Current Thoughts on Ankle Arthritis

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ABSTRACT

The ankle is the most commonly injured joint in athletic and work activities. In contrast, osteoarthritis of the ankle joint is relatively rare and is typically post-traumatic or inflammatory in nature. Common symptoms that prompt an orthopaedic consultation include pain, disability and altered gait mechanics. Non-operative management has been the mainstay for previously undiagnosed patients. For those with advanced disease, ankle fusion or total ankle replacement may be the only surgical options. Though some recent studies have shown patients' preference for a well functioning ankle replacement, significant long- term follow-up data is lacking.

KEYWORDS: ankle anatomy, arthritis, arthrodesis, total ankle replacement

INTRODUCTION

The ankle is the most commonly injured joint in the body and is also the most frequently injured area of the musculoskeletal system during athletic activity. In contrast to the hip and knee, primary osteoarthritis of the ankle joint is relatively rare.[1] Cartilage destruction due to trauma to the distal tibia, medial and lateral malleoli, and the talus is the most common etiology of arthritis of the ankle. Similarly, cumulative trauma from chronic ligamentous instability can lead to mechanical derangement resulting in insidiously progressive arthritis. Inflammatory arthropathies account for many of the remaining cases.[1] Ankle arthritis is painful and can seriously alter day-to-day function by causing pronounced deterioration of gait and weight bearing ability. Pain, swelling, stiffness, and deformity due to ankle arthritis are common afflictions evaluated by a foot and ankle specialist.

Ankle Anatomy

The tibia, fibula and talus compromise the ankle joint. While commonly thought of as a simple hinge joint, the ankle joint is better thought of as a rolling cylinder that rotates on an oblique axis between the medial and lateral malleoli.[2] Many ligaments support the bony articulations and hold the talus centered under the tibia and its articulation with the fibula. The tibia and fibula are joined by a complex known as the syndesmosis which is made up of four separate ligaments and is located 2–3 cm above the tibiotalar joint line. These supportive ligaments are very important to the ankle joint stability. Chronic excess movement within the mortise due to ligamentous instability leads to rapidly progressive arthritis. Additionally, the ankle rests directly upon the foot and positional changes or deformities of the foot can have dramatic effects on ankle function, alignments, and symptoms.

Due to the significantly smaller surface area of the ankle, the forces transmitted through the joint are much greater than in the hip or knee. During normal walking, forces up to five times body weight are transferred through the ankle, and this increases with running and other strenuous exercise. The cartilage in the ankle is stiffer and more resistant to deformation than other weight bearing joints, allowing it to support these increased loads. Comparisons of articular cartilage samples harvested from knee and ankle joints have demonstrated a higher composition of glycosaminoglycans and proportionally less water content in the articular surface of the ankle. Simply put, the cartilage in the ankle, despite its relative thinness, is denser and stronger than either the distal femur or proximal tibia, and this difference appears consistent among individuals.[4]

Three views of the ankle joint: AP, Lateral and Mortise; note the well preserved joint space.[3]

TREATMENT

Treatment options for ankle arthritis include non-operative as well as operative management. Traditional non-operative care techniques which should always be considered the mainstay and first-line management for any patient initially presenting with ankle arthritis. These include activity modification, bracing, weight loss, shoe modification and physical therapy. Additionally, intra-articular corticosteroid injection, anti-inflammatory drugs and perhaps even the newer forms of injected hyaluronate viscosupplementation (although supportive scientific data are currently lacking and it remains a controversial therapy) can reduce inflammation and pain. The vast majority of patients presenting with as yet untreated mild or moderate ankle arthropathy can derive great benefit from utilizing varying combinations of these modalities, often for many years. In the face of advanced arthritic disease these combined therapies often have poor outcomes with little positive effect on symptoms. These patients are most frequently the candidates for whom operative management is considered. Open or arthroscopic debridement and decompression can be useful early when the patient's chief complaint is mechanical in nature due to impingement, loose bodies or small osteochondral defects. In the case of advanced disease, arthrodesis or total ankle arthroplasty are the surgical options.

