



# Tibio-calcaneal fusion by retrograde intramedullary nailing in charcot neuroarthropathy



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## ABSTRACT

**Introduction:** Charcot's neuroarthropathy of ankle leads to instability, destruction of the joint with significant morbidity that may require an amputation. Aim of surgical treatment is to achieve painless stable plantigrade foot through arthrodesis. Achieving surgical arthrodesis in Charcot's neuroarthropathy has a high failure rate. We assess the outcomes of retrograde intramedullary interlocked nailing in tibio-talar arthrodesis for Charcot's neuroarthropathy.

**Materials and Methods:** 42 diabetic patients with a mean age of 49 year underwent ankle tibio-talar arthrodesis using retrograde nailing for Charcot's neuroarthropathy. The postoperative complications have been discussed and their management outlined. The outcomes were measured radiologically and clinically. Follow up was done after 6 weeks, 3 months, 6 months and 1 year.

**Results:** 14 patients (33.3%) achieved uneventful uncomplicated fusion. Thirty three patients had varus deformity. Nine patients had valgus deformity. Using Paired t test, it showed statistically significant improvement in the functional outcomes (AOFAS& EQ-5D-5L) over the follow up time, despite of the mild deterioration of radiological angles in the final follow up visit compared to the postoperative radiological findings.

**Conclusion:** Retrograde nailing is one of the best options for tibio-talo-calcaneal arthrodesis in the high-risk Charcot's neuroarthropathy population. It could be done through small incisions with lower soft tissue complications, its load-sharing properties allows a considerable compression across the ankle and talocalcaneal joints with early weight bearing and with satisfactory functional outcomes.

## 1. Introduction

Charcot neuroarthropathy (CN) is a degenerative, progressive disease affecting the foot and ankle and it is usually a disabling factor in diabetic patients. This degenerative neuroarthropathic disorder was first described by Jean-Martin Charcot in 1868 as a denervation-induced joint destruction which is a sequel of tertiary syphilis [1]. It was thought that, diabetes mellitus is the commonest cause of charcot neuroarthropathy [2]. Charcot neuroarthropathy is also associated with other diseases with peripheral neuropathy as leprosy, syringomyelia and in alcoholic patients as well [3].

Charcot neuroarthropathy is commonly affecting ankle and midfoot joints, although knee, hips and spine may be affected as well. CN usually has many complications affecting limb stability and function and leads to joints destruction with significant morbidities that may ends up with amputation [4]. The aim of surgical management of CN is to obtain a painless stable plantigrade foot which can be achieved through fusion. Achieving joint arthrodesis in CN usually carries high

failure rate. This study was carried out to assess the success rate of retrograde nailing of charcot ankle joint in achieving stable successful arthrodesis and to assess its effect on the functional outcome.

## 2. Material & methods

During 2011–2016, 42 patients with severe ankle and subtalar arthritis with foot and ankle charcot neuroarthropathy underwent tibio-talocalcaneal arthrodesis by calcaneo-tibial nailing. These patients were 38–59 years (mean 49.6 years) old, and the duration of DM was 3–11 years (mean 6.6 years). The included patients were 31 males and 11 females; 23 had surgery on the left side and 19 patients on the right.

The duration of DM in the patients ranged from 3 to 11 years. One patient was of type 1 DM while 41 patients (97.6%) had type 2 DM. Ten patients were on insulin treatment while, 32 patients (76.2%) were on oral hypoglycemic. Five patients (11.9%) had elements of DM nephropathy while 37 (88.1%) patients were not. 27 patients (64.3%) were associated with peripheral vascular disease. While 100% of the

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patients had neuropathy of the affected limb, there were 14 patients (33.3%) suffered from previous ulceration.

### 2.1. Clinical and statistical assessment

It includes clinical efficacy evaluation and radiological assessment.

#### 2.1.1. Clinical efficacy evaluation

The American Orthopaedic Foot & Ankle Society (AOFAS) Ankle-Hindfoot Score and EuroQol five dimensions questionnaire (EQ-5D-5L) were used pre-operative, post-operative and at the last follow up visit [5].

#### 2.1.2. Radiological assessment

- Radiological union: was assessed by apparent trabeculation through ankle and subtalar joint line with disappearance of joint line gradually.
- Alignment assessment: was examined radiologically through measurement of the tibiocalcaneal angle in coronal plane radiographs, calcaneal pitch angle, longitudinal arch angle and lateral talar – 1st metatarsal (meary's angle) pre-operative, post-operative and at the last follow up visit [6].

SPSS13.0 software (version 13.0; SPSS Inc., Chicago, IL, USA) was used for data statistics. The mean was compared with *t* test.  $P < 0.05$  suggested that a difference was statistically significant.

### 2.2. Surgical technique

Patients were operated in supine position with tourniquet inflated over the thigh with a pressure of 350 mmHg. After sterilization and draping, antero-medial approach to the ankle used to access the ankle and subtalar joints for drilling and cartilage removal with curettage of subchondral bone. Small calcaneal incision done over the plantar aspect to go through calcaneo-tibial nailing with passage of guide wire from calcaneus to tibia through talus which is followed by reaming of the tibial medulla and application of suitable size calcaneo-tibial intramedullary nail followed by wound irrigation and closure.

