Journal of Orthopaedics, Trauma and Rehabilitation 16 (2012) 42–44

Contents lists available at SciVerse ScienceDirect

Journal of Orthopaedics, Trauma and Rehabilitation

Journal homepages: www.e-jotr.com & www.ejotr.org

Review Article

Total Ankle Arthroplasty: A Brief Review
全踝關節置換術概述

Mann Roger A.*, Harrison Matthew J.

Oakland Bone and Joint Specialists, Oakland, CA, USA

ARTICLE INFO

Article history:
Accepted November 2011

Keywords:
ankle arthritis
ankle arthroplasty
total ankle replacement

ABSTRACT

Ankle fusion has long been the standard of treatment for end-stage ankle arthritis, and a successful arthroplasty has been a long sought alternative. It is a motion sparing procedure and may greatly reduce the potential for adjacent level degeneration as seen with arthrodesis. The typical candidate for arthroplasty is a healthy low demand patient, although the indications are widening as the success of the procedure has increased. Nevertheless, it is not fail-safe, technical expertise and experience are necessary to achieve a successful result. We have been treating ankle arthritis with the Scandinavian Total Ankle Replacement (STAR) ankle replacement prosthesis for over ten years. We believe that arthroplasty will surpass arthrodesis as the standard of care for severe ankle arthritis.

中 文 摘 要

踝關節融合術一直是末期踝關節炎的標準治療，一個成功的關節置換術是尋求已久的替代品。它是一個能保持關節活動的手術，並可以大大減少在關節融合術後相鄰關節的退化情況。關節置換術的典型適合者是一個健康及需求低的病人，雖然其適應症因手術成功率增加而不斷擴大，然而，它不是萬全的，必需要有技術的專家和經驗才能成功。我們應用斯堪的納維亞的全踝關節置換（STAR）的踝關節置換假體去治療踝關節炎已經十幾年了。我們相信關節置換術將超越踝關節融合術而成為治療嚴重踝關節炎的標準。

Introduction

Ankle arthrodesis has long been accepted as the gold standard for treatment of ankle arthritis.[1] However, advances in prosthesis design and the reported outcomes of arthroplasty are challenging that notion.[2–4] Although not without complications, arthroplasty theoretically avoids adjacent joint degeneration and the potential for separation seen with arthrodesis. Additionally, functional outcomes support the role of a motion-sparing procedure.[5] It seems plausible that total ankle arthroplasty will surpass fusion as the standard treatment for end-stage ankle arthritis.

In this review, we present our experience with ankle arthroplasty, the prosthesis we have adopted, and tips we have learned through our experiences.

Indications and Contraindications for Ankle Arthroplasty

Severe arthritis is the main indication for ankle replacement surgery. The vast majority of these patients have posttraumatic arthritis. Other etiologies include inflammatory arthropathy or metabolic disease such as gout. The ideal patient for this procedure is usually over 50 years old and less than 200 pounds. Also, lower-demand patients might increase the longevity of the device. However, we do have patients that enjoy sports such as hiking, snow skiing, and doubles tennis and are doing quite well many years after surgery. We typically reserve the procedure for those patients that have failed extensive nonoperative treatment, including activity modification, anti-inflammatory medications, and bracing.

There are several contraindications to ankle arthroplasty. Previous ankle joint infection and osteomyelitis are absolute contraindications. Additionally, inadequate bone stock from avascular necrosis (AVN) or osteoporosis usually negates the procedure. Magnetic resonance imaging scans can be used to evaluate the extent of AVN, although occasionally it can overestimate the area of involvement. Nonplantigrade foot, neuropathic joint, and inadequate healing potential due to a poor soft tissue envelope or poor vascularity are also contraindications. Although we offer the procedure to patients with noninsulin-dependent diabetes mellitus, we believe the risk to patients with insulin-dependent diabetes to be too great and instead offer ankle arthrodesis. Other relative

* Corresponding author. *E-mail:* nosirrah@gmail.com.

doi:10.1016/j.jotr.2011.12.001

contraindications include excessive varus or valgus malalignment, patients under 40 years of age, engaging in manual labour as a profession, obesity, and tobacco use.

The STAR Prosthesis

The Scandinavian Total Ankle Replacement (STAR) was designed in 1978 by Hakon Kofoed. It was originally a cemented two-component system. In 1984, the design was changed to a mobile-bearing, three-component prosthesis (Figure 1). This reduces stress by allowing for rotation and translation at the polyethylene-tibial plate interface. The first STAR prosthesis was implanted in the United States in 1998 under an investigational device exemption. In 2009, after a multiyear investigation, the U.S. Food and Drug Administration approved the device for use. To date, over 17,000 prostheses have been implanted worldwide.

The tibial plate and talar component are made of a cobalt-chromium alloy with a titanium plasma spray coating on the nonarticulating surfaces. They come in five sizes. The mobile bearing is made of ultra-high molecular weight polyethylene and is available in thicknesses of 6–14 mm. We have had patients with an ankle anatomy larger than the available commercial implants. In these cases, the manufacturer has made custom-sized components, albeit at an increased cost.