Ankle Arthrodesis

Arthrodesis was originally described in the late 1800s. It has been the gold standard for end-stage ankle arthritis for many years and, for most surgeons, remains so today. Despite many reported techniques, the goals have always remained the same: to remove all painful motion from the articulation, restore and maintain alignment, and withstand the significant day-to-day stresses of standing, walking, and even impact activity (in younger patients). Today arthrodesis is performed open or arthroscopically using some combination of plates or screws with bone graft. Using modern methods, roughly 90% of patients are able to achieve bony union and experience significant pain relief. Optimal position of fusion restores the weightbearing axis of the lower extremity (if deformity was present) and places the forefoot in position to be accommodative.[1] Inevitably, some patients will have problems such as infection, delayed or nonunion as well as progressive degenerative changes in nearby joints due to the increased stresses placed on them after ankle fusion. The overall satisfaction rate with ankle fusion in patients remains excellent, although it is clear that walking with a stiff ankle requires certain accommodations and some patients unequivocally dislike the lost ankle motion and never seem to be able to adjust well to that despite an improvement in their pain level.

TOTAL ANKLE REPLACEMENT

Total Ankle Replacement (TAR) was initially introduced in the 1970s as an alternative to ankle fusion for the treatment of debilitating ankle arthrosis. The postoperative limitation in motion, altered gait mechanics, and possibility of gradually progressive arthritic development in nearby foot joints caused by ankle fusion remain the longstanding driving factors in the continued search for a better option.[5,6] Despite the inherent promise, potential advantages, and multigenerational designs associated with replacement of the ankle, ankle arthroplasty has historically never enjoyed the same level of success documented with hip and knee arthroplasty. Early total ankle implant designs were plagued with complications such as implant loosening and subsidence as well as limited function. All of these problems made ankle fusion a more attractive option. Due to recent improvements in design and surgical technique interest in total ankle replacement has returned.

There are currently five commercially available ankle prostheses in the United States today approved by The Food and Drug Administration (FDA), which are considered 3rd generation designs, one of which was designed and patented by one of the authors. Most of the modern prosthetic designs consist of three pieces, two of which are comprised of a metal alloy and the third which makes up an interface composed of a very durable plastic piece made of highly cross-linked polyethylene. The two metal components are usually made of titanium or cobalt-chrome, with one piece designed for insertion into and replication of the distal tibial surface (top of the ankle) and the other designed for replacing the talar dome (bottom of the ankle joint). While all but one of these devices are fixed bearing, two-piece designs that have the plastic piece fixed to the tibial component, one is a three component "mobile bearing" system, whereby the plastic liner is intended to move freely between the two metal components. To date there exists little if any data which definitively supports a difference in survivorship or outcome between these design concepts, and currently the majority of the purported advantages and disadvantages remain theoretical. The short and midterm follow-up data, supporting a survivorship ranging between 80–95% for approximately 5–10 years postoperatively for these 3rd generation designs, remains promising, and foot and ankle surgeons retain a cautious optimism with these implants, given the historically poor track record of earlier (1st and 2nd) generation design technology. [6-9]

Design advances

Early designs of ankle replacements were simple hinge joints and were highly constrained. Constraint refers to the restriction of motion and can be rotational, anterior to posterior or medial to lateral. Increased constraint led to higher forces being transmitted to the bone-prosthesis interface and ultimately implant loosening and failure.[1] The current generation of implants on the market today incorporate different metallurgy and plastic technology, are more anatomic and less constrained leading to more equal transfer of force to the surrounding bone and subsequently lower rates of implant failure.[6]