### 2.3. Postoperative rehabilitation

After operation, cold packs used for 4 days with limb elevation. Weight bearing allowed in Air-cast is tolerated. Follow up was done after 6 weeks, 3 months, 6 months and 1 year.

## 3. Results

During this study, 14 patients (33.3%) achieved uneventful uncomplicated fusion (Fig. 1“A–H”), while others develop different complications, loosening in 8 patients (19%), superficial infection in 6 patients (14.3%) who underwent debridement, revision fixation in 5 patients (11.9%), 5 patients underwent bone grafting (11.9%) and 4 patients suffered from Ulcer (9.5%) (Table 1).

Thirty three patients had varus deformity. The mean preoperative varus was 15° (range, 4–29°; SD ± 10.8). Postoperatively, the mean deformity was 3.1° of varus (range, 4.7° of valgus to 12° of varus; SD ± 4.3). At the final follow up visit, the mean deformity was 5.8° of varus (range, 2.2–16°; SD ± 5.1). Nine patients had valgus deformity. The mean preoperative valgus was 11.4° (range, 4–26°; SD ± 10.9). Postoperatively, the mean deformity was 1.4° of varus (range, 1.8° of valgus to 3.9° of varus; SD ± 2.2). At the final follow up visit, the mean deformity was 4.2° of valgus (range, 1.3–15°; SD ± 3.8).

### 3.1. Clinical efficacy evaluation

The mean AOFAS Ankle-Hindfoot Score improved from 44.57 (22–77) preoperative to 57.07 postoperative then improved to 71.19 (45–88) at final follow up visit (Table 2). Preoperative EQ 5D5L was 0.56 (0.34–0.68) which had been improved to 0.67 postoperative then improved to 0.71 (0.55–0.88) at final follow up visit (Table 3) (Fig. 2).

### 3.2. Radiological assessment

The calcaneal pitch improved from –0.07 preoperative to 16.12 post-operative, after that it decreased to 12.57 at the final follow up visit (Table 4). The preoperative angle of the longitudinal arch was 185.83, which had been improved to 153.33 post-operatively, after that it decreased to 160.24 at the final follow up visit. (Table 5) (Fig. 3).

Using Paired *t* test, it showed statistically significant ( $P < 0.05$ ) improvement in the functional outcomes (AOFAS& EQ-5D-5L) over the time (Table 6), despite of the mild deterioration of the radiological angles in the final follow up visit compared to the postoperative radiological findings (statistically non-significant angle changes,  $P > 0.05$ ).

## 4. Discussion

Charcot neuroarthropathy is one of the major complicated situations that carry a lot of comorbidities which affect patients' general health and lifestyle. There were a lot of research work and ideas carried on to solve this major issue. A lot of surgical techniques had been done to manage charcot neuroarthropathy through different modalities like plate and screws, wires, headless screws and external fixators.

The authors discovered through this study that there was a mild deterioration of the radiological angles occurred later on during follow up assessment after tibio-talo-calcaneal arthrodesis of charcot ankle with calcaneo-tibial nail. Although, it was found that, this mild radiographic changes between the immediate post-operative assessment and the radiographic assessment at the last follow up visit, it did not affect the overall functional outcome through patients' assessment by AOFAS Ankle-Hindfoot Score and EQ 5D5L scoring system.

Tibiocalcaneal arthrodesis for charcot neuroarthropathy with headless compression screws carried on by Gong et al. in 2016 showing that AOFAS Ankle-Hindfoot Score was 68.5 on average at last follow up visit [7]. They used other follow up scores as satisfaction rate which was 94.1 % and VAS pain score was 1.56 on average. The present study results of using calcaneotibial nail showed that AOFAS Ankle-Hindfoot Score became 71.19 at the final follow up visit. In this study, a different general health score which is more reliable to determine the overall effect of Tibio-calcaneal arthrodesis on patient general health and lifestyle was used. EuroQol five dimensions questionnaire (EQ-5D) is a standardized instrument for measuring generic health status [5]. The present study showed that EQ 5D5L improved from 0.56 preoperatively to 0.67 postoperatively and it became 0.71 in the last follow up visit. On biomechanical point of view, calcaneo-tibial nail has more load sharing properties which allows early weight bearing postoperative rather than that weak headless screws which require delayed weight bearing.

Previous studies of tibiototalcalcaneal arthrodesis with intramedullary nailing showed that the union rates ranged from 74% to 93% [8,9]. Ankle fusions are known to be more challenging to occur in the neuropathic ankle. In a study by Pinzur and Kelikian [8], 19 of 21 charcot ankles had a successful fusion with a retrograde locked intramedullary nail. 80% of patients achieved radiological union on an average follow-up of 16 weeks. At the most recent follow-up visit, all patients were independently ambulant on a braceable limb with or without the use of an assistive device. Siebachmeyer et al. had a 100% limb salvage rate and 43% revision rate in 21 charcot patients treated with a hindfoot fusion nail [10].

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