

# RESULTS OF ANKLE ARTHRODESIS USING A TIBIAL SLIDING BONE GRAFT

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## Keywords:

ankle  
osteoarthritis,  
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**Abstract:** Currently, ankle arthrodesis is still considered the treatment of choice in advanced stages of ankle osteoarthritis. Harvesting a bone graft from the distal tibia and sliding and fixing it in the talus leads to a strong stabilization without the need for osteosynthesis material. In this study we aimed to evaluate the clinical course, osseous consolidation and the frequency of complications of this technique. We included 32 cases of ankle arthrodesis in 32 patients (21 men, 11 women, mean age  $48 \pm 22$  years) that were followed for a mean of 3.7 years (1-6 years). We found a statistically significant improvement of the AOFAS Ankle-Hindfoot Scale score ( $p=0.02$ ) and consolidation in 31 cases (96.87%) after a medium of 13 weeks. There were two cases of superficial soft tissue necrosis and one case without bone fusion. The method is simple, reproducible and provides excellent clinical results with a high rate of consolidation.

**Cuvinte cheie:** artroza  
gleznei, artrodeza de  
gleznă, grefon osos  
tibial

**Rezumat:** Artrodeza gleznei constituie și în prezent tratamentul chirurgical de elecție al artrozei de gleznă în stadiile avansate. Recoltarea unui grefon osos de la nivelul extremității distale a tibiei și translarea cu fixarea acestuia în astragal permite obținerea unei stabilizări ferme, fără nevoia unui material de osteosinteză. În acest studiu ne-am propus evaluarea acestei tehnici din punct de vedere al evoluției clinice, consolidării osoase și frecvenței complicațiilor. Am inclus 32 de cazuri de artrodeză de gleznă la 32 pacienți (21 bărbați, 11 femei, vârsta medie  $48 \pm 22$  ani), urmăriți în medie 3,7 ani (1-6 ani). Am înregistrat o îmbunătățire statistic semnificativă a scorului AOFAS Ankle-Hindfoot Scale ( $p=0.02$ ) și consolidare în 31 cazuri (96,87%), în medie după 13 săptămâni. La două cazuri a apărut necroza superficială a părților moi, iar la un caz absența fuziunii osoase. Metoda este simplă, ușor de reproduș și oferă rezultate clinice excelente, cu o rată înaltă de consolidare.

## INTRODUCTION

Symptomatic osteoarthritis of the ankle is a major clinical problem with an estimated incidence of approximately 50,000 new cases per year in the United States.(1) The degree of disability associated with this condition is comparable to that caused by coronary artery disease, hemodialysis or hip osteoarthritis.(2,3.) It is also noteworthy that most ankle arthritis cases develop secondary to trauma, affecting adults at a relatively young age.(4) There are numerous methods of treatment for ankle osteoarthritis, e.g. the use of orthotics, intra-articular administration of corticosteroids, open or arthroscopic debridement of the joint, various periarticular osteotomies, ankle replacement and arthrodesis. Conservative treatment may provide short-term relief of symptoms, but usually pain increases progressively, with severe limitation of motion and joint function. Although the results of ankle arthroplasty may be similar to those of ankle arthrodesis, the latter remains the "gold standard" in the treatment of advanced stages of ankle osteoarthritis that do not respond to other treatment methods.(5,6) Most data suggest that ankle fusion offers patients a painless and stable foot.(7) Ankle arthrodesis was first reported by Albert in 1879; since then, more than 30 different surgical techniques have been described.(8) Fusion may be intra-articular, extra-articular or mixed, with different types of fixation: the use of external compression fixation devices or internal fixation with cancellous screws, absorbable screws,

Kirschner wires, Steimann nails, intramedullary rods or "T" plates. Bone grafts can also be used – these may be harvested from close (fibula, tibia) or remote sites (iliac crest).(9) Ankle arthrodesis can also be performed arthroscopically.(7,10) The postoperative complications of ankle arthrodesis may include delaying of or lack of consolidation, fusion in a vicious position, infection, neurovascular injuries, algoneurodystrophy syndrome and tibial stress fractures.(11,12) The results of numerous clinical and biomechanical studies have highlighted the superiority of rigid internal fixation versus external fixation, as evidenced by increased rates of consolidation, decrease postoperative infections, reduced patient discomfort and the possibility of early weight-bearing on the affected leg.(5) Ankle arthrodesis using a bone graft harvested from the distal end of the tibia can provide a rapid consolidation through stable fixation, without the need for osteosynthesis materials.(13)

## PURPOSE

In this study we aimed to evaluate the clinical and radiological results and potential complications in a series of patients with ankle arthrodesis and stabilisation with a sliding tibial bone graft locked in the talus.

