

Tibiototalcalcaneal arthrodesis with a retrograde intramedullary nail

Artrodese tibioalcanear com haste intramedular retrógrada

Bertil W. Smith¹, Michael J. Coughlin²

Abstract

Objective: Tibiototalcalcaneal (TTC) arthrodesis is used to salvage severe hindfoot arthritis and deformity. This study provides a prospective evaluation of ten consecutive patients undergoing TTC fusion with a retrograde intramedullary nail for a variety of conditions.

Methods: All ten patients were evaluated using a variety of outcome measures including the visual analog scale (VAS), American Orthopaedic Foot and Ankle Society (AOFAS) ankle-hindfoot score, and a subjective satisfaction scale. The average followup was 15 months. **Results:** The average AOFAS score improved from 39 points preoperatively to 69 points postoperatively. The visual analog score decreased from 8.3 to 2.0 points. Six patients reported excellent results, three good, and one poor. Eighteen of 20 joints fused. There were two nonunions, one ankle and one subtalar. **Conclusion:** This study supports the use of a retrograde intramedullary nail for hindfoot salvage.

Keywords: Arthrodesis; Subtalar joint/surgery; Ankle joint/surgery; Talus/surgery; Tibia/surgery; Calcaneus/surgery; Bone nails

Resumo

Objetivo: A artrodese tíbioalcanear tem sido usada como procedimento de salvamento para artrose e deformidade no retropé. Esse estudo diz respeito a uma avaliação prospectiva de dez pacientes consecutivos que foram submetidos à artrodese tibioalcanear com haste intramedular retrógrada num espectro variável de apresentações. **Métodos:** Todos os dez pacientes foram avaliados usando diferentes scores que incluíram a escala visual analógica o método da AOFAS para o retropé e a escala subjetiva de satisfação. A média de seguimento foi de 15 meses. **Resultados:** A média do score da AOFAS melhorou de 39 para 69 pontos. A escala visual analógica diminuiu de 8.3 para 2.0 pontos. Seis pacientes referiram resultados excelentes, três bons, e um mau. Dezoito das vinte articulações resultaram em fusão. Houveram duas pseudoartroses, uma no tornozelo e outra na articulação subtalar. **Conclusão:** Este estudo da suporte a utilização da haste intramedular retrógrada como procedimento de salvamento.

Descritores: Artrodese; Articulação subtalar/cirurgia; Articulação do tornozelo/cirurgia; Tálus/cirurgia; Tibia/cirurgia; Calcâneo/cirurgia; Pinos ortopédicos

Corresponding author

Michael J. Coughlin 901 N Curtis Rd, Ste 503
Boise, ID 83706-1343
United States
E-mail: foolmd@aol.com.br
Phone: (208) 377-1000

Data de Recebimento

24/10/07

Data de Aceite

07/11/07

Study carried out at Treasure Valley Hospital, Boise, Idaho

¹ MD, Treasure Valley Hospital, Boise, Idaho

² MD, Treasure Valley Hospital, Boise, Idaho

INTRODUCTION

Patients with disease involving both the ankle and subtalar joints represent difficult clinical challenges. Nonoperative treatment often fails to provide adequate pain relief, and the surgical options are limited. Tibiototalcaneal arthrodesis has been described as a salvage option for patients with disease processes including Charcot arthropathy, post-traumatic degenerative joint disease, avascular necrosis of the talus with collapse, and failed total ankle arthroplasty⁽¹⁻⁴⁰⁾.

There are many described fixation methods for performing the arthrodesis, including compression screws⁽⁵⁾, blade plates⁽⁶⁻⁷⁾, locking plate constructs⁽¹⁾, and intramedullary nails^(3-4,8-9). The intramedullary nail has the advantage of being a load-sharing device that allows for a controlled dynamization with weight bearing. The purpose of this study was to evaluate the clinical results of tibiototalcaneal arthrodesis performed with a retrograde intramedullary nail.

