

TIBIOTALOCALCANEAL ARTHRODESIS
WITH INTRAMEDULLARY FIXATION

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ABSTRACT

In this paper is described a technique for performing tibiotalocalcaneal arthrodesis using a new type of intramedullary fixation, the ankle fusion nail. This paper also contains a retrospective review of 17 patients with a mean age of 46 years who underwent tibiotalocalcaneal arthrodesis with intramedullary fixation for diagnoses of osteoarthritis (12 patients), rheumatoid arthritis (4 patients), and destructive distal tibial giant cell tumor (1 patient). With a mean follow-up interval of 22 months, an 82 percent union rate was achieved at a mean time to union of 14 weeks.

The authors of this paper describe their technique for accomplishing this form of ankle and hindfoot arthrodesis with an intramedullary ankle fusion nail, and conclude that intramedullary nailing is a solid method of fixation for tibiotalocalcaneal arthrodesis in the appropriately selected patients. The best clinical results (100 percent union rate, 0 percent complication rate) after tibiotalocalcaneal arthrodesis with intramedullary fixation have been obtained in nonneuropathic patients undergoing their first fusion procedure for diagnoses of primary osteoarthritis or rheumatoid arthritis.

Key words: Tibiotalocalcaneal arthrodesis, intramedullary fixation, ankle fusion nail.

INTRODUCTION

Many techniques, approaches and appliances have been developed to achieve ankle and hindfoot arthrodesis.¹⁻¹⁰ The purpose of this paper is to describe new instrumentation available in performing an old technique initially described in the 1940's to establish tibiototalcalcaneal arthrodesis.⁴ The purpose of this paper is also to retrospectively review the results of this type of fusion, employing an older technique with newly available instrumentation.

Placed percutaneously, often combined with arthrotomy and debridement of the ankle, the Richards intramedullary supracondylar nail is placed transcalcaneally through the talus into the tibia and locked proximal and distal to these joints (Smith-Nephew-Richards; Memphis, Tennessee).

The indications for a tibiototalcalcaneal arthrodesis include avascular necrosis of the talus or failed total ankle arthroplasty with subtalar intrusion. The failed ankle fusion with insufficient talar body and the rheumatoid patient are also benefitted by this procedure. Other indications include osteoarthritis, the sequelae of trauma, and the severe deformity of untreated clubfoot and neuromuscular disease.

Contraindications to this technique include a dysvascular extremity or one that has a severe active infection. Also to be avoided is a plantar approach in the patient who has an insufficient plantar weight bearing surface for padding. Moderately severe and fixed deformity of the ankle, hindfoot, and distal tibia are probably also relative contraindications for closed nailing and arthrodesis.

The significance of this report lies in the fact that a method of hindfoot arthrodesis, first described more than 40 years ago by Kuntscher, may be even more successfully employed today with the availability of a better fixation device, namely the intramedullary ankle fusion nail.⁴

MATERIALS AND METHODS

Hardware: The intramedullary supracondylar nail is a fully cannulated, stainless steel, closed section nail with an 11, 12 or 13 millimeter outer diameter and lengths of 15 centimeters, 17_ centimeters,

20 centimeters, or 25 centimeters. The first two, distal holes are located 15 millimeters and 30 millimeters from the driving end for good calcaneal and talar fixation. The transfixing holes are locked with 5 millimeter fully threaded screws, and numerous interlocking holes are available proximal to the ankle for proximal fixation (See Figure 1).

Surgical Technique: The patient is positioned supine on a radiolucent operating table with a well-padded bump under the ipsilateral buttock in order to internally rotate the involved extremity. We place another bump under the heel so that intraoperative cross-table fluoroscopic imaging is facilitated. General or spinal anesthesia is usually used, and a thigh tourniquet greatly facilitates the plantar dissection. We use intraoperative C-arm fluoroscopy. The first author has been a proponent of an anteromedial ankle arthrotomy in order to correct what deformity may be present across the tibiotalar joint and to prepare the joint surfaces by removing what is left of the articular cartilage. This arthrotomy also allows the surgeon a site for insertion of bone graft if he feels it is necessary.

