Total Ankle Arthroplasty in the Patient with a Pathologic Fibula

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Statement of Purpose

Total ankle replacement and implant devices have evolved greatly. Nonetheless, the surgery can be challenging especially when pre-operative deformity exists. It is widely reported that a contraindication to total ankle arthroplasty is lack of an intact fibula[1-3]. In the post traumatic ankle status post open reduction internal fixation, the fibula can be left in a shortened position. In addition, a fibula take-down is sometimes performed in ankle arthrodesis. We present two surgical techniques to re-establish the lateral fibula as a "lateral post" to provide stability and prevent lateral subluxation/dislocation of the talus allowing one to perform a total ankle arthroplasty

Literature Review

Complex pre-operative alignment presents as a challenging case for a surgeon. Fibular position should be carefully assessed. In normal gait, the fibula is constantly in motion with a small amount of rotation as well as translation[4]. For this reason, an intact fibula is reported as a requirement when considering total ankle replacement. Shortening and lateral rotation of the fibula is a complication after open or closed treatment of malleolar fractures. A shortened and rotated fibula will interfere with the normal function of the ankle[5]. Displacement of as little as 1 mm will change the mobility of the talus and fibula, as well as, the distribution of load in the talofibular and talotibial articulations[6]. Cadaveric studies showed that 30° of lateral rotation deformity decreases the tibiotalar contact area by 30 to 50%[6-8]. Additionally, one technique for ankle arthrodesis is take down of the fibula. When the arthrodesis becomes painful or a non-union ensues, it is common practice that a repeat fusion is necessary. A case report by Brooke et al discusses successful fibula lengthening osteotomy to correct valgus mal-alignment following total ankle arthroplasty. There were no reports in the literature of fibular lengthening preceding total ankle arthroplasty[9].

Case Study 1-Shortened, posteriorly rotated fibula w/ 20 degree ankle valgus

A lateral incision is made over the shortened and posteriorly rotated distal fibula. Once the fibula is exposed, an osteotomy is made midshaft (Figure 1). Dissection is then carried down to the syndesmosis which is fully debrided and the bone surfaces are extensively prepared for syndesmotic fusion. Next, the deformity within the tibia was corrected with an opening wedge osteotomy (base lateral and apex medial) and fixated with a plate and screws. The fibula was able to be lengthened distally and rotated anteriorly into the incisura. The fibula was then brought to length, rotated and held in a corrected position with a plate over the fibula. The syndesmosis was stabilized with four syndesmotic screws inserted across the syndesmosis through the fibula plate (Figure 2). In this particular case, a staged approach was employed. Once there was adequate consolidation across both the tibial osteotomy and across the syndesmosis, confirmed via CT scan, the patient was brought back to the operating room for a total ankle replacement (Figures 3 and 4). An incision was made through the previous lateral ankle surgical site. A fibular osteotomy was made below the syndesmosis fusion and above the level of the ankle joint ensuring not to disturb the distal tibial fibula syndesmosis fusion, allowing enough space to resurface the distal tibia. The Zimmer Trabecular Metal total ankle was then implanted using the standard approach.

Case Study 2- Previously resected fibula

This patient had a previous ankle fusion with fibular onlay graft (Figure 5)A lateral incision was made through the previous ankle arthrodesis surgical site. The incision was carried approximately 10 cm proximal to identify the remaining fibula. A distraction arthrodesis of the subtalar joint with iliac graft allograft was performed to correct the valgus hindfoot and restore height. The desired placement of the ankle joint was identified and the ankle joint fusion was taken down utilizing the technique for placement of a Zimmer Trabecular Metal total ankle. Once the implant was inserted, the distance from the tip of the fibula to the talar component was measured. This is the amount of fibula deemed necessary to provide an adequate lateral strut. In our case, the distance measured eight centimeters; therefore, a transverse osteotomy was made eight centimeters proximal to the tip of the remaining fibula. The minimal amount of dissection of the fibula was performed to provide freedom of motion of the fibula strut and maintain as much blood supply as possible (Figure 6). The fibula was then rotated in the sagittal plane allowing the most proximal portion of the strut to be placed distal. The medial side of the fibula, extending to the tibial component, and the lateral side of the tibia were prepared to promote a syndesmostic fusion(Figure 7). The fibula strut was fixated using a six hole 1/3 tubular plate. The three proximal holes were filled with 3.5 cortical non-locking screws and placed using four cortices. The distal hole was filled with a 3.5 cortical non-locking screw and placed bicortical in the fibula to prevent a valgus tilt of the fibula (Figure 8 and 9).

