Total Ankle Replacement

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Background: When the Tibiotalar joint begins to wear away, ankle inflammation, pain, and joint swelling occur. To get rid of the inflammation and pain, which are usually caused by Arthritis/Osteoarthritis, an ankle replacement needs to be done. There are other options available but an ankle replacement is the best option for patients with severe Arthritis. Patients who have suffered from deformed/unstable ankles, bone infections, diabetes, obesity, severe osteoporosis, and other comorbidities, do not typically qualify for an ankle replacement. When the Tibiotalar joint is replaced it reaps many benefits, such as: regained ankle strength and stability, preserved range of motion, normal gait with less pain, and allows patients to return to a more active lifestyle. An ankle replacement is better than Arthrodesis (Ankle Fusion) because Arthrodesis limits the range of motion and can cause Arthritis to develop elsewhere.

Current Status: An ankle replacement is made up of three components. First, a titanium metal component that's attached to the Tibia, which replaces the socket of the ankle. Then a cobalt-chrome piece which is connected to the Talus, which replaces the top of the Talus. Finally, a polyethylene implant that is placed between the Tibia and Talus, which provides the bearing surface. Patients with a nickel allergy can receive an all titanium implant instead. The metal components are fixed into the bone with stems or pegs and have a special coating to persuade the bone to grow into them.

Challenges: Ankle replacement surgeries have risks such as: infection, damage to nearby nerves, bleeding, blood clot, the bones not joining together properly, misalignment of the bones, new Arthritis in neighboring joints, loosening of the artificial components due to osteolysis, and wearing out of the components. Infection is the leading cause of revision surgery, which often requires multiple surgeries to fix. Joint infections are difficult to treat because the bacteria adhere to the biomaterial and cannot be eliminated without removing the implant. The bacteria also have a high antibiotic resistance, which eventually leads to the formation of biofilm. Osteolysis is a condition where the bone is steadily destroyed, causing the bone to weaken over time and eventually causes the implant to loosen. Periprosthetic Osteolysis affects patients who've recently had a joint replacement, which can potentially lead to a follow-up surgery.

Proposed Solutions: The first proposed solution for infection is to use the metallic implant as an electrode to provide voltage controlled electrical stimulations. This helps to destroy infections without removing the implant, helps to prevent infections, and has the ability to enhance bone ingrowth of the implant, also known as osseointegration. Another proposed solution is to use

ultrasound therapy to kill the biofilm on the implant. This enhances the activity of the antibiotics, is minimally invasive, and the implant infected with biofilm can be directly targeted. The final proposed solution for infection is to use an implant that's coated in antibiotics. This prevents the formation of a biofilm and specifically targets the infected implant. Some proposed solutions for osteolysis are: have the patient take antiresorptive drugs to prevent osteolysis, coat the implant with antiresorptive drugs to directly prevent osteolysis, and coat the implant with hydroxyapatite, which can help regenerate bone and reduce implant rejection or failure. Overall it would be beneficial to use an implant that's coated in antibiotic and antiresorptive drugs, along with using ultrasound or the implant as an electrode. This prevents infection and loosening of the bones, specifically targets the implant site, and can potentially enhance the antibiotic drugs.

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