The authors have not found a subtalar arthrotomy to be necessary, although the surgeon may want to consider a fibular osteotomy at the time of the hindfoot fusion if there is significant varus deformity or loss of tibial length relative to the fibula.

A longitudinal plantar approach is used, placing the incision slightly lateral to the midline, especially in the patient with significant valgus of the hindfoot and ankle. After the incision is made, blunt dissection is taken down to the plantar fascia, which is split longitudinally. The intrinsic muscles are swept laterally, and the neurovascular bundle is identified at the medial portion of the wound. A sharp awl is used to make a plantar calcaneal corticotomy, and the subtalar and tibiotalar articular surfaces are usually opened up with the use of a cannulated drill over its threaded guide wire. This opens up the tibiotalocalcaneal canal enough that a spade-tipped guide wire can be passed into the tibial medullary canal more readily. A series of progressively larger flexible reamers are used to open the tibiotalocalcaneal canal, reaming to a full _ to

1 millimeter diameter larger than the anticipated nail outside diameter.

The nail is attached to its alignment guide after noting the appropriate bow, and which holes are to be used for interlocking once the nail is inserted. The nail is slightly internally rotated so that when the screws are inserted from lateral to medial they will pass into the tibia, clearing the fibula.

The nail is quite readily inserted manually and then impacted. The distal aspect of the nail is countersunk within the os calcis, and usually the distal two screws are inserted for interlocking first. This allows good purchase of the foot, and then further impaction can be done, giving compression across the arthrodesis site before the nail is interlocked in the tibia. The interlocking screws are inserted from lateral to medial, using the interlocking alignment device, and when necessary, intraoperative fluoroscopy (See Figures 2a and 2b)

RESULTS

Seventeen patients (8 male and 9 female) with a mean age of 46 years underwent tibiototalcalcaneal arthrodesis with intramedullary fixation for diagnoses of osteoarthritis (12 patients), rheumatoid arthritis (4 patients), and destructive distal tibial giant cell tumor (1 patient). With a mean follow-up interval of 22 months (range: 7 to 49 months), an 82 percent union rate was achieved at a mean time to union of 14 weeks (See Table).

Complications related to the nail included 4 instances of painful retained or fractured interlocking screws, 3 cases of nonunion, one of which was asymptomatic, and a single case of 20 degree valgus malunion. One ulceration occurred in a neuropathic patient over a fractured interlocking screw which was subsequently removed. This same patient had posterior tibial nerve entrapment due to that screw prior to its removal. The overall nonunion rate was 3 patients out of 17, or 18 percent. Only 2 of these 17 patients, or 12 percent, had a symptomatic nonunion. These two patients have subsequently been revised successfully with Ilizarov technique.

The 6 patients who underwent this procedure for the sequelae of post-traumatic osteoarthritis had undergone a mean of 5 prior procedures before coming to their index tibiotalocalcaneal arthrodesis with medullary fixation. The 1 patient who had a giant cell tumor had 6 prior procedures, 1 of which was an unsuccessful attempt at ankle arthrodesis. This was successfully salvaged with tibiotalocalcaneal arthrodesis by the technique described here.

DISCUSSION

The goals of ankle arthrodesis are the relief of pain and deformity and the development of a solid fusion. Numerous techniques and instrumentation devices have been described and created to achieve these goals. The authors believe that intramedullary nailing is a solid method of fixation for tibiotalocalcaneal arthrodesis.

In a German text entitled "The Practice of Intramedullary Nailing", published in the 1940's and 1950's, Gerhard Kuntscher described a method of combined arthrodesis of the ankle and subtalar joints.⁴ He employed a technique of closed medullary nailing with a conical nail inserted over a guide pin through the sole of the foot. He felt that extensive destruction of the joint and nailing should be done simultaneously. He used a 12 to 14 millimeter nail to achieve an interference fit, and no locking of the nail was done. The patients were kept at bed rest for 3 weeks and then ambulated in plaster.