METHODS

Ten consecutive patients undergoing tibiototalcaneal arthrodesis with a locked retrograde intramedullary nail were prospectively enrolled in this study between January, 2006 and October, 2006. Institutional Review Board approval was first obtained for the study. All fusions were performed by one surgeon (MJC). The average age of the patients was 60.6 years (range 48 to 78). Five patients were female and five were male. The surgical indications required both ankle and subtalar joint involvement and included talar avascular necrosis (1), degenerative arthritis (4), equinovarus deformity (1), failed ankle arthrodesis (2), and post-traumatic degenerative arthritis (2). (Figure 1). No patient carried the diagnosis of Charcot arthropathy.



Figure 1 A,B - AP and lateral xrays demonstrating post-traumatic degenerative arthritis of the ankle and subtalar joints in a 48 year old woman.

All patients filled out questionnaires preoperatively and rated their pain on a zero to ten point scale. They were also evaluated using the AOFAS ankle-hindfoot score. The fusion mass was assessed radiographically on plain anteroposterior (AP) and lateral weight-bearing xrays. The average time of follow-up was 14.7 months (range 12-18). The patients were also clinically evaluated postoperatively rating their pain on a zero to ten point scale and using the AOFAS hindfoot scoring system.

They rated their overall subjective outcome using a previously published scale⁽¹⁰⁾. A result was considered excellent if the patient has no problem related to the foot, is very satisfied, has mild or no pain, walks with mild or no difficulty, and would have the surgery again under similar circumstances. A result was considered good if the patient has a few problems, is satisfied, has mild pain, walks with no or mild difficulty, and would have the surgery again under similar circumstances. A fair result meant that the patient has moderate pain, some difficulty with walking, and reservations about the success of the surgery. A poor result indicated that the patient has continued pain, has little or no improvement in walking, and regrets having had the surgery.

OPERATIVE TECHNIQUE

Surgery was performed with a regional nerve block under general anesthesia in most cases. The patients were placed in a lateral decubitus position on a bean bag with a thigh tourniquet. A curvilinear lateral incision was made from 10 cm above the ankle joint extending anterior over the subtalar joint. The fibula was transected with a beveled cut 8 cm proximal to the ankle joint. An acetabular reamer was used to harvest bone graft from the resected fibula.

All osteophytes were removed. The ankle and subtalar joints were prepared with an osteotome to remove all remaining cartilage and subchondral bone. The sinus tarsi was debrided as well for supplementation with an extraarticular fusion mass. Final joint preparation consisted of drilling the joint surfaces with a 2.0 mm drill. The wound was thoroughly irrigated. A longitudinal incision was made just anterior to the heel pad in line with the tibial diaphysis for insertion of the intramedullary nail (Trigen Nail, Smith and Nephew Inc, Memphis, Tennessee). The nail was inserted under fluoroscopic guidance. Bone graft from the fibula was placed between the prepared joint surfaces prior to final insertion of the nail. The three distal interlocking screws were placed initially. The nail was impacted before placement of the proximal interlocking screws. The ankle and hindfoot were positioned in neutral dorsiflexion, 5 degrees of valgus, and 10 degrees of external rotation during insertion of the nail⁽¹¹⁾. The wounds were closed in layers over a medium hemovac drain. A below knee splint was then placed.

All patients were admitted to the hospital and placed into a below-knee cast on the second postoperative day. The cast

was changed every three weeks. Patients were maintained non-weight bearing in a below-knee cast for 6 weeks, followed by another 6 week period in a below-knee walking cast.

RESULTS

The average AOFAS ankle-hindfoot score improved from 39 points preoperatively (range 14 to 51) to 69 points postoperatively (range 51 to 91). The pain score decreased from 8.3 points preoperatively (range 7 to 10) to 2.0 points postoperatively (range 0-7). There were no infections or plantar nerve injuries.

Eight of ten patients fused radiographically by 5 months (80%). (Figure 2). One patient required a subsequent procedure during the study period. This patient underwent a double arthrodesis for progressive transverse tarsal arthritis.

Two nonunions were noted. The first patient developed a nonunion of the subtalar component of the arthrodesis.



Figure 2 A, B - AP and lateral xrays showing a solid tibiototalcalcaneal arthrodesis with intramedullary nail in place in the same patient seen in figure 1 with post-traumatic arthritis.