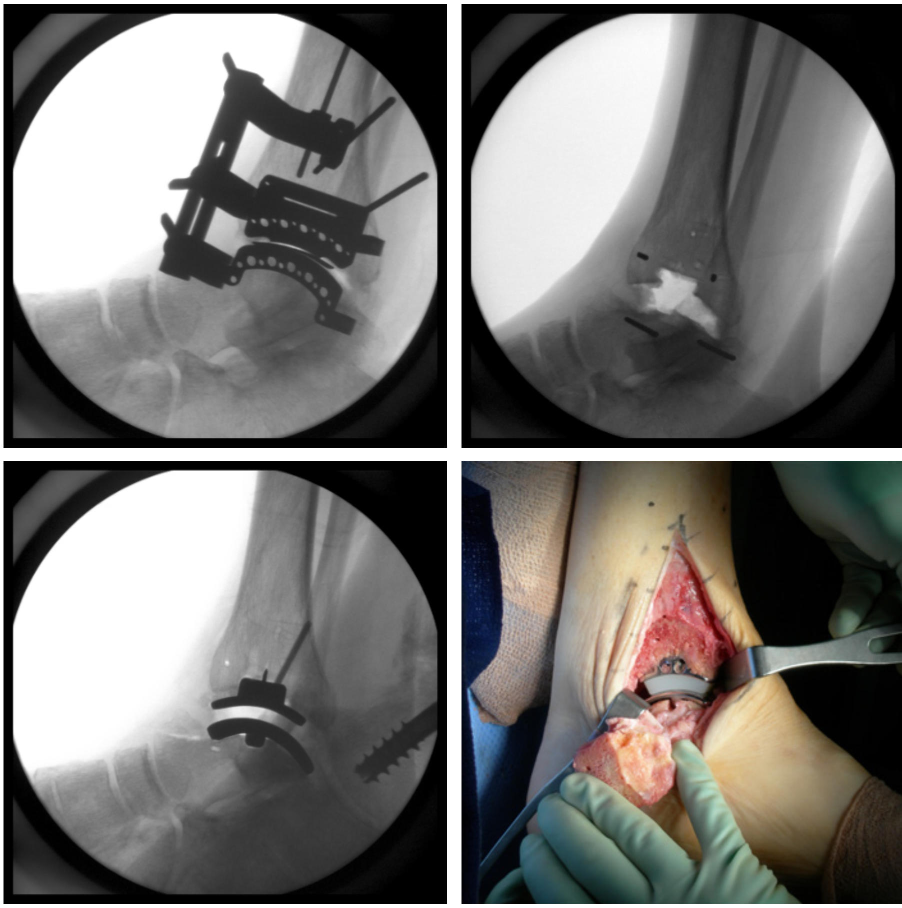
All prosthetic implants must firmly attach to bone. Most early ankle replacement prostheses were cemented in the distal tibia and required a significant amount of distal tibial bone to be removed. The cement provides an additional surface where failure can occur. Additionally, removal of large pieces of bone to fit the prosthesis and cement made future conversion to a fusion (if required) difficult.[7] Current ankle replacement designs, although typically approved for cemented use, are being predominantly utilized as "press-fit" devices, being implanted directly onto the raw bony surface in a process quite similar to many modern hip replacement designs that take advantage of biological bony ingrowth. These prostheses are coated with tiny beads that have intervening spaces as small as 50 microns. The pores allow for the surrounding bone to literally grow into the prostheses and form a potentially life-lasting bond that retains the capability of remodeling over time. This advancement has led to increased survival not only in total hip replacements but also total ankle replacements. Combined, these advances have led to better fixation, better survival, and lower rates of implant loosening and failure in modern total ankle replacement surgery.[6]

While there have been many improved advances and techniques in ankle replacement there is also mounting evidence to suggest that patients are increasingly preferring ankle replacements because they seem to offload adjacent joints and also mimic a more normal gait cycle as compared to ankle fusion patients on a day-to-day basis. It also remains clear (and is important to remember) that the ideal candidate who would benefit most from ankle replacement has yet to be been fully determined. Importantly, there are several agreed upon contraindications to an ankle replacement.

Contraindications

Absolute contraindications include those patients with peripheral vascular disease, active infections, as well as those with neuropathic or Charcot arthropathy. Patients who already have a stiff ankle are less likely to gain motion after joint replacement and should be counseled appropriately. As with any joint replacement surgery infection is always a dreaded complication which can lead to implant failure and necessitate removal and long-term IV antibiotics. If the infection cannot be cleared, below the knee amputation may be considered. Relative contraindications include smoking, young active patients, those with ligamentous laxity about the ankle, overall lower extremity malalignment as well as pre-operative ankle stiffness.

It is clear that the horizon for total ankle replacement looks very promising, but this procedure is still not for every surgeon or every patient. A pooled meta-analysis done several years ago evaluated the intermediate and long-term outcomes of TAR versus fusion and, despite limited and arguably confounding data, confirmed overall comparable results between the groups.[9] Certainly, further investigation is needed in the area of TAR before we truly know who will benefit most from this operation, and for how long. Given the recent promising early results of newer technology there is no doubt that interest in ankle replacement will continue. The ultimate goal for defining a wholly successful total ankle replacement – which would eliminate the need to ever perform an ankle fusion ever again in a manner similar to the evolution of hip and knee replacement surgery supplanting any need for hip or knee fusion surgery – will be to provide our patients with a safe, reliable, durable ankle arthroplasty that 1) preserves ankle motion and function, 2) provides excellent long-term pain relief, and 3) exhibits a 95% 20–25 year survivorship akin to the most successful hip and knee replacements currently available.



Eclipse (Integra Life Sciences) total ankle replacement. Cutting blocks guide the precise bony resection of the distal tibia and talus. The space for the implants is evidence and final implants are placed. Finally before wound closure.[10]

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