In 1979, Tomeno and Danan presented 45 pan arthrodeses using various fixation techniques, but with a fairly high infection rate.⁹ These authors had an 80 percent consolidation rate. Russotti and Johnson reported in 1988 on 21 tibiotalocalcaneal arthrodeses employing Steinmann pins and external fixation.⁸ They had radiographic union in 86 percent with satisfactory results in 75 percent employing a posterior Achilles splitting approach.

Papa and Myerson published a series of 21 pantalar and tibiotalocalcaneal arthrodeses for osteoarthritis.⁶ They achieved an 86 percent fusion rate using a transfibular approach with cannulated

screws. These authors also had 2 patients who underwent tibiototalcaneal arthrodesis in a neuropathic fusion series.⁵ Both these patients fused in under 5 months using a cannulated screw technique.

Drs. Johnson and Gehrke returned to using an IM nail for tibiototalcaneal fusion in a presentation given at the 1993 Summer Meeting of the American Orthopaedic Foot and Ankle Society.² They positioned the patient prone and used an Achilles splitting approach, but they claimed that the technology involved in using the nail was more involved than other established techniques, and that the long-term results were not known as yet. The Richards supracondylar nail was initially designed to aid in the fixation of supracondylar femur fractures and is available in a variety of lengths and diameters. A special order ankle fusion nail in which some of the locking holes that would be present near the arthrodesis sites are eliminated is now under investigation.

As described above, we have modified and simplified the technique initially described by Dr. Johnson.²

The results of this series would indicate that intramedullary nailing is a solid method of fixation for tibiototalcaneal arthrodesis in the appropriately selected patients. We achieved an overall union rate of 82 percent at a mean time to union of 14 weeks in a large series that included patients undergoing tibiototalcaneal arthrodesis for a variety of indications. We had a symptomatic nonunion rate of 12 percent.

The best clinical results (100 percent union rate, 0 percent complication rate) after tibiototalcaneal arthrodesis with intramedullary fixation have been obtained in nonneuropathic patients undergoing their first fusion procedure for diagnoses of primary osteoarthritis or rheumatoid arthritis.

The significance of this report is that a method of hindfoot arthrodesis first described by Kuntscher more than 40 years ago may be even more successfully employed today with the availability of a better fixation device (intramedullary ankle fusion nail). Fusion rates employing this nail are very high in

appropriately selected patients, even in cases of salvage arthrodesis after failures of more conventional techniques of fixation.

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LEGENDS

Figure 1: The Richards intramedullary ankle fusion nail.

Figure 2a: Postoperative AP radiograph of 72-year-old female patient who underwent tibiotalocalcaneal arthrodesis with medullary fixation for a diagnosis of primary osteoarthritis.

Figure 2b: Postoperative lateral radiograph for the patient pictured in Figure 2a.

Table: Clinical data for seventeen patients treated with tibiotalocalcaneal arthrodesis employing intramedullary fixation.

TTC = Tibiotalocalcaneal

OA = Osteoarthritis

RA = Rheumatoid Arthritis

GCT = Giant Cell Tumor

TTC ARTHRODESIS WITH IM NAIL (17 PATIENTS)

<u>INDICATION</u>	<u>S</u>	<u>#</u> <u>PT</u>	<u>MEAN #</u> <u>PRIOR</u> <u>PRO</u> <u>CEDURE</u> <u>S</u>	<u>MEAN</u> <u>TIME</u> <u>TO</u> <u>UNION</u> <u>(WE</u> <u>EKS)</u>	<u>MEAN</u> <u>N #</u> <u>NAIL</u> <u>COMPLIC</u> <u>ATIONS</u>	<u>#</u> <u>NONU</u> <u>NIONS</u>
OA, Primary		5	<1		0	0
		6		10		2
OA, Traumatic		1	5	14	1	1
			0		2	
OA, Neuropathic		4	0	Stabl e at 22	0	0
		1				0
RA			6	12	0	
Tumor (GCT)				32		