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# Posterior Arthroscopic Tibio-Talo-Calcaneal Fusion: Early Experience with a New Surgical Technique

A. Papachristou MD, I. Giannaros MD, and A. Eleftheropoulos MD

*Department of Orthopaedic Surgery, Naousa's General Hospital, Lanara & Pechlivanou 3 Naousa - Imathia 59200 - Greece*

## ABSTRACT

Combined arthritis of the ankle and the subtalar joint is traditionally treated by tibio-talo-calcaneal fusion. We describe a new minimally invasive method for tibio-talo-calcaneal fusion with the use of a retrograde nail, under posterior hindfoot arthroscopy. The surgical technique, as well as the results of several cases, are presented. This novel surgical procedure seems to have a higher rate of patient satisfaction and lower morbidity than traditional methods, although it is not favourable when a significant deformity is present.

**KEY WORDS: arthrodesis, tibio-talo-calcaneal, arthroscopy, intramedullary nail**

**Introduction**

Hindfoot arthritis (combined arthritis of the tibiotalar and subtalar joints) is usually treated by tibio-talo-calcaneal fusion (TTC fusion) when conservative treatment has failed. Indications of TTC fusion are wide, including post-traumatic arthritis (avascular necrosis of the talus, pilon fracture, calcaneus fracture), rheumatoid arthritis, adult-acquired flatfoot (Myerson stage IV), as well as failed total ankle arthroplasty (**Fig. 1**). Several methods are already proposed in the literature comprising open, mini-invasive and arthroscopic techniques using screws, plates, external fixators or fibular grafts [1]. The use of an intramedullary nail under arthroscopic assistance offers a load-sharing rigid internal fixation, providing better fusion rates compared with open procedures while avoiding skin complications and presumably reducing the rate of infection (**Fig. 2**). Indeed, various studies demonstrated that intramedullary nails offer greater stiffness in bending and rotational directions than screws [2], and although their fixation might not be as rigid as blade or locking plates, they are load-sharing devices promoting healing [3]. Besides, by using a posterior arthroscopic approach, only two posterior portals are needed for preparation of the joint surfaces allowing one-step procedure. Moreover, by preserving vascularity, an optimal blood supply is provided locally, so high rates of fusion are expected within a shorter time frame.

CORRESPONDING AUTHOR, GUARANTOR

**Alexandros Eleftheropoulos MD**
Foot & Ankle Orthopaedic Consultant, Head of Orthopaedic Department, Naousa's General Hospital, Lanara & Pechlivanou 3, Naousa - Imathia, 59200 - Greece,
Phone: +30 23320 59250, Fax: +30 23320 59254, E-mail: el.alexandros@gmail.com

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***Fig. 1*** *Failed Total ankle arthroplasty.*

***Fig. 2*** *TTC Arthrodesis with arthroscopically assisted intramedullary nail.*

We present the surgical technique, refer to several cases treated by this method and discuss some distinguishing characteristics of the above-mentioned procedure compared to other methods of fusion.

**Surgical technique**

The procedure takes place under spinal or general anaesthesia. The patient is positioned in a prone position. Prophylactic antibiotic is given before the induction of anaesthesia. A tourniquet is applied at the thigh. Standard surgical preparations and draping are applied. No soft tissue distraction device is needed. Superficial anatomic landmarks are drawn on the skin. Using the standard posteromedial and posterolateral portals as they have been described by Nick van Dijk [4] (**Fig. 3**) , a standard 4-mm knee arthroscope with 30º of optics is inserted through the posterolateral portal. Posterior compartment is prepared using a 4.0 to 4.5 mm shaver through the posteromedial portal. The flexor hallucis longus tendon is identified and preserved as a medial landmark, as power instruments should not move beyond it to avoid damage to the posterior neurovascular bundle. Capsule, intermalleolar and posterior tibiofibular ligaments should be resected as they block access to the ankle joint (**Fig. 4**). The posterior talofibular ligament should only be partially resected as is mainly a posterolateral structure. Os trigonum is also resected, to allow easy access to the subtalar joint. The debridement and preparation of the articular surface of the ankle joint are made with a 4.5 mm shaver and a 4.5 mm barrel burr for cartilage removal. Sometimes, a fine osteotome or a fine flexible chisel can be used through the posteromedial or posterolateral portal (**Fig. 5**). All cartilage and approximately 2 mm of the subchondral bone are removed from the tibial plafond and the talar dome until fresh cancellous bone is visible (**Fig. 6**). After the preparation of the ankle joint is completed, the hindfoot is placed in neutral dorsiflexion, 0 to 5 degrees of heel valgus and 0 to 5 degrees of external rotation of the foot. Subsequently, a 2 cm incision is made in the plantar skin of the heel. Under fluoroscopic control, a guide wire is inserted through the calcaneus and the talus into the tibia. After reaming is performed (**Fig. 7**), a retrograde intramedullary nail is inserted (10 or 11 mm x 150 mm T2 Stryker®) and locked statically with one screw in the calcaneus (from posterior to anterior), one in the talus (from lateral to medial or the other way) and two screws proximally in the tibial shaft (from medial to lateral). Thereafter, preparation of the sub-

