

Open Ankle Arthrodesis

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KEYWORDS

• Ankle fusion • Arthritis • Deformity • PTTD

KEY POINTS

- Open ankle arthrodesis remains the standard in the operative treatment of end-stage ankle arthritis, allowing patients to regain function while decreasing pain and discomfort to the affected limb.
- Successful ankle arthrodesis is multifaceted and requires consideration of concomitant deformities, careful dissection, thorough joint preparation, rigid fixation, and postoperative compliance.
- A variety of acceptable fixation constructs exist. Advancements in technology allow appropriate fixation and may include a combination of plates, screws, and external fixation.

INTRODUCTION

History

Arthrodesis is a surgical approach commonly used to address long-standing pain and deformity, arthritis, and dysfunction in the foot and ankle. Albert¹ initially described arthrodesis in 1879 as a knee and ankle fusion for children with neuromuscular disorders. Moving into the 1900s, arthrodesis was used in the ankle as a surgical correction for poliomyelitis. By the early 1950s, Charnley² described compression arthrodesis using external fixation devices for ankle fusions. The goals of Charnley's² ankle arthrodesis were to eliminate shear forces and fixate with close apposition of bony surfaces. Compression across the arthrodesis site proved to be a necessary step to improve union rates. However, Charnley's² surgical method used a transverse anterior approach. This method was purportedly a more amenable incisional approach for compression.² This incision and dissection resulted in the sacrifice of tendons and neurovascular structures at the anterior ankle. Despite reports that vascular compromise from the loss of the anterior tibial artery and anesthesia resulting from the

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transection of nerves were unfounded misconceptions of the transverse anterior approach,² this technique was abandoned.

The lateral incision became more popular because of the access to the fibula for autogenously derived bone graft as well as visualization of the tibiotalar joint.³ With the recent improvements and popularity of total ankle arthroplasty there has been a renewed increase in anterior ankle incisions for arthrodesis in order to preserve the lateral malleolus for possible future implant.

Glissan⁴ first described specific principles of ankle arthrodesis. In 1949, he published his procedure describing 4 goals for fixation of ankle arthrodesis leading to higher fusion rates. First, he stressed the importance of removing all cartilage and tissue that would prevent intimate approximation of adjacent bony surfaces. The subsequent keys to union included a close-fitting construct for the fusion with optimal positioning of the fusion site.⁴ In addition, maintenance of correction without interruption during the fusion period was pivotal for successful outcome.⁴⁻⁶ AO technique, formally known as *Arbeitsgemeinschaft für Osteosynthesefragen*, expounded on Glissan's principles⁴ of arthrodesis to produce fixation concepts currently adhered to today.

Over time, the principles of arthrodesis have remained largely unchanged; however, fixation modalities have progressed drastically. Initially fixation consisted of cadaveric allograft, ivory, fibular autograft, or suture and was followed by extended periods of immobilization. Despite adherence to strict non-weight bearing, materials and surgical techniques did not afford high union rates.⁷

At present, ankle arthrodesis uses a variety of fixation techniques, including internal screw fixation, external fixation, intramedullary nails, plates, and arthroscopic approaches (Fig. 1). When combined with correct surgical approach, each of these fixation techniques has resulted in high rates of fusion. In addition to changes in fixation techniques, which are discussed later, the incision approaches have also changed.

Indications

Ankle arthrodesis has numerous applications given advancements in surgical approaches and fixation techniques. The procedure remains at the forefront of treatment of advanced ankle arthritis. Ankle arthrosis and concomitant articular damage are often the result of previous trauma (Fig. 2). Injuries resulting in arthritis include crush injuries, comminuted fractures, and ankle instability with history of repetitive sprains.⁸ Although posttraumatic arthritis is the primary indication for ankle arthrodesis,^{5,6} the procedure can be used to treat congenital and neuromuscular disorders, infection, avascular necrosis of the talus, advanced posterior tibial tendon dysfunction, and Charcot neuroarthropathy, and serves as a salvage procedure for failed total ankle arthroplasty (Fig. 3).^{5,9}

Contraindications

Contraindications for ankle arthrodesis are similar to those for other surgical interventions. Ankle arthrodesis for patients with multiple comorbidities who are medically unstable to undergo an elective procedure should be avoided until the patients are able to do so. In addition, local surgical site factors such as peripheral vascular disease and poor soft tissue quality from conditions such as lymphedema or venous disease should serve as deterrents from ankle arthrodesis.^{5,8} Social factors such as tobacco use and excessive alcohol consumption, and ongoing psychological conditions must also be evaluated during risk/benefit analysis, because these conditions may produce unsatisfactory results.¹⁰ Smoking is a relative contraindication, as shown in previous studies with increased nonunion rates in smokers compared with

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