Figure 3 A, B - AP and lateral xrays showing a fibrous nonunion of the ankle joint in a patient undergoing tibiototalcalcaneal arthrodesis for congenital clubfoot deformity.

The second developed a nonunion of the ankle component. (Figure 3). Both patients had a history of smoking. All told, 18 of 20 joints fused (90%). Six patients rated their result as excellent, three good, and one poor.

DISCUSSION

Treatment of patients with disabling arthritis, pain, and deformity of the ankle and subtalar joint remains challenging. The surgical goals of the tibiototalcalcaneal fusion are to eliminate pain and provide a stable, plantigrade foot for ambulation. The retrograde intramedullary nail represents one of the available fixation devices and remains a viable treatment option for obtaining this fusion.

The retrograde intramedullary nail has been compared biomechanically with two crossed compression screws, and the nail construct was reported to be of superior strength⁽⁵⁾. Further biomechanical data demonstrated the superior strength of a fusion nail with posterior-to-anterior interlocking screws⁽¹²⁾. Both of these studies were purely in vitro biomechanical studies, with no in vivo data provided.

The reported fusion rates achieved with a tibiototalcalcaneal arthrodesis using a retrograde intramedullary implant range from 74% to 93%^(2-4,8,13). Kile et al.⁽⁶⁾ reported on a retrospective series of patients undergoing a TTC fusion with an intramedullary nail as a salvage procedure for a multitude of disease processes. A union rate of 93% was achieved. All patients underwent a posterior approach with iliac crest autograph, and there is no mention of smoking history. Pelton et al.⁽¹³⁾ reported on their series of TTC nail fusions, obtaining a union rate of 88%. There was also no mention of smoking history.

More recently, Ahmad et al.⁽¹⁾ reported on the use of a 7.3 mm cannulated screws with a proximal humeral locking plate for a TTC arthrodesis. While they achieved a union rate 94%, there was no mention of smoking history or other comorbidities.

Smoking significantly decreases the union rate of hindfoot fusions. Ishikawa et al.⁽¹⁴⁾ reported on a group of 160 patients undergoing a hindfoot arthrodesis. Patients who smoked cigarettes had more than two and a half times the nonunion rate as the non-smokers in the group. Perlman et al.⁽¹⁵⁾ reported a 28% nonunion rate in high risk ankle fusions. Comorbidities in this study included history of open fractures, smoking, and alcohol abuse.

We believe that the smoking history and comorbidities of both our patients with nonunions dramatically affected their outcome. The first patient had a prior failed ankle fusion for which he was revised to a tibiototalcalcaneal fusion. We believe that the nonunion developed as a result of the patient's smoking history. While his ankle fusion subsequently healed following the intramedullary rodding, he then developed a

symptomatic subtalar nonunion. He has quit smoking and is scheduled for repair of his subtalar nonunion with an iliac crest bone graft. He was the only poor result in this study.

The second nonunion occurred in a patient who denied current tobacco use, although he had a history of smoking and alcohol use. The patient's social situation was also marginal. He developed a stable fibrous nonunion of his ankle joint, but was minimally symptomatic. He rated his result as excellent because of the excellent correction achieved of his malaligned ankle and hindfoot. His pain score was two out of ten, and his AOFAS score was 64. He is not scheduled for any further surgical intervention.

Colman et al.⁽¹⁶⁾ reported the results of their series of isolated ankle fusions. In this series, the AOFAS score improved from 38 points to 74 points in a high-risk patient population, and from 34 points to 69 points in a low-risk patient population. They obtained a fusion rate of 93% and 97% in the high and low-risk groups, respectively. Johnson et al.⁽¹⁷⁾ reported on their results of isolated subtalar fusions combined with a flexor digitorum longus transfer for treatment of posterior tibial tendon dysfunction. AOFAS scores in this study improved from 40 points to 82 points.

The results obtained in this study compare favorably with those of previous tibiototalcaneal arthrodesis studies. However, the fusion rates and scores are inferior to those obtained in studies evaluating isolated ankle or subtalar fusions.

