and 7 females. The average age at the time of surgery was 65.25 years (range 51-81 years). The average duration of follow-up was 8 months (range between 6-15 months).

Results. Solid fusion was achieved in all 11 cases. The average AOFAS score (maximum 78 points) improved from a pre-operative mean of 16 points [range 3 to 29] to a mean of 54 points [range 42 to 70], excluding the scores for stability and range of motion. Patient satisfaction scale (maximum 10 points) improved from 3 to 7 in both pain and function.

Conclusions. 1. Arthrodesis should be considered only after all conservative treatments fails; it is one of the most challenging surgical procedures that must be undertaken with care in order to provide the best possible outcome. 2. Thorough evaluation and examination will help the surgeon to find the correct indication and identify patients who are not suitable for the procedure. It is crucial to assess the vascular and neurological status and to obtain weight-bearing radiographs (possibly CT) of the ankle to evaluate the deformity. 3. The optimal position of the ankle is in neutral flexion, 0-5° valgus, and 10° external rotation, similar to the contralateral foot and posterior translation of the talus under the tibia (5mm). 4. Tibio-talo-calcaneal fusion with retrograde nailing and bone grafting is a successful salvage procedure in severe ankle and hind foot arthrosis with deformity.

Key words: arthroses; deformity; tibio-talo-calcaneal arthrodesis; retrograde intramedullary nail(ing); salvage procedure

BACKGROUND

Severe ankle and hindfoot deformities combined with arthritis are disabling and present a challenging management problem. Non-operative measures such as an ankle-foot orthosis are frequently unsuccessful while surgical options are limited and tibio-talo-calcaneal arthrodesis may be helpful in some cases. The fusion techniques vary from clamp and screw arthrodesis to retrograde nailing. However, non-union commonly complicates clamp and screw fusion techniques and the immobilisation time generally exceeds 12 weeks.

MATERIAL AND METHODS

We present an ongoing prospective study of 11 fusions in 11 consecutive patients with advanced ankle and hind foot disease with deformity. Patients underwent 13 tibio-talo-calcaneal fusions from May 2006 to January 2008 (2 patients had initial tibio-talo-calcaneal screws fusion and subsequently developed a non-union).

All 11 patients were available for follow up (4 males and 7 females). The procedure was performed unilaterally in all cases. The average age at the time of surgery was 65.25 years (51-81 years). The average duration of follow-up was 8 months (6-15 months).

The indications for surgery were end stage arthritis with severe pain, instability and difficulty in weight bearing in 9 cases (Fig. 1), painful hind foot with non-united hind foot fusion in 2 cases, and one case of upper ankle joint loosening (Fig. 2).

Preoperative deformities were clinically measured using a goniometer in normal weight bearing positions; they included 4 varus and 7 valgus hind

foot deformities. Eight patients were on methotrexate and three patients were on oral glucocorticosteroids. All patients had regular clinical and radiological follow-up and complications were recorded as of the expected time for clinical and radiological union. At 6 months follow-up, each patient completed a questionnaire that included the modified ankle and hindfoot score of the American Orthopaedic Foot and Ankle Society. This 100-point scale was modified to a maximum score of 78 points after excluding the scores for stability and range of motion. The mean pre-operative AOFAS score was 16 points (range 3-29).

The ankle arthrodesis nail is made of type II anodized titanium alloy (Ti6Al4V) for enhanced biomechanical and biomedical performance. The proximal locking configuration features a round and oblong hole to allow static or dynamic locking.

Controlled apposition/compression up to a maximum of 5 mm can be applied at the tibio-talar joint by introducing a compression screw from the driving end of the nail against the 5 mm shaft screw placed in the talus through the L/M oblong hole. The compression screw is cannulated, allowing nail insertion over a guide-wire with the compression screw pre-loaded.

The ankle arthrodesis nail is available in 10, 11, and 12 mm diameter (driving end 11 mm for 10 and 11 mm nails, 12 mm for the 12 mm nail). The available length is 150 and 200 mm. The nail design features a 5° lateral or valgus bend providing a "best fit" and better introduction through the calcaneal bone. Proximal locking is performed in a medial-to-lateral direction in order to avoid damage to muscular and neuro-vascular structures located on the lateral aspect of the tibia and avoid interference with the fibula.



Fig. 1. (Case 11 F, 80y) End stage arthritis with hind foot valgus deformity



Fig. 2. (Case 3 M, 71y) Upper ankle joint loosening

Two 5 mm fully threaded locking screws can be placed in the calcaneus. The proximal one is inserted in a lateral-to-medial direction through a threaded locking hole and the distal one anteroposteriorly with a 10° deviation between the posteromedial and anterolateral positions. This design dictates the need for left and right nails.

