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Long-Term Effectiveness of Cementless Shallow-sulcus and Deep-sulcus Mobile-Bearing Total Ankle Replacements: 2 Case Reports with over 20 years Follow-up

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Introduction

Long-term studies of 20 years or more concerning ankle replacements are rare [1,2]. Problems of loosening, avascular necrosis of the talus, component subsidence, osteolysis, bearing dislocation, bearing wear, stress fractures and infections have been reported causes of failure [3-9].

Mobile-bearing total ankle designs have had the greatest long-term success to date by minimizing torsional stresses that tend to loosen components and maximizing area contact surfaces on the polyethylene bearings, which extends the wear life of these devices [10].

The following case reports describe long-term follow-up of two mobile bearing total ankle replacements. The first report is a 29 year follow-up of the first cementless mobile-bearing shallow-sulcus device developed by the authors in 1978 [11]. The second report describes the improved deep-sulcus device [12] developed in 1989 which has functioned well for 22 years in this patient.

The history, surgical technique and follow-up protocol, as well as authors' insights, will be presented for both patients.

Sliding-Cylindrical Total Ankle, Mark I-Anatomic Shallow-sulcus Design for use with Intact Malleoli and Functioning or Reconstructable Collateral Ligaments

Case Report: 1

History

A 33 year old, 180 pound (81 kg), 6 foot (183 cm) tall, white male office manager developed intractable weight bearing pain with crepitus and limited range of motion in his left ankle (10° dorsiflexion and 20° plantarflexion) over a 2 year period, after sustaining a bimalleolar fracture that was treated with cast immobilization. His hindfoot alignment was neutral, and he had good collateral ligament stability. Pre-operative X-rays revealed advanced post-traumatic arthritis of the left tibio-talar joint with complete joint space loss and peripheral osteophytes on the tibia and talus (Figure 1).

Figure 1: AP, mortise and lateral X-rays of a post-traumatic arthritic left ankle in a 33 year old man with intractable pain and limited range of motion.

Procedure

This patient underwent a left cementless B-P Mark I Shallow-Sulcus meniscal-bearing total ankle replacement (DePuy LCS total ankle replacement, Warsaw, Indiana) on December 12, 1984. Intraoperatively, after using an anterior ankle approach between the anterior tibialis and extensor hallucis longus tendons, an anterior cortical window was removed from the distal tibia to allow central placement of the stem of the flat-surfaced tibial component. The talus was contoured with a power burr and a central slot was made to accept the talar component fixation fin. A 3 mm standard polyethylene (sterilized by gamma-in-air radiation) meniscal bearing, matching the

upper tibial flat surface and the lower talar shallow-sulcus, was pressed into place to provide ligament tension and normal unrestricted motion. A routine wound closure was performed, followed by application of a very well-padded short leg plaster cast with the foot and ankle in neutral position.

