ABSTRACT

Purpose. To report 18 patients who underwent tibiotalocalcaneal arthrodesis using a retrograde intramedullary nail or cannulated screws.

Methods. 10 men and 8 women (19 ankles) aged 36 to 70 (mean, 52) years underwent tibiotalocalcaneal arthrodesis using a retrograde intramedullary nail (n=13) or cannulated screws (n=6). Indications for arthrodesis were severe cavovarus deformity secondary to polio or charcot-marie-tooth disease (n=7), severe osteoarthritis in the ankle and subtalar joints (n=6), Charcot joint deformity (n=3), failed fusion procedures (n=2), and foot drop secondary to T12 tumour surgery (n=1). The visual analogue score (VAS) for pain was assessed, as were the American Orthopaedic Foot and Ankle Society (AOFAS) scores (for subjective and objective pain, function, and stability of the ankle), short form 36 (SF-36), and patient expectation and satisfaction scores.

Results. The mean follow-up period was 35.6 (range, 11–144) months. 13 of 18 patients returned for assessment of scores. 18 of the 19 ankles achieved fusion after a mean period of 5.9 (range, 3–11) months. The mean VAS scores for pain, AOFAS scores, and SF-36 scores all improved. 11 patients had good-to-excellent satisfaction and expectation scores. Two patients had severe wound infections and underwent implant removal (after bone union), debridement, and intravenous antibiotic therapy. Two other patients had superficial wound infections. One patient with retrograde intramedullary nailing had a pseudoarthrosis and underwent implant removal, re-debridement, re-autografting, and cannulated screw fixation. Fusion was achieved subsequently.

Conclusion. Tibiotalocalcaneal arthrodesis improved the pain score and quality of life, despite a high risk of complications.

Key words: arthrodesis; bone screws; fracture fixation, intramedullary; subtalar joint

INTRODUCTION

Tibiotalocalcaneal arthrodesis is considered the
last resort for advanced osteoarthritis, Charcot arthropathy, rheumatoid arthritis, post-traumatic arthritis, and foot deformities such as fixed equinovarus. It is often the only alternative to amputation. The aim is to correct as much of the deformity while providing a stable plantigrade foot and adequate pain relief. Arthrodesis can be achieved through external fixation,\(^1\) blade plating,\(^2\) intramedullary fibular grafting,\(^3\) screw fixation,\(^4\) or retrograde intramedullary nailing.\(^3\),\(^5\) Contraindications to surgery include severe peripheral vascular disease (for which amputation is more appropriate), severe plantar fat pad atrophy (when using retrograde nails), and active osteomyelitis. We report on 18 patients who underwent tibiotalocalcaneal arthrodesis using a retrograde intramedullary nail or cannulated screws.

**MATERIALS AND METHODS**

Between 1996 and 2007, 10 men and 8 women (19 ankles) aged 36 to 70 (mean, 52) years underwent tibiotalocalcaneal arthrodesis by 2 senior surgeons using a retrograde intramedullary nail (n=13) or cannulated screws (n=6) [Fig.]. Indications for arthrodesis were severe cavovarus deformity secondary to polio or charcot-marie-tooth disease (n=7), severe osteoarthritis in the ankle and subtalar joints (n=6), Charcot joint deformity (n=3), failed fusion procedures (n=2), and foot drop secondary to T12 tumour surgery (n=1).

Either the standard anterior approach or posterior lateral approach was used depending on the surgeon’s preference. All cartilage and debris from the articular surfaces were adequately removed until good punctate bleeding from the bony surfaces was evident. Good opposition of bony surfaces with adequate alignment of the hindfoot and tibia were necessary. For intramedullary nailing, either a Zimmer MDN nail or a Synthes distal femoral nail was used. The nail was inserted from the calcaneum up into the talus and distal tibia, and locked proximally. For screw fixation, multiple 6.5-mm cannulated screws were used. Autografts were harvested from the iliac crest to fill the joint cavities before the screws were inserted.

Postoperative rehabilitation was standardised. The visual analogue score (VAS) for pain was assessed, as were the American Orthopaedic Foot and Ankle Society (AOFAS) scores (for subjective and objective pain, function, and stability of the ankle),\(^6\) short form 36 (SF-36), and patient expectation and satisfaction scores (after a mean period of 55.3 months). Fusion was defined as radiographically evident trabeculae crossing of the sites. Results were analysed using a paired t test. A p value of <0.05 was considered statistically significant.

