Foot and Ankle Surgery 21 (2015) 202–205

Contents lists available at ScienceDirect

Foot and Ankle Surgery

journal homepage: www.elsevier.com/locate/fas

Tibiotalocalcaneal arthrodesis with a compressive retrograde nail: A retrospective study of 59 nails

A.E. Thomas BSc, BM, MRCS[a,*], P.M. Guyver MB BS, FRCS (Tr&Orth)[a,1], J.M. Taylor BMBS, MSc, MRCS[b,2], M. Czipri MD[a,3], N.J. Talbot MA, BM BCh, FRCS (Tr&Orth)[a,3], I.T. Sharpe BSc, MB BS, FRCS (Tr&Orth)[a,3]

[a] Royal Devon and Exeter Hospital, Barrack Road, Exeter EX2 5DW, United Kingdom
[b] Radiology Department, Level 6, Derriford Hospital, Plymouth PL6 8DH, United Kingdom

ARTICLE INFO

Article history:
Received 14 June 2013
Received in revised form 1 January 2015
Accepted 2 January 2015

Keywords:
Tibiotalocalcaneal
Arthrodesis
Ankle
Subtalar
Fusion

ABSTRACT

Background: Tibiotalocalcaneal arthrodesis is an important salvage method for patients with complex hindfoot problems. This study reports the elective results of combined subtalar and ankle arthrodesis using one design of retrograde intramedullary compression nail.
Methods: Retrospective review identified 58 patients undergoing 59 tibiotalocalcaneal arthrodesis procedures. Mean follow up was 9.15 (3–36) months with average age 60.7 (22–89) years. A function and subjective patient satisfaction questionnaire was achieved in 89%.
Results: 53 patients (93%) achieved union at a mean time of 4.17 months. Four patients (8%) subjectively thought the procedure was of no benefit while 42 (84%) had an excellent or good result. The mean visual analogue scale (VAS) score for preoperative functional pain was 7.46 compared to 1.98 post-operatively ($p < 0.001$).
Conclusions: This device and technique offers an effective treatment of hindfoot pathology giving reliable compression and subsequent fusion with excellent patient satisfaction and pain relief.
Level of evidence: IV case series.
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1. Introduction

Hindfoot arthrodesis is a recognised salvage procedure for patients with a number of hindfoot conditions ranging from failed arthroplasty, charcot joints, previous trauma, talar avascular necrosis and severe osteoarthritis [1]. The goal of hindfoot arthrodesis is pain relief and correction of deformity through solid fusion. For those with tibiotalar and talocalcaneal joint involvement a tibiotalocalcaneal (TTC) arthrodesis can be performed [2].

Tibiocalcaneal fusion was first introduced in 1879 by Albert but has evolved over the decades as new technologies have developed. During these early years, patients had only cast immobilisation postoperatively with no other fixation method to hold the fusion. Surprisingly good results were obtained using this technique which was primarily used for severe mal-united fractures [3]. A number of different techniques have been trialled in the following years including external fixators as well as plate and screw devices. In the 1960s, the use of intramedullary (IM) nails was developed which renewed interest in hindfoot fusions. The first IM nails used by Kuentschner in 1962 were unlocked nails, commonly femoral or humeral nails or straight ankle arthrodesis nails [4].

Their use became more widespread in 1994 when Johnson introduced locked, valgus curved IM nail fixation. This, combined with a longitudinally placed calcaneal screw from a posterior approach to the hindfoot as opposed to the originally used transverse calcaneal screw, was found to allow significantly more rotational stiffness, hence achieving better fusion rates. This has since been modified to use a lateral approach to the tibiotalar joint with excision of the distal fibular [5].

Specialised IM nails with locking systems and compression options have evolved over the past decade with third generation locking TTC nails such as the Stryker T2 ankle arthrodesis nail,

* Corresponding author. Tel.: +44 7736321559.
E-mail addresses: aet81@hotmail.com (A.E. Thomas), Guyver@hotmail.com (P.M. Guyver), James.Taylor@doctors.org.uk (J.M. Taylor), Matyas.Czipri@nhs.net (M. Czipri), Nicktalbot@doctors.org.uk (N.J. Talbot), IanSharpe@nhs.net (I.T. Sharpe).
[1] Tel.: +44 7808298833.
[2] Tel.: +44 7988220671.
[3] Tel.: +44 1392403598.

http://dx.doi.org/10.1016/j.fas.2015.01.001
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which provides more rotational stiffness. This system has been used at our centre since 2005 and the authors believe this to be a safe and effective salvage procedure in appropriately selected patients. This study aims to report results of elective patients undergoing tibiotalocalcaneal arthrodesis using one design of retrograde intramedullary compression nail, the Stryker T2 ankle arthrodesis nail. The authors believe this to be one of the largest consecutive series for this device in the literature.