All operations were performed with the patients in the supine position. The procedure was performed using a tourniquet (closed after 20 minutes and opened before closure of the wounds) under general or spinal anaesthesia. We used a lateral transfibular approach [9] with an additional optional medial approach in 3 cases. The lateral malleolus was excised above the joint line, morcellized and used as a bone graft. Appropriate bone wedges were removed to achieve deformity correction and translation of the calcaneus in order to align the hind foot. The articular surfaces of the ankle and subtalar joints were completely denuded of articular cartilage. Special care was taken to protect the lateral plantar nerve, the lateral plantar artery, and the nerve supplying the abductor digiti minimi, which are at risk during insertion of the nail [13].

In the coronal plane, a line was drawn from the second toe to the centre of the calcaneus. A second line was drawn in the axial plane at the junction of anterior third and middle third of the calcaneus or bisecting the medial malleolus. A 3 cm longitudinal incision was placed just lateral to the intersection of the two lines, which should be 2.5 cm from the lateral border of the heel. Under fluoroscopic guidance, a pilot hole was made in the calcaneus and a guide wire was inserted in retrograde fashion through the

calcaneus and talus into the medullary canal of the tibia. No reaming was needed. The nail was inserted and impacted flush with the plantar surface of the calcaneus. The locking screws were also placed in the same manner. All feet underwent distal locking with an anteroposterior locking screw in the sagittal plane to increase torsional stability (Fig. 3).

Postoperative management included non-weight bearing mobilization for at least 2 weeks with a light cast in place until the wound healed, followed by progressive weight bearing mobilisation with average fusion time between 12-14 weeks.

Revision and severe osteoporosis patients required a modified shoe with a rigid sole and a rocker bottom during the first 3-6 postoperative months. These are frequently used to facilitate walking and help adjusting to the lost ankle's motion.

RESULTS

The AOFAS (American Orthopaedic Foot and Ankle Society) score improved from a pre-operative mean of 16 point (3 to 29) out of 100 points to a mean of 54 points (42 to 70) out of 78 points after excluding the points for stability and range of motion.

All 11 patients had a successful arthrodesis both clinically and radiologically (fig 4) and early complications were recorded as two minor superficial infections that were managed without need for antibiotic treatment, and two cases of infections that needed antibiotic treatment. No patient had non-union and the mean time from arthrodesis to fusion was 3 months (1,5 to 4).



Fig. 3. (Case 11 F, 80y) Post-operative follow-up radiograph



Fig. 4. (Case 3 M, 71y) Post-operative follow-up radiograph

DISCUSSION

The aim of tibial-talo-calcaneal arthrodesis is to provide pain relief, correct deformity and stabilise ankle and hindfoot. Patients with severe ankle and hindfoot disease (e.g., in the course of rheumatoid arthritis) present with technical difficulties secondary to disuse osteoporosis, inflammatory arthritis, bone loss, and compromised soft tissues due to previous surgery. Most of these patients are on disease-modifying agents such as steroids and methotrexate.

Contraindications include an intact subtalar joint, severe peripheral vascular disease, active infections of foot and ankle, severe angular deformity in the distal tibia, and significant fat pad atrophy [1,2].

A multitude of procedures have been described to accomplish tibio-talo-calcaneal arthrodesis which vary from external fixation, screw fixation, blade plate, intramedullary fibular grafts and retrograde intramedullary nails but there is no uniformly accepted technique [3,4,5,6,7,8,9,10,11,12].

The purpose of our study was to evaluate the outcome of tibio-talo-calcaneal arthrodesis with a locked retrograde intramedullary nail developed especially for this indication. The early results are encouraging. Medium-term results will be available when the nail is more commonly used.



CONCLUSIONS

1. Arthrodesis should be considered only after all conservative treatment fails. It is one of the most challenging surgical procedures that must be undertaken with care in order to provide the best possible outcome and patient satisfaction.
2. Thorough evaluation and work-up will help the surgeon to find the correct indication and identify patients who are not suitable for that procedure. It is crucial to assess the vascular and neurological status and to obtain weight bearing radiographs (possibly computed tomography studies) of the ankle to evaluate the deformity.
3. The optimal position of the ankle is neutral flexion, 0-5° of valgus, and 10° of external rotation, similar to the contralateral foot and posterior translation of the talus under the tibia (5mm).
4. Tibio-talo-calcaneal fusion with retrograde nailing and bone grafting is a successful salvage procedure in severe ankle and hind foot arthrosis with deformity.

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