Advanced Salvage Strategies for Failed Total Ankle Replacement: Emphasizing Anterior Ankle Muscle Flap Reconstruction and PEKK Implant Integration

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STATEMENT OF PURPOSE

This case study showcases the use of a custom polyetherketoneketone (PEKK) implant for ankle fusion in a patient with severe arthritis following failed total ankle replacement (TAR) complicated by infection requiring the use of a muscle flap.

INTRODUCTION

Total ankle replacement has become an increasingly viable surgical option for managing severe ankle arthritis and other related pathologies, particularly in older adults who seek to maintain function and quality of life. However, complications such as failed TARs with infection may necessitate more invasive procedures, including fusion which often requires femoral head allografts. These allografts, while effective, come with a higher risk of complications, including immune rejection, donor site morbidity, and lengthy recovery times. The emergence of metallic cages as a replacement to femoral head in ankle fusion can provide added stability, but they are not without their own challenges, such as stress shielding, potential failure under excessive load, and limitations in screw placement due to the inability to secure screws through the cage, which can hinder proper stabilization and healing.

In recent years, advancements in implant technology have introduced custom polyetheretherketone (PEKK) implants as a promising alternative for improving outcomes in ankle fusion surgeries. Unlike bone grafts, which carry risks, PEKK implants are biocompatible, reducing the risk of adverse reactions. Moreover, they can be filled with autologous bone, eliminating the need for additional surgical sites and promoting better integration with the surrounding tissue.

PEKK's biomechanical properties further enhance its suitability for ankle fusion. The material has high tensile strength and an elastic modulus that closely matches that of bone, allowing for better load distribution and reduced risk of implant failure. Its durability and flexibility provide additional benefits, making it an excellent choice for patients with compromised bone quality. Furthermore, PEKK's compatibility with CT and MRI imaging techniques allows for improved post-operative monitoring and assessment. The ability to leverage 3D printing technology to customize PEKK implants also ensures a more precise fit and better functional outcomes, tailored to each patient's unique anatomy. These advancements collectively make PEKK implants a promising alternative to traditional materials in ankle fusion procedures.

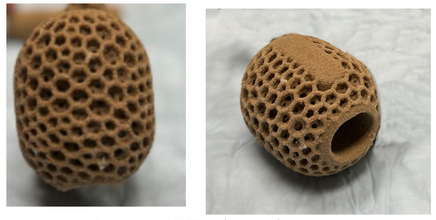

Figure 1: . PEKK implant used in case

CASE STUDY

An 83-year-old patient presented with severe ankle arthritis and underwent a total ankle replacement (TAR) in 2009. In 2015, a revision TAR was performed due to subsidence of the initial implant. Several years later, the patient experienced another revision TAR due to recurrent subsidence.

Figure 2: . TAR revision done in 2015

Figure 3: . TAR revision done in 2023 with subsequent infection and I&D

TAR revision was done 8 years later. One month after TAR revision, an irrigation and debridement (I&D) with explantation of the TAR along with Talectomy was required because of a severe infection. Subsequent interventions included an I&D and the insertion of an antibiotic spacer.

Following infection control, an angiogram with vascular surgery accompanied by a lateral thigh myocutaneous flap procedure that involved end-to-end anastomosis to the anterior tibial artery was performed by the plastic surgery team.

Figure 4: . Muscle flap placement with healing noted 3 months later

Five days after the flap procedure, the antibiotic spacer was exchanged.

Ultimately, the patient had a revision pantalar fusion, which included the removal of the antibiotic spacer and the implantation of a custom polyetherketoneketone (PEKK) implant with an intramedullary nail. Notably, at one year post-fusion, successful healing was achieved and patient was ambulating at his preoperative level.

CONCLUSION

This case illustrates the complexities of managing severe ankle arthritis in an elderly patient through multiple surgical interventions. Although an ankle fusion was considered at initial presentation, the patient refused citing his active lifestyle. Therefore, a TAR was performed to address severe arthritis, but complications necessitated revision surgery several years later highlighting the challenges in maintaining implant integrity. Infection management became crucial, as a severe infection following the revision TAR required several interventions, including multiple I&D's, an antibiotic spacer with exchange and a lateral thigh myocutaneous flap.

The final outcome, featuring the successful implantation of a custom PEKK implant with an intramedullary nail, underscores the advantages of PEKK over traditional allograft femoral head options. PEKK offers superior biocompatibility, mechanical strength, and a reduced risk of complications, such as graft rejection or failure, which are common with allografts. Achieving fusion at one year highlights the potential of PEKK technology in improving outcomes for complex cases and positions it as a promising alternative to allograft procedures in ankle fusions.

The patient's journey emphasizes the inherent risks of joint surgeries, particularly in older adults, and the importance of a multidisciplinary approach to managing complications when they arise, especially infections. Additionally, the use of PEKK mitigates challenges typically seen with metallic cages, such as stress shielding and difficulties in securing screws effectively. This enhancement in stability and fusion success is key in promoting optimal healing. However, the high cost of PEKK implants remains a significant limitation, making careful patient selection crucial for success. Despite this, the material's lightweight nature, resistance to fatigue, and favorable mechanical properties offer significant improvements in patient outcomes.

The successful fusion achieved at one year post-surgery reflects the importance of personalized treatment strategies and ongoing research to refine surgical techniques and implant materials. The use of PEKK implants represents an important advancement in ankle fusion procedures, providing a safer and more effective alternative for patients with complex ankle conditions. Further studies are necessary to assess the long-term safety and effectiveness of PEKK implants in orthopedic applications and to better understand their role in improving outcomes for complex ankle pathologies in older patients.

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