

Tibio-talo-calcaneal arthrodesis with a novel retrograde intramedullary nail

Cesare Faldini, Alberto Arceri, Simone Ottavio Zielli, Gianmarco Gemini, Federico Sgubbi, Laura Langone, Gianmarco Di Paola¹, ELENA ARTIOLI, Antonio Mazzotti

¹First Clinic

Introduction

Tibio-talo-calcaneal arthrodesis (TTCA) is a well-established surgical treatment for complex hindfoot pathology, including post-traumatic ankle arthritis, severe deformities, Charcot neuroarthropathy, rigid neurological equinovarus, and failed total ankle arthroplasty (TAA). Although retrograde intramedullary nails have improved outcomes compared to traditional fixation techniques, conventional designs often fail to address the anatomical constraints, particularly in cases with severe deformity or bone loss, where optimal screw placement and compression mechanisms are difficult to achieve. To overcome these limitations, a new retrograde nail has been developed and several technical refinements have been implemented to optimize the procedure.

The aim of this video is to present the surgical technique of TTCA using the newly developed retrograde nail, focusing on its innovative design, dedicated instrumentation, and the technical tips that enhance surgical precision and outcomes. This device addresses critical limitations of conventional nails by allowing versatile screw placement, independent compression control, and improved anatomical alignment.

Materials and Methods

A consecutive series of nine patients who underwent TTCA using the new retrograde nail between 2022 and 2024 was reviewed. Data collected included patient demographics, aetiology, follow-up duration, radiographic fusion time, and clinical outcomes. Functional assessment was performed using the AOFAS Ankle-Hindfoot score, while pain was evaluated with the VAS score. The surgical procedure includes anterior joint exposure, precise joint surface preparation through a "LockBox" osteotomy, aimed at improving stability and correcting deformities in both the coronal and sagittal planes. Accurate hindfoot alignment is crucial and is achieved by adjusting the entry point for nail insertion mediolaterally according to the type of deformity: lateralized for valgus hindfoot correction and medialized for varus deformities, associated to careful manipulation of the guidewire, which is used as a joystick.

The innovative nail design features a distal valgus curve that mirrors physiological subtle valgus hindfoot alignment, a dynamic talar screw with an adjustable screw placement to accommodate severe bone loss, and an independent compression system in both talus and calcaneus, that prevents undue stress on the calcaneus.

Results

The series included five post-traumatic cases (55.6%), two flatfoot deformities (22.2%), one neurological equinovarus foot (11.1%), and one Charcot foot (11.1%). The mean follow-up was 24.8 ± 11.3 months. Radiographic fusion was consistently achieved between 12 and 14 weeks. No complications were reported. Functional scores significantly improved, with mean AOFAS increasing from 38.2 ± 7.5 preoperatively to 76.3 ± 8.1 postoperatively ($p < 0.001$). Pain relief was substantial, with VAS decreasing from 7.8 ± 1.1 to 1.98 ± 0.9 ($p < 0.001$).

Discussion and Conclusions

TTCA remains the gold standard for managing severe ankle and hindfoot deformities where joint-preserving procedures or TAA are not feasible. The innovative retrograde nail addresses the limitations of traditional nails by offering enhanced control over alignment, versatile screw placement even in cases of severe talar bone loss, and an independent compression system that avoids excessive loading on the calcaneus. Clinical results from this preliminary series demonstrated high fusion rates, absence of complications, and significant improvement in functional and pain outcomes. The anatomical design and technical versatility of the new nail provide surgeons with a reliable tool for achieving stable fixation and optimal alignment in complex hindfoot reconstructions.