2. Patients and methods

A retrospective study identified 58 patients (27 female and 31 male) having undergone 59 TTC nail fusions between 2005 and 2011. All were undertaken electively by two consultants with special interest in foot and ankle surgery and performed at the same centre. Two patients died from unrelated causes before initial follow up leaving 56 patients with 57 TTC nails. All patients who had elective TTC nail fusions between 2005 and 2011 using the Stryker T2 nail were included. Exclusion criteria included patients undergoing TTC nail fusions with alternative nail designs, patients undergoing surgery immediately following trauma or those with incomplete clinical, radiological or microbiological follow up data. The Hospital Research and Audit Department approved the study.

Completed questionnaires were obtained in 50 of the 56 patients as part of their routine follow-up. These included data on use of orthotics and walking aids as well as roles and Maudley patient satisfaction scores [6] and visual analogue pain scores [7,8]. Data was also collected on indication for surgery, time to union, any complications or further surgery required and if a bonegraft was used.

The mean age for patients was 60.7 (range 22–89) with median age 62. The mean follow up for patients post-operatively was 9.15 months (range 3–36) with median 6 months. Indications for surgery primarily included combined ankle and subtalar arthritis (53.4%), and complex hindfoot deformity (25.9). Rarer indications included sequalae of Charcot-Marie Tooth disease, foot drop and congenital deformities (Table 1).

3. Operative technique

The Stryker T2 nail was used in all cases with the same surgical technique used by both surgeons. The patient is positioned supine on a radiolucent table with careful neutral alignment of the knee and ankle. The affected limb is elevated on a bolster under the calf to allow easy exposure to the C-arm for intra-operative imaging. A lateral incision is made in line with the distal lateral malleolus allowing resection of the distal portion of the fibular to gain access to the tibiotalar and talocalcaneal joint.

Any joint deformity is corrected after the articular surfaces of the ankle and subtalar joints are resected allowing the ankle to be positioned plantigrade, with correct hindfoot alignment. A longitudinal incision is made in the heel pad just lateral to the mid line and blunt dissection is performed to the calcaneus. The position for optimum arthrodesis is maintained while a guidewire is inserted under fluoroscopic guidance across the subtalar and ankle joint into the tibial medullary canal. Flexible reamers are then used to increase the canal to 1 mm above the diameter of the nail thus allowing insertion. The ankle joint is compressed with the internal compression screw and the subtalar joint with the exterior compression device fixed on the target arm. Bone graft is used where necessary. The resected distal fibula can be used to fill small defects. Larger defects and severe deformity correction can be facilitated by the use of shaped femoral head allograft bone blocks.

Postoperatively, they are immobilised in a non-weightbearing cast for six weeks, followed by six weeks in an aircast boot, progressing to fully weightbearing as tolerated. Radiological follow up was at 6 and 12 weeks post-operatively or until union.

Table 1
Indications for surgery.

Indication	Number of patients	% of patients
Combined arthritides	31	53.4
Complex hindfoot deformity	15	25.9
Failed TAR	3	5.2
AVN	3	5.2
Other	6	10.3

4. Results

53 of the 57 nails achieved union giving a union rate of 93% with a mean time to union of 4.17 months (range 3–7) and median of three months. A femoral head structural block allograft was used in 11 cases, nine of which went on to achieve union (union rate of 82%) with a mean time of 4.22 months. Union was assessed by clinical examination with asymptomatic, pain-free patients deemed clinically united and this was confirmed radiologically with plain X-ray. CT scanning was not employed routinely except if there was clinical concern regarding union.

Additional complications besides non-union included superficial infection (8.8%) which all resolved with antibiotics, persistent pain (8.8%), and metalwork irritation or failure (8.8%) including one broken screw that was asymptomatic and so not removed. Two prominent screws required removal, one proximal and one distal. Of the four cases with non-union, two had associated deep infection. Two developed CRPS and ultimately underwent amputation, one was successfully revised following debridement and antibiotics for deep infection and one was removed and managed with an ilizarov frame with resolution of infection and subsequent union. Complication rates are shown in Table 2 with overall rates of 34%.

The mean pre-operative pain score using the visual analogue score (VAS) was 7.46 (range 2–10, median 7) compared with post-operative pain score mean of 1.98 (range 0–10, median 1) demonstrating a 73.4% reduction in pain post-operatively ($p < 0.001$). The roles and Maudsley scale results revealed a mean score of 1.77 (median 1) indicating high patient satisfaction with good to excellent results with significant improvements in function. Only four (8.8%) patients gave a score of 4 indicating a poor result or no improvement in symptoms while 42 out of 50 (84%) gave a score of 1 or 2 indicating excellent or good results (Fig. 1).

21 (42%) of patients required walking aids preoperatively which decreased to 14 (28%) post-operatively, and 16 (32%) were requiring the use of orthotics pre-operatively which decreased to 8 (16%) post-operatively giving a postoperative reduction of 66% for use of walking aids and 50% for use of orthotics.

Correction of deformity was assessed on post-operative weight-bearing AP radiographs measuring the position of the talus with

Table 2
Incidence of complications.

Complication	Number of patients	% of patients
Superficial infection	5	8.8
Persistent pain	5	8.8
Metalwork problems	5	8.8
Non-union	4	7
Delayed wound healing	3	5.3
Deep infection	2	3.5
Amputation	2	3.5
Numbness	1	1.8
Stress fracture	1	1.8

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