Although the results of the early studies are good, many procedures were performed when the instrumentation was rudimentary, leading to component malalignment. In recent years, the instrumentation has undergone extensive redesign in order to ensure repeated cuts and accurate drilling. A system of alignment jigs, cutting guides, and the use of intraoperative fluoroscopy has increased the precision of the component placement. We feel the new developments will improve the outcomes of the procedure relative to the early results.

Technical Tricks, Pitfalls, and Complications

Here, we will describe a few pearls of wisdom we have learned. Detailed guides to the step-by-step instructions for the procedure can be found elsewhere.[2,5,6]

Surgical exposure has a few common complications. The skin of the anterior ankle is quite thin and susceptible to wound-healing issues. This can manifest as minor problems such as skin sloughing or mild drainage. At other times, severe full-thickness necrosis can occur, requiring tissue transfer and skin grafts in order to obtain adequate coverage. We have minimized this complication through careful soft tissue handling, by not using self-retaining retractors, tension-free closure, and strict limb elevation in order to minimize swelling during first 2 weeks after surgery. The superficial and deep peroneal nerves are also at risk. Occasionally, a small branch of the superficial peroneal nerve crosses the ankle joint and must be sacrificed in order to proceed. Patients should be counselled regarding the potential for foot and ankle numbness.

As mentioned above, many procedures were performed in the past using simple instrumentation. Today, a well-designed system of guides and cutting jigs aids in proper alignment. Fluoroscopy has been a valuable tool in this regard as well. However, we feel it imperative to visually align the tibial cutting jig to the mechanical axis of the leg. A thin osteotome, held perpendicular to the alignment guide, helps with visualizing the varus or valgus orientation of the tibial cut (Figure 2). We seldom have to make corrections to this preliminary alignment when we verify it using fluoroscopy. Additionally, the foot needs to be held in neutral to slight valgus when pinning the talar dome and cutting jig into position.

The tibial component is stabilized using two 6.5-mm barrels on the superior surface. The holes for these are drilled using the barrel guide. When doing so, it is imperative that the surgeon aim the drill in a slightly superior direction. Otherwise, the tibial component may not rest firmly against the cut tibial surface after implantation (Figure 3). Should this occur, the tibial component needs to be removed and the barrel holes redrilled.

Approximately 33–44% of patients who present for ankle replacement have greater than 10° of coronal plane deformity.[7] Several researchers have suggested that severe coronal plane deformity may be a contraindication to ankle arthroplasty.[8,9] We recently presented our data regarding coronal plane correction using the STAR prosthesis.[10] We observed that coronal plane deformities up to 25° can be corrected and maintained. For deformities of up to 18°, no adjunct procedure is usually necessary. However, for greater deformities, soft tissue balancing, such as deltoid release or lateral ligament reconstruction, is necessary. Occasionally, a calcaneal, cuneiform, or metatarsal osteotomy is necessary to create a plantigrade foot in patients with fixed deformities. This is essential for obtaining a neutral position for the arthroplasty components.

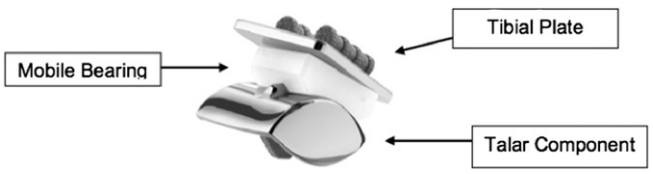

Figure 1. The three components of the STAR ankle prosthesis.

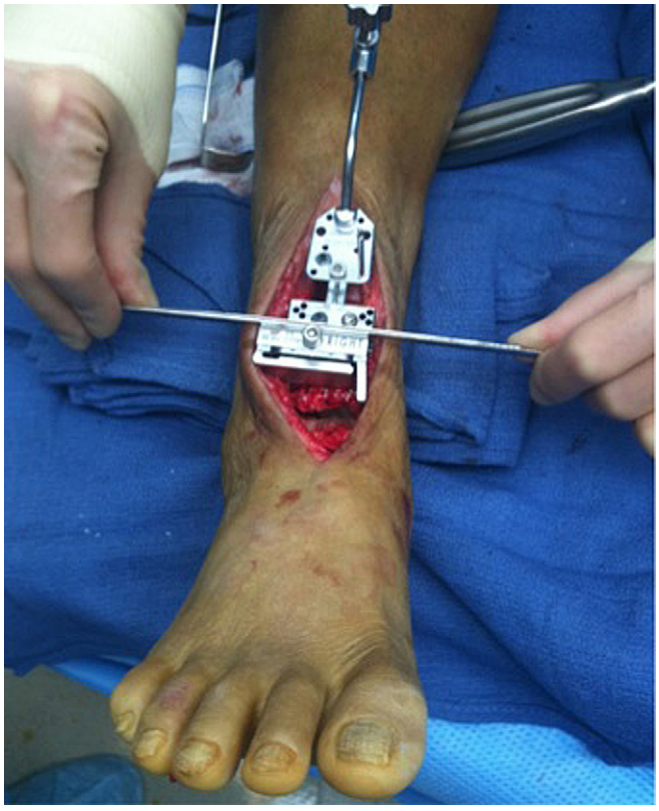

Figure 2. Photograph showing alignment of the tibia cutting jig by placing an osteotome perpendicular to the long axis of the leg.