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***Fig. 3*** *Standard posteromedial and posterolateral portals as described by Nick van Dijk [4].*

***Fig. 4*** *Typical instruments used in posterior hindfoot arthroscopy.*

talar articular surfaces takes place as described by van Dijk et al. [4]. The skin incisions are then closed, sterile dressings and a posterior splint are applied. Postoperatively, prophylactic anticoagulation is administrated for six weeks. At discharge, the back slab is exchanged with a non-weight bearing full cast. After 3 weeks, a walking boot is applied and patients are referred to physiotherapy with partial weight bearing of 15 to 20 kg. Progression to full weight bearing and muscle-strengthening exercises are commenced 6 weeks after surgery. Radiographic evaluation of the fusion is done 6, 8 and 12 weeks post-operatively (**Fig. 8**). Further follow-up is scheduled at 6 and 12 months following surgery, and annually thereafter.

**Patients and Methods**

Between 2014 and 2017, in our clinic, we operated on 12 patients (4 male and 8 female) with severe hindfoot arthritis. The mean age of the population was 68 years and their mean BMI 30.5. They all complained about pain and disability to perform their daily activities.

Patients' history and co-morbidities were investigated. Physical examination revealed severely restricted and painful arc of motion of the ankle and the subtalar joint. The posterior tibial and pedal pulses were present, and no neurologic deficit was recorded. Standard weight-bearing anteroposterior and lateral radiographs of the ankle and Broden's view of the hindfoot were taken. A CT scan was also requested in all patients to assess the degree of osteoarthritis.

**Results**

The mean hospitalization was 1.2 days. Deformity correction and hindfoot fusion were achieved in all twelve cases. There were no significant complications, such as infection, wound healing problems, nonunion, malunion or hardware failure. Fusion was achieved in approximately three months' time (2.5-3.5 months). All the patients returned to their daily activities in four to five months' time. The postoperative AOFAS score was significantly improved.

**Discussion**

Intramedullary fixation for hindfoot arthrodesis was first described in 1906, and its use has become steadily more popular over the last two decades [5]. Generally, it is reserved for salvage foot and ankle procedures with end-stage osteoarthritis, significant deformity, and gross instability. Also, as patients frequently present severe co-morbidities (for example diabetes mellitus, peripheral arterial disease, inflammatory arthritis and compromised soft tissue envelope from previous surgeries), com-

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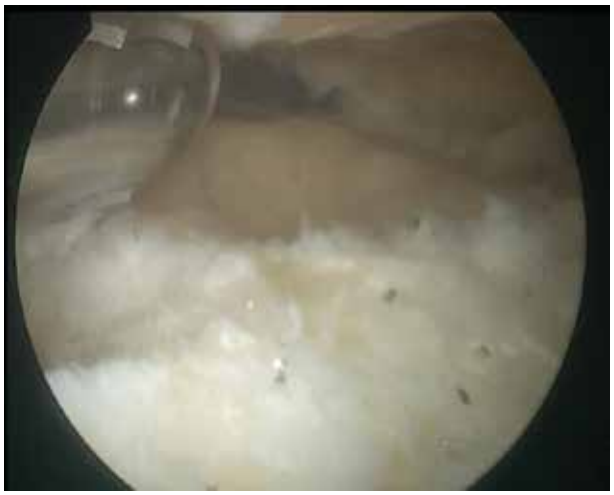