**RESULTS**

The mean follow-up period was 35.6 (range, 11–144) months. 13 of 18 patients returned for assessment of scores. Two patients died from unrelated causes, one from squamous cell carcinoma of the mouth.

![Figure](a) Retrograde intramedullary nailing (b) cannulated screw fixation for tibiotalocalcaneal arthrodesis.
and the other from pneumonia. Three patients did not respond to the questionnaire and thus patient satisfaction scores were not obtained, but radiological assessment was performed. 18 of the 19 ankles achieved fusion after a mean period of 5.9 (range, 3–11) months. The mean time to fusion was 6.2 (range, 3–11) months for those treated with intramedullary nailing (after excluding the patient with pseudoarthrosis) and 5.3 (range, 3–9) months for those treated with cannulated screw fixation.

The mean VAS scores for pain improved from 7.9 to 2.5 (p<0.01), as did the mean AOFAS scores from 30.5 to 63.6 (p<0.01). For mean SF-36 scores, physical function improved from 40.4 to 66.2 (p=0.02), physical role from 15.4 to 53.9 (p=0.03), bodily pain from 36.7 to 62.2 (p<0.01), emotional role from 69.2 to 100 (p=0.04), and mental health from 62.8 to 70.2 (p=0.04). 11 patients had good-to-excellent satisfaction and expectation scores.

Five patients developed complications. Two of them had severe wound infections and underwent implant removal (after bone union), debridement, and intravenous antibiotic therapy. Two others had superficial wound infections (one over the ankle and another over the iliac crest) and were treated with debridement and/or intravenous antibiotics. One patient with retrograde intramedullary nailing had a pseudoarthrosis and underwent implant removal, re-debridement, re-autografting, and cannulated screw fixation. Fusion was achieved subsequently.

DISCUSSION

Both retrograde intramedullary nailing and cannulated screw fixation are widely used for tibiotalocalcaneal arthrodesis. In 50 patients who underwent retrograde nailing and followed up for a mean of 51 months,7 48 achieved fusion after a mean of 20 weeks, and the satisfaction rate was 92% and the mean postoperative AOFAS score was 70. In 34 patients (mean age, 57 years) who underwent retrograde nailing and followed up for a mean of 24 months,a 26 achieved fusion after a mean of 16 weeks; 10% of the patients considered surgery had no benefit, whereas 90% reported symptomatic improvement. The mean VAS score at rest improved from 66 to 19 and from 83 to 32 when walking.a In 48 patients who underwent ankle fusion using 4 cancellous screws,a preoperatively 17.5% rated their AOFAS scores as satisfactory and 82.5% as poor, whereas postoperatively 52.5% rated their AOFAS scores as excellent, 30% as good, 10% as satisfactory, and 7.5% as poor. In our patients, the union rate was 95%, which was slightly higher than the average in the other major studies that ranged from 74% to 93%.b

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Retrograde nailing has advantages over cannulated screw fixation. It is a stronger construct, with a lower failure rate.c Intramedullary nailing is biomechanically stiffer than lag screws with respect to both bending and torsional forces, which may contribute to increased stability and maintenance of hindfoot alignment.c Nonetheless, the time to fusion in our patients treated with cannulated screws appeared shorter, and the only patient enduring a pseudoarthrosis had undergone intramedullary nailing.

Potential complications after tibiotalocalcaneal arthrodesis include deep and superficial infections, stress fractures or stress reactions, delayed or non-union, and injuries to the neurovascular bundle resulting in neurological deficits or vascular injury.d Diabetes mellitus is a major risk factor of such complications; 70% of complications occur in patients with diabetes.e In 21 diabetic patients treated with retrograde locking nailing for Charcot ankles,7 18 developed complications including ulceration (n=8) and wound infection (n=6) resulting in one ankle disarticulation and 3 revision surgeries. In the current study, 2 out of 4 patients with wound infections were diabetic, which implies that control and optimisation of diabetes is important to reduce the risks of complications.

Good alignment of the bones before fixation is also essential, and can be achieved with intra-operative image intensifier guidance. Varus deformity of the hindfoot should be avoided; the ideal placement should be 5° to 7° of valgus. Varus deformity results in an increased nail-tibial angle, which may lead to non-union and even stress fractures.f

One limitation of this study was its small sample size (19 ankles) but tibiotalocalcaneal arthrodesis is uncommon in Singapore. In addition, 2 different techniques were used and were surgeon dependent. A cohort comparative study of the 2 techniques would have been better, but may have been underpowered owing to small sample sizes.

DISCLOSURE

No conflicts of interest were declared by the authors.
REFERENCES