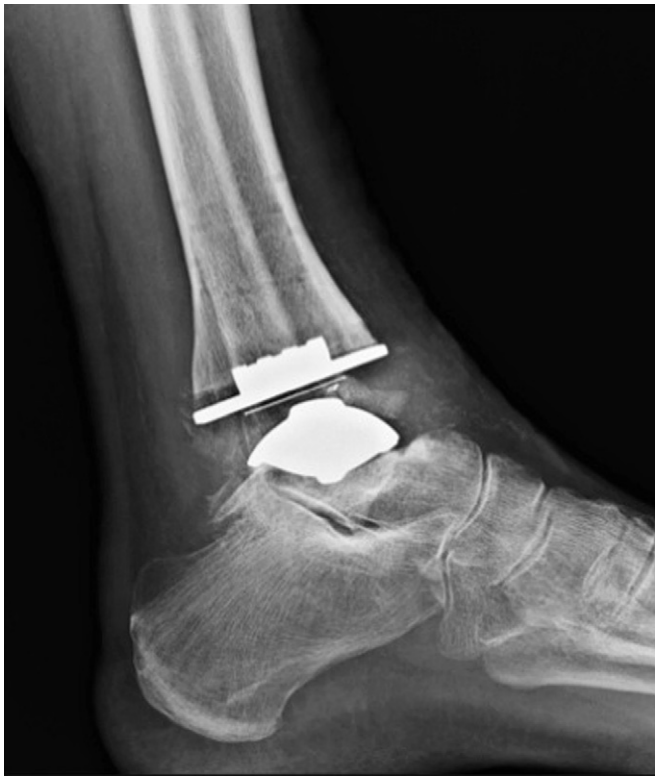

Figure 3. Lateral ankle x-ray showing posterior gap between tibia and tibial component. This needs to be re-aligned.

Postoperative Protocol

Patients are placed in a well-padded, short-leg splint immediately at the conclusion of the procedure. The drain is removed the day after surgery, and most patients are ready for discharge. Although we occasionally perform the surgery as an outpatient procedure, national health insurance (Medicare) guidelines mandate an overnight hospital stay. The patients are advised not to bear weight on the leg until their first follow-up visit 2 weeks after surgery. At that time, the splint and sutures are removed and the patient is placed into a removable controlled ankle motion (CAM) walker boot. The patient is allowed 50% weight bearing at that time. At 4 weeks after surgery, the patient is transitioned to full weight bearing. At 6 weeks after surgery, the patient is seen in the clinic once again and transitioned out of the CAM walker boot into a regular shoe. Further appointments occur at 3, 6, and 12 months postsurgery and then annually thereafter.

Conclusion

Total ankle arthroplasty has quickly overcome its reputation from the 1970s. There are multiple studies that show very good outcomes.[2–5] The latest design of instrumentation will only improve on these results. We believe that with proper patient selection, careful preoperative planning and surgical techniques, and postoperative care, total ankle arthroplasty will result in improved patient outcomes and satisfaction versus ankle arthrodesis. The new gold standard for treatment of arthrosis of the ankle will be ankle arthroplasty.

References

1. Chao W, Mizel M. What's new in foot and ankle surgery. *J Bone Joint Surg Am* 2006;**88**:909–22.
2. Saltzman C, Mann R, Ahrens J, et al. Prospective controlled trial of STAR total ankle replacement versus ankle fusion: initial results. *Foot Ankle Int* 2009; **30**(7):579–95.
3. Mann J, Mann R, Horton E. STAR ankle: long-term results. *Foot Ankle Int* 2011;**32**(5):473–83.
4. Kofoed H, Lundberg-Jensen A. Ankle arthroplasty in patients younger and older than 50 years: a prospective series with long-term follow-up. *Foot Ankle Int* 1999;**20**:501–6.
5. Wood P, Deakin S. Total ankle replacement: the results in 200 ankles. *J Bone Joint Surg Br* 2003;**85-B**:334–41.
6. Anderson T, Montgomery F, Carlsson A. Uncemented STAR total ankle prosthesis: surgical technique. *J Bone Joint Surg Am* 2004;**86-A**(Supp. 1):103–11.
7. Haskell A, Mann R. Ankle arthroplasty with preoperative coronal plane deformity. *Clin Orthop* 2004;**424**:98–103.
8. Doets H, van der Plaat L, Klein J. Medial malleolar osteotomy for the correction of varus deformity during total ankle arthroplasty: results in 15 patients. *Foot Ankle Int* 2008;**29**(2):171–9.
9. Kim B, Choi W, Kim Y, et al. Total ankle replacement in moderate to severe varus deformity of the ankle. *J Bone Joint Surg Br* 2009;**91**(9):1183–90.
10. Mann R, Mann J, Reddy S, et al. Correction of moderate to severe coronal plane deformity with the STAR ankle prosthesis. *Foot Ankle Int* 2011;**32**(7):659–64.