CONCLUSION

Arthritis and deformity involving both the ankle and subtalar joints continues to present a clinical challenge. Advances in technique and newer methods of fixation have expanded the indications for a TTC arthrodesis. To our knowledge, this is the only reported prospective study evaluating the clinical outcomes of a tibiototalcaneal fusion with an intramedullary nail.

Pain relief is not complete and AOFAS scores are improved, but not high when compared to isolated ankle or subtalar fusions. However, all but one patient reported an excellent or good result. This seeming discordance can be explained by the advanced nature of our patients' deformity and pain, and the excellent correction achieved. We believe that the TTC arthrodesis remains a salvage procedure and that the outcomes presented here support its continued use.

REFERÊNCIAS

- Ahmad J, Pour AE, Raikin SM. The modified use of a proximal humeral locking plate for tibiototalcaneal arthrodesis. *Foot Ankle Int.* 2007; 28(9):977-83.
- Chou LB, Mann RA, Yaszay B, Graves SC, McPeake WT 3rd, Dreeben SM, et al... Tibiototalcaneal arthrodesis. *Foot Ankle Int.* 2000; 21(10):804-8.
- Hammitt R, Hepple S, Forster B, Winson I. Tibiototalcaneal (hindfoot) arthrodesis by retrograde intramedullary nailing using a curved locking nail. The results of 52 procedures. *Foot Ankle Int.* 2005; 26(10):810-5.
- Moore TJ, Prince R, Pochatko D, Smith JW, Fleming S. Retrograde intramedullary nailing for ankle arthrodesis. *Foot Ankle Int.* 1995; 16(7):433-6.
- Berend ME, Glisson RR, Nunley JA. A biomechanical comparison of intramedullary nail and crossed lag screw fixation for tibiototalcaneal arthrodesis. *Foot Ankle Int.* 1997; 18(10):639-43.
- Hanson TW, Cracchiolo A 3rd. The use of a 95 degree blade plate and a posterior approach to achieve tibiototalcaneal arthrodesis. *Foot Ankle Int.* 2002; 23(8):704-10.
- Ritter M, Nickisch F, DiGiovanni C. Technique tip: posterior blade plate for salvage of failed total ankle arthroplasty. *Foot Ankle Int.* 2006; 27(4):303-4.
- Kile TA, Donnelly RE, Gehrke JC, Werner ME, Johnson KA. Tibiototalcaneal arthrodesis with an intramedullary device. *Foot Ankle Int.* 1994; 15(12):669-73.
- Mann MR, Parks BG, Pak SS, Miller SD. Tibiototalcaneal arthrodesis: a biomechanical analysis of the rotational stability of the Biomet Ankle Arthrodesis Nail. *Foot Ankle Int.* 2001; 22(9):731-3.
- Coughlin MJ. Arthrodesis of the first metatarsophalangeal joint with mini-fragment plate fixation. *Orthopaedics.* 1990; 13(9):1037-44.
- Buck P, Morrey BF, Chao EY. The optimum position of arthrodesis of the ankle. A gait study of the knee and ankle. *J Bone Joint Surg Am.* 1987; 69(7):1052-62.
- Pelton K, Hofer JK, Thordarson DB. Tibiototalcaneal arthrodesis using a dynamically locked retrograde intramedullary nail. *Foot Ankle Int.* 2006; 27(10):759-63.
- Ishikawa SN, Murphy GA, Richardson EG. The effect of cigarette smoking of hindfoot fusions. *Foot Ankle Int.* 2002; 23(11):996-8.
- Perlman MH, Thordarson DB. Ankle fusion in a high risk population: an assessment of nonunion risk factors. *Foot Ankle Int.* 1999; 20(8):491-6.
- Colman AB, Pomeroy GC. Transfibular ankle arthrodesis with rigid internal fixation: an assessment of outcome. *Foot Ankle Int.* 2007; 28(3):303-7.
- Johnson JE, Cohen BE, DiGiovanni BF, Lamdan R. Subtalar arthrodesis with flexor digitorum longus transfer and spring ligament repair for treatment of posterior tibial tendon insufficiency. *Foot Ankle Int.* 2000; 21(9):722-9.