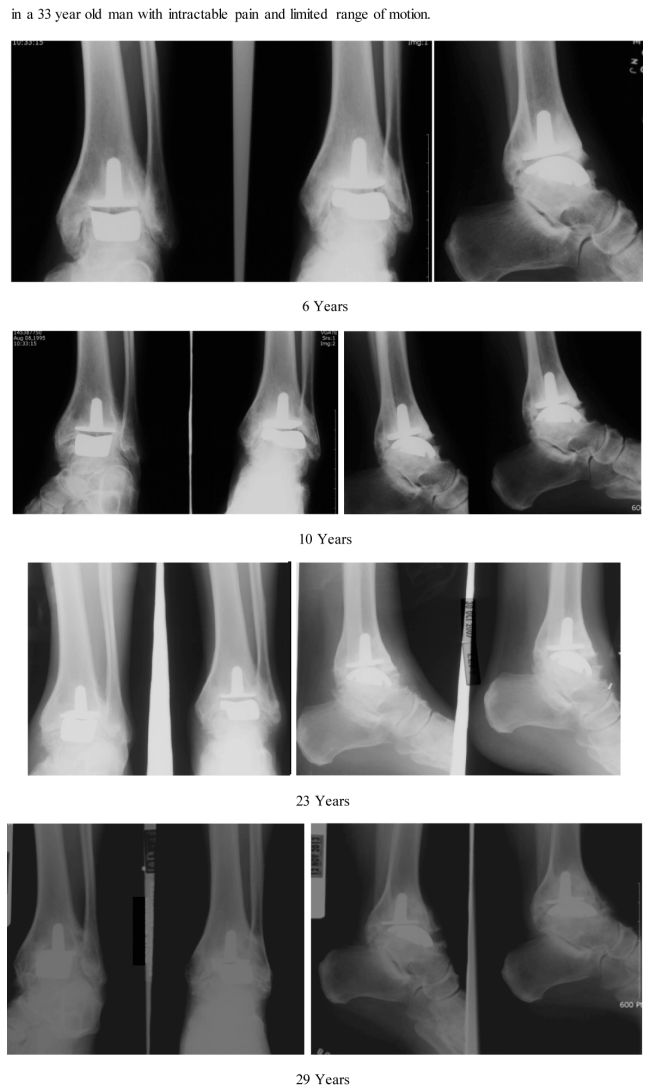

Figure 2: Sequential AP and lateral X-rays of the left ankle in the patient from Figure 1 with a cementless B-P shallow-sulcus ankle after 6, 10, 23 and 29 years, respectively. Note the progression of anterior and posterior osteophytes with time, and the nearly-complete wear- through of the meniscal bearing after 29 years.

Post-operative Course

The patient recovered uneventfully with skin staple removal and cast change to a well-padded short leg fiberglass cast after 10 days. Total cast immobilization with weight bearing to tolerance lasted six weeks, followed by application of an air-stirrup for an additional six weeks to protect the malleoli and ligaments from sudden twisting injuries. High-top hiking shoes or work boots were then worn for an additional three months, followed by comfortable foot wear to tolerance. Ankle swelling was minimal by six months post-op and the patient regained a painless range of motion of 5° dorsiflexion and 25° plantarflexion with excellent medial-lateral stability and unlimited (greater than six blocks) walking ability.

Over the next 25 years, he remained pain-free, and played golf on a regular basis. Serial X-rays demonstrated overgrowth osteophytes anteriorly and posteriorly over time. Aside from limiting his range of motion to 0 to 250 plantarflexion, he remained active and without pain (Figure 2).

Authors' Insights

Shallow-sulcus cementless mobile-bearing ankle replacements, using short tibial stems and only talar components can function well for nearly 30 years, but conventional polyethylene sterilized by gamma-in-air radiation can wear out despite near-perfect congruity. Incomplete bony coverage of the resected distal tibia can allow overgrowth osteophytes (as seen in this case) that can reduce range of motion in the long term.

Note the progression of anterior and posterior osteophytes with time, and the nearly-complete wear- through of the meniscal bearing after 29 years

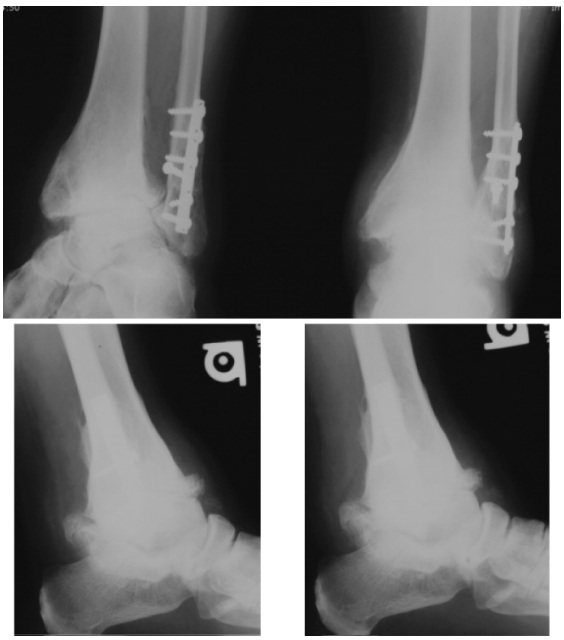

Figure 3: AP, mortise and flexion-extension X-rays of an osteoarthritic right ankle in a 61 year old woman with intractable pain and limited range of motion.

Sliding-Cylindrical Total Ankle, Mark II (Anatomic Deep-Sulcus Design for use with Intact Malleoli and Functioning or Reconstructable Collateral Ligaments)

Case Report: 2

History

A 52 year old, 197 pound (89 kg), 5 foot 3 inch (160 cm) tall, white female developed intractable weight bearing pain and significant stiffness in her left ankle (<5° dorsiflexion and <5° plantarflexion) after open reduction and internal fixation of a fracture 16 years earlier and bone grafting of a non-union one year later through medial and lateral incisions augmented by cast immobilization. Her hindfoot alignment was neutral and she had good collateral ligament stability. Pre-operative X-rays revealed advanced post-traumatic arthritis of the right tibio-talar joint with complete joint space loss, diastasis of the distal tibio-fibular syndesmosis and retained hardware (Figure 3).