Figure 1: midshaft fibular osteotomy

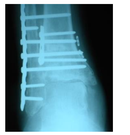

Figure 2: Syndesmotic fusion with four screws inserted through the fibular plate

Figure 3: Figure 3: AP XRay status post total ankle replacement

Figure 4:Lateral XRay status post total ankle arthroplasty

Figure 5: Pre-operative AP XRay showing ankle fusion with fibula onlay graft

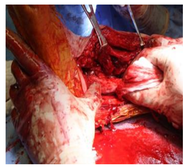

Figure 6: Dissection of the fibula. The peroneal muscle attachments are left intact

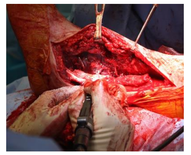

Figure 7: The medial side of the fibula and lateral side of the tibia is prepared for syndesmotic arthrodesis

Figure 8: A fibula locking plate is utilized for syndesmotic fusion and to keep the fibula in place

Figure 9: Post operative AP XRay showing advancement of the fibula and insertion of total ankle implant

Analysis and Discussion

There is a paucity of literature evaluating the biomechanical and longer clinic results of Tibio-talo-calcaneal arthrodesis. Tenebaum et al in 2014 performed a prospective biomechanical evaluation of TTCA in 21 patients. The results showed a significant decrease in ankle joint sagittal plane motion and an increase in the sagittal plane motion of the hip on the operative side. The hypothesis is the hip on the ipsilateral side of the TTCA is now compensating for the lack of motion at the ankle joint. The study did not provide subject evaluations of the patients' pain[11]. Additionally, Fuchs et al retrospectively reviewed 18 ankle arthrodesis' in 17 patients over a period of more than 20 years. They found that arthrodesis of the ankle leads to deficits in functional outcome, limitations in activities of daily living and radiographic changes in adjacent joints[12]. While performing total ankle arthroplasty doesn't restore ankle joint range of motion to normal, it does allow fluid motion of the joint and less compensation through adjacent joints.

Our technique re-establishes length of the fibula in both scenarios. With successful syndesmotic fusion, fibular motion is eliminated thus eliminating a source of continuous shear stress to the ankle joint4. Re-establishing the length of the fibula acts as a lateral strut thus redistributing the talofibular and talotibial load.

While lack of an intact fibula is listed as a contraindication to total ankle replacement, we were able to successfully re-establish a lateral buttress and insert a Zimmer total ankle (Zimmer, Warsaw, IN) implant. With reconstruction of the fibula along with a successful syndesmotic fusion, the authors feel that it is feasible to insert a total ankle replacement in patients without an intact fibula.

References

1. Feldman M, Dinh T, Blake W. Total Ankle Arthroplasty. Chapter 32 Podiatry Institute
2. Brigido S, DiDomenico LA. Primary Zimmer Trabecular Metal Total Ankle Replacement. Primary and Revision Total Ankle Replacement Chapter 12. 131-149. Springer
3. Bonasia D et al. Total Ankle Replacement: Why, When and How? The Iowa Orthopaedic Journal. Vol 30. 119-130.
4. Saltzman S. Perspective on Total Ankle Replacement. Foot and Ankle Clinics. 5(4): 761-775. December 2000
5. Rukavina A. The role of fibular length and the width of the ankle mortise in post-traumatic osteoarthrosis after malleolar fracture. International Orthopedics. 22:357-360. 1998
6. Weber D, Friederich NF, Müller W (1998). Lengthening osteotomy of the fibula for post-traumatic malunion: indications, technique and results. International Orthopedics 22:149-152.
7. Curtis MJ, Michelson JD, Urquhart MW, Byank RP, Jinnah RH (1992) Tibiotalar contact and fibular malunion in ankle fractures: a cadaver study. Acta Orthop Scand 63:326-329.
8. Moody ML, Koenemann J, Hettinger E, Karpmann RR (1992) The effects of fibular and talar displacement on joint contact areas about the ankle. Orthop Rev 21:741–744.
9. Brooke B, Harris N, Morgan S. Fibula lengthening osteotomy to correct valgus mal-alignment following total ankle arthroplasty. Foot and Ankle Surgery. 18: 144-147, 2012
10. Pellegrini M et al. Conversion of Tibiotalar Arthrodesis to Total Ankle Arthroplasty. J Bone Joint Surg Am. 97:2004-2013. 2015.
11. Tenenbaum S et al. Improvement in gait following combined ankle and subtalar arthrodesis. J Bone Joint Surg. 96(22):1863-9. 2014.
12. Fuchs S et al. Quality of life 20 years after arthrodesis of the ankle. A Study of Adjacent Joints. J Bone Joint Surg Br. 85-B:994-998. 2003.