## METHODS

In this study we included a consecutive series of 32 cases of arthrodesis in 32 patients with severe osteoarthritis of

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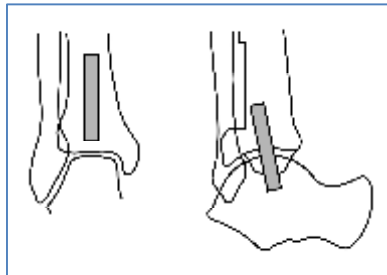
## CLINICAL ASPECTS

the ankle, treated in our Clinic between 2007 and 2012. Preoperatively we recorded patient demographic data and American Orthopaedic Foot and Ankle Society (AOFAS) Ankle-Hindfoot Scale values. The later is a numerical score with a maximum of 100 points, providing information on pain (40 points), function (50 points) and joint range of motion (10 points), results being considered excellent between 90-100 points, good for 75-89 points, fair for 50-74 points and poor for <50 points. Radiological examination consisted of weight-bearing radiographies of both ankles (anterior-posterior and lateral views). Diagnosis was based on radiological images, patient history and specific laboratory analyses. We recorded postoperative values of the AOFAS Ankle-Hindfoot Scale score and the complications that occurred during follow-up. Patients returned for monthly regular follow-ups until radiologically proven consolidation.

### Operative technique

Surgery was carried out under the protection of a pneumatic tourniquet, with the patient in regional anesthesia. We made an approximately 12 cm long anterior longitudinal incision, placed in the centre line of the foot and calf. The space between the tendon of the extensor digitorum longus and the tendons of extensor hallucis longus and tibialis anterior was used to reach the front of the tibio-talar joint. The joint capsule was incised and the periosteum removed from the lower end of the tibia and the dorsal aspect of the talar neck. The articular surfaces of the tibial pilon, malleoli and talus were exposed and resected to reach the subchondral cancellous bone layer. A bone graft is harvested from the distal end of the tibia – this should be about 8 cm long and 1 cm wide, and of a trapezoidal shape with the large base of the anterior cortex of the tibia, maintaining an intact portion of 1-1.5 cm above the joint space. A bone tunnel is made, starting from the bottom of the harvest site, passing through the articular surface of the tibial pilon and penetrating 2-2.5 cm of the talar body; tunnel dimensions should be approximately equal to those of the graft. The tibial graft is inserted through this tunnel and down into the talus, similar to a latch (figure 1). The anterior margin of the tibial pilon acts like a bridge over the graft and ensures the stability of the assembly, without having to use osteosynthesis material. We performed arthrodesis with the foot in 5° of equinus for men and 10° of equinus for women. If there isn't a perfect apposition of the resected surfaces of the tibia and talus, the remaining gap can be filled with small bone grafts obtained from the removed bone fragments. The lower limb is immobilized in a short leg cast until radiographic evidence of consolidation. Partial weight-bearing is allowed after the first 6-8 weeks, with full weight-bearing after 12 weeks postoperatively.

**Figure no. 1. Schematic representation of the surgical technique**

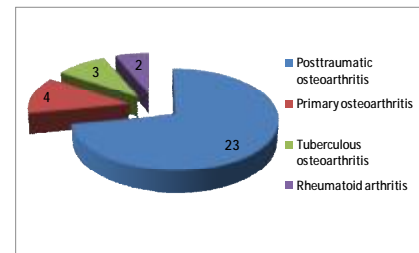


### RESULTS

The 32 arthrodeses were performed in 32 patients, 21 men and 11 women, with a mean age of  $48 \pm 22$  years at the date of surgery. Patients were followed for an average of 3.7 years (range 1 to 6 years). Initial diagnosis was post-traumatic

arthrosis in 23 patients (71.87%), primary osteoarthritis in 4 cases (12.5%), tuberculous osteoarthritis in 3 cases (9.37%) and rheumatoid arthritis in 2 cases (6.25%) - figure no. 2. At the last follow-up, 26 patients had a relatively normal walk with a slight limp while the remaining 6 patients had a moderate limp. In all 32 cases, pain either disappeared or decreased, and the patients were satisfied with the outcomes of surgery. The AOFAS Ankle-Hindfoot Scale score increased from a preoperative mean value of 34 points (28-45) to a postoperative mean of 75 points (68-96), with a statistically significant improvement ( $p=0.02$ ).