Procedure

This patient underwent a right cementless B-P Mark II deep-sulcus total ankle replacement (Endotec Buechel-Pappas total ankle replacement, Orlando, Florida) on September 30, 1991. Intraoperatively, after using an anterior ankle approach between the anterior tibialis and extensor hallucis longus tendons, an anterior cortical window was removed from the distal tibia to allow central placement of the stem of the flat-surfaced tibial component. The talus was contoured with a power burr and two fixation channels were made to accept the talar component fixation fins. Large tibial and talar components were used. A 5 mm large polyethylene (sterilized by ethylene oxide) meniscal bearing, matching the upper tibial flat surface and the lower talar deep-sulcus, was pressed into place to provide ligament tension and normal unrestricted motion. An additional lateral incision was made to remove the plate and screws. A routine wound closure was performed, followed by application of a very well-padded short leg plaster cast with the foot and ankle in neutral position.

Post-operative Course

The patient developed poor anterior wound healing despite short leg cast immobilization for six weeks and local wound care. A 2.5 cm diameter mid-incision, full-thickness wound required a vascular free-flap from the volar aspect of the left forearm 8 months after her primary total ankle surgery to completely heal her anterior ankle incision. By one-and-a-half years post-op she was independently ambulatory for limited distances, with improved range of motion (5° dorsiflexion and 30° plantarflexion).

Her vascular pedicle graft was well-healed and stable, but she developed mild peroneal tendinitis that responded to local whirlpool therapy and anti-inflammatory medication over a three month period. By 4 years post-op she maintained a painless range of motion (10° dorsiflexion and 30° plantarflexion), and continued unlimited walking and activities of daily living, which remained stable for 22 years (Figure 4).

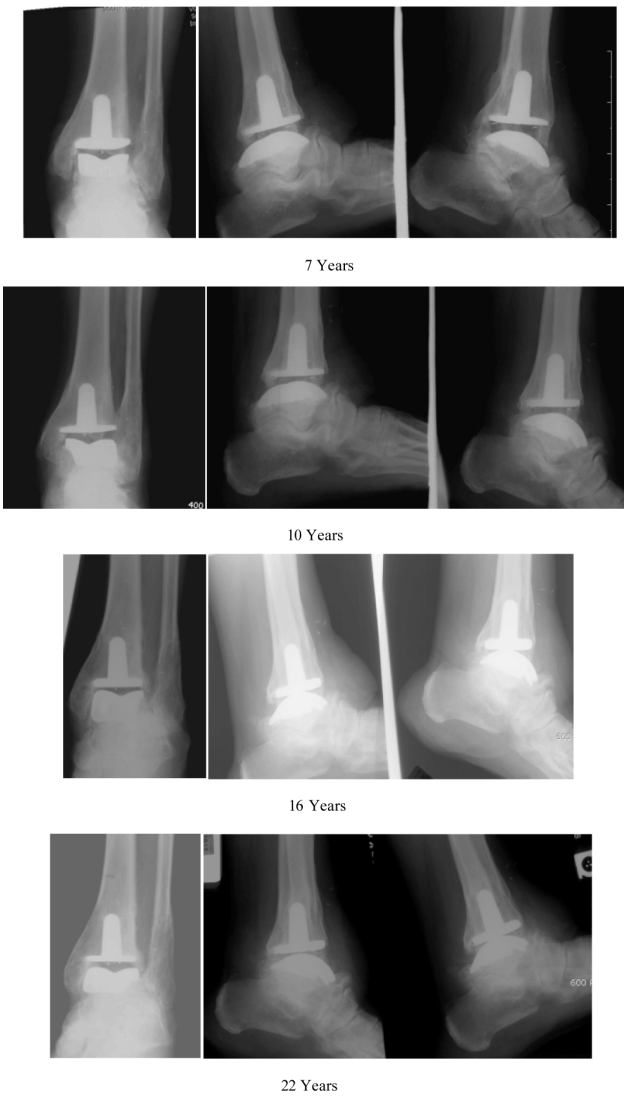

Figure 4: Sequential AP and lateral X-rays of the left ankle in the patient from Figure 3 with a cementless B-P deep-sulcus ankle replacement after 7, 10, 16 and 22 years, respectively.

Authors' Insights

Deep-sulcus, onlay talar components remain stable in the long term in the absence of AVN or significant osteolysis. Anterior tibial windows heal and remodel, allowing precise placement of stemmed tibial components, which rarely loosen. Full implant coverage of the distal tibia helps to inhibit osteophyte overgrowth which can limit range of motion, see lateral X-rays. Anterior ankle incisions are very sensitive to prolonged retraction, and are especially sensitive to healing when previous medial and lateral incisions are present. Vascular free-flap grafts can be limb saving (as in this case) and are extremely durable.

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