***Fig. 5*** *Arthroscopic preparation of the ankle joint.*

***Fig. 6*** *Subchondral bone removal until fresh cancellous bone is visible.*

plications such as infection, nonunion, malunion and nerve injuries are not uncommon. In some series, these complications rise to 50-60%, especially in complex cases [6]. Arthroscopically assisted IM nailing greatly reduces the rate of postoperative complications, although the small number of patients included in the reported series, do not allow achieving statistical significance [7]. Initially, anterior arthroscopic techniques were used for TTC fusion with retrograde intramedullary nail [8]. However, based on the description of posterior subtalar arthrodesis by van Dijk et al. [4], a posterior arthroscopic TTC fusion with retrograde intramedullary nail was later described by Bevernage et al. in 2010 [3]. They used this technique in 3 patients with a 100% reported fusion after 8 to 12 weeks. It is a minimally invasive procedure with several advantages compared to traditional or anterior arthroscopic methods.

To begin with, due to the reduced invasiveness of the procedure and the seemingly lower rate of skin complications and infection [9], the hospitalization length is reduced, there is no need for blood transfusion and patients return to their daily activities sooner. Furthermore, in this technique, a higher rate of fusion seems to be achieved, by retaining the vascularisation and the byproducts of reaming. Indeed, the blood supply to the distal tibia, the talus and the posterior facet of the calcaneus is theoretically preserved as the peroneal artery, the anterior and posterior tibial arteries and the vessels coming through the sinus tarsi and the deltoid ligament are not usually damaged. In addition, the anterior tibiotalar capsule remains intact, and as a result, the retaining reaming material rich in growth factors provides excellent consolidation without the need for auto- or allograft. Moreover, as the resection of the articular cartilage and subchondral bone is performed under arthroscopic vision, an optimal coaptation of the bony surfaces is obtained, which is essential for fusion [10]. In our technique, in order not to disturb the alignment of the ankle and hindfoot, the retrograde nail is inserted before the debridement of the subtalar joint. Finally, in comparison with the anterior approaches which prepare the posterior talocalcaneal facet through the sinus tarsi, by using an entirely posterior technique, the nutrient arteries through the interosseous ligament and the tarsal canal are not at risk, and the blood supply of the talus is not compromised [3].

**Conclusion**

Arthroscopically assisted IM nailing for TTC fusion is a promising technique with high patient satisfaction, earlier fusion rate, fewer wound complications and lower postoperative morbidity. However, it is technically demanding and is recommended for surgeons familiar with posterior ankle and sub-

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***Fig. 7**. Guide wire insertion and reaming.*

***Fig. 8**. Postoperative radiographic evaluation of fusion.*

talar arthroscopy. Indications are the same as for open TTC arthrodesis, with the prerequisite that deformity is not significant and can be reduced. To our knowledge, this is the larger case series of posterior arthroscopic TTC fusion with a retrograde intramedullary nail. We achieved fusion in all patients with excellent post-operative results.

***Conflict of interest:***
*The authors declared no conflicts of interest.*

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Papachristou A, Giannaros I, Eleftheropoulos. A Posterior Arthroscopic Tibio-Talo-Calcaneal Fusion: Early Experience with a New Surgical Technique. *Acta Orthop Trauma Hell* 2018; 69(2): 66-71.

# ΠΕΡΙΛΗΨΗ

Η συνδυασμένη οστεοαρθρίτιδα της ποδοκνημικής και της υπαστραγαλικής άρθρωσης αντιμετωπίζεται παραδοσιακά με διπλή πτέρνο-αστράγαλο-κνημιαία αρθρόδεση. Περιγράφουμε μια νέα ελάχιστα παρεμβατική μέθοδο ενδομυελικής ήλωσης με αρθροσκοπική υποβοήθηση για την διπλή αυτή αρθρόδεση. Η νέα αυτή μέθοδος έχει υψηλότερα ποσοστά ικανοποίησης και μικρότερα ποσοστά νοσηρότητας σε σχέση με τις παραδοσιακές τεχνικές. Παρόλα αυτά δεν ενδείκνυται σε περιπτώσεις προχωρημένης οστεοαρθριτικής παραμόρφωσης.

**ΛΕΞΕΙΣ ΚΛΕΙΔΙΑ: Οστεοαρθρίτιδα, ποδοκνημική, υπαστραγαλική, αρθρόδεση, ενδομυελική ήλωση**