**Figure no. 2. Distribution of studied cases according to initial diagnosis**



Radiologically, we observed arthrodesis consolidation in 31 of the studied cases (96.87%), after a mean of 13 weeks (11-16 weeks - figures 3, 4 and 5). In one case (3.12%), radiological examination revealed nonunion at 12 months after fusion, requiring reoperation (refreshing of the cut surfaces and stabilization with two cancellous screws). At the final follow-up assessment, the clinical outcome was more than satisfactory. Surgery did not raise technical difficulties in any of the studied cases, the described method being fast and accessible. We observed superficial necrosis of the soft tissues in two patients (6.25%), with spontaneous healing. There were no other complications.

**Figure no. 3. A, B – Primary ankle arthritis. C, D – Ankle arthrodesis with a sliding and locked tibial graft**



**Figure no. 4. A, B – Post-traumatic ankle arthritis. C, D – Arthrodesis with a tibial graft**



**Figure no. 5. A, B – Ankle arthrodesis; immediate postoperative image. C, D – Radiologic image at 12 months postoperatively**



## DISCUSSIONS

In 1945 Charnley proposed using an external compression device for arthrodesis of the ankle, but the method is associated with increased rates of complications, including infection at hardware implantation sites, and lack of consolidation in 10-30% of cases.

The disadvantages of this compression device include the lack of a solid rotational fixation and its unpleasant appearance that is hardly accepted by the patients.(9) In response to the problems of external fixation, numerous techniques have been developed that use internal fixation. Internal fixation methods produce results that are superior to those of external fixation, with greatly reduced technical difficulties and excellent consolidation rates.(14)

The best consolidation rates have been reported for the use of cancellous screws displaced in various configurations (95-97% in most studies).(14) Plate fixation also led to excellent results, with consolidation rates ranging from 94 to 98%.(9) In order to adapt to various clinical situations and increase consolidation rates of ankle arthrodesis, several techniques have been described that use bone autografts harvested from the iliac crest, tibia or fibula. Chuinard and Peterson recommended the use of cortical-cancellous iliac bone grafts embedded between the resected surfaces of the tibia and talus, while Blair described a technique in which a tibial graft from the anterior portion of the distal tibia is slid distally.(15) In the method we used, an osseous autograft is harvested from the distal end of the tibia and it is forcibly inserted into a tunnel made in the body of the talus, with the preservation of a bony bridge at the anterior margin of the tibial pilon, which has a stabilising role.

There is still no consensus on the effects of ankle arthrodesis on other joints of the lower limb. Some authors consider that ankle fusion does not considerably change hip and knee movements, since the lack of motion of the ankle is compensated by the small joints of the foot.(16) Others have published studies that demonstrate significant alterations in gait and lower limb function after ankle arthrodesis with the advent of arthritic changes in the joints of the foot.(17-20) However, Sheridan et al. pointed out that damage to the small joints of the foot may already be present at the time of ankle arthrodesis, and thus are not caused by it.(21) In our series most patients had an almost normal walk with shoes on.

Besides a rigid fixation, proper fusion is dependent on the presence of an adequate blood supply. Extensive interventions with high tissue destructions may negatively influence the healing process. The importance of this issue is also emphasised by the high percentage (96.87%) of consolidation obtained by us.

## CONCLUSIONS

Ankle fusion continues to be a standard method of surgical treatment in severe arthrosis. The simple and

reproducible technique of using a distal tibial bone graft provides excellent clinical results. However, long term effects of this intervention are not fully known, but it is certain that after ankle arthrodesis other joints of the foot are subjected to increased levels of stress, which ultimately lead to the development of osteoarthritic changes in these joints.

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