Total Knee Arthroplasty with Significant Osteolysis following Gore-Tex Anterior Cruciate Ligament Reconstruction: Recommendations on Reducing Risk of Arthroplasty Failure

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Keywords
Knee · Arthroplasty · Replacement · Knee · Arthroplasty · Polytetrafluoroethylene (Gore-Tex) · Osteolysis

Abstract
Synthetic substitutes for ligament reconstruction surgery have been widely used in orthopaedic surgery; however, many have been susceptible to mechanical failure and associated with osteolysis. A 58-year-old male underwent total knee arthroplasty (TKA) for valgus knee osteoarthritis on the background of a Gore-Tex anterior cruciate ligament reconstruction over 30 years prior. Radiographic imaging preoperatively demonstrated extensive osteolysis, particularly on the tibial side. At the time of arthroplasty, the extent of osteolysis was noted to be greater than that on the preoperative imaging. The patient underwent a robotic-assisted TKA with the use of a cemented stemmed tibial prosthesis and bone grafting. The patient was prescribed a period of protected weightbearing following the procedure. Our recommendations for undertaking arthroplasty with a Gore-Tex graft in situ are as follows: (1) thorough preoperative workup including computed tomography imaging to identify tunnel widening and osteolysis; (2) ensure that additional bone allograft is available for the procedure; (3) use of cemented implants where there has been significant osteolysis; (4) removal of the entire synthetic graft with copious irrigation post-removal to ensure the joint does not remain exposed to particulate debris; (5) grafting of the tunnels and bone defects post-removal of synthetic graft; (6) use of a stemmed prosthesis to bypass any cortical defects and reduce the risk of subsidence of the component.
Background

Synthetic substitutes for ligament reconstruction surgery have been widely used in orthopaedic surgery. During the 1980s and early 1990s, Gore-Tex became the synthetic graft of choice for anterior cruciate ligament (ACL) reconstruction [1]. Despite good early results [2, 3], it quickly became evident that Gore-Tex grafts were susceptible to mechanical failure and associated with osteolysis [4, 5]. We present the case of a total knee arthroplasty (TKA) in a patient with significant osteolysis secondary to a Gore-Tex graft.

Case Presentation

A 58-year-old male was referred to the orthopaedic outpatient clinic with valgus knee osteoarthritis. The patient had previously undergone an ACL reconstruction over 30 years prior with a Gore-Tex graft. Prior to development of osteoarthritis, the patient’s knee had been asymptomatic and he had no issues with instability. Examination of the knee revealed a valgus alignment with a stable knee and a range of motion of 5–130°. The patient had no medical comorbidities. Radiographic examination revealed tricompartmental osteoarthritis of the knee with valgus alignment and severe osteoarthritic change in the lateral compartment (Fig. 1). Preoperative inflammatory markers (C-reactive protein and erythrocyte sedimentation rate) were not elevated. TKA was recommended. Preoperative computed tomography scanning was undertaken as part of routine surgical planning and to facilitate use of a robotic-assisted technique which revealed significant tunnel widening and osteolysis of the tibia (Fig. 2).

Arthroplasty was performed with the aid of a robotic arm using a hybrid cruciate-stabilized prosthesis (Triathlon; Stryker, Kalamazoo, MI, USA). A medial parapatellar approach was used. The Gore-Tex graft was identified intact and the intra-articular portion removed to

Fig. 1. Preoperative radiograph.
facilitate exposure. The intraosseous portions were left in situ whilst femoral and tibial cuts were made. Following bony cuts, the Gore-Tex graft was removed in its entirety. In order to remove the graft, individual strains were removed until the remainder of the graft was sufficiently loose to facilitate complete removal. No bony ingrowth of the graft was noted. There was significant osteolysis surrounding the graft, most notably in the tibial tunnel where osteolysis exceeded that noted on the preoperative imaging (Fig. 3), with erosion of the anterior cortex of the tibia requiring bone grafting.

Given the significant tibial osteolysis, the operative plan was changed and a 50-mm stemmed cemented tibial prosthesis was used to bypass the region of cortical erosion. An uncemented femoral component was used as planned preoperatively and the patella was not resurfaced (Fig. 4).

Post-operative protocol consisted of a 6-week period of protected weightbearing with the remainder of the patient rehabilitation unchanged from the routine protocol at our institution.
Free range of motion was permitted and the patient undertook routine post-operative physiotherapy.

**Discussion and Conclusions**

Synthetic substitutes for ligament reconstruction continue to have a role in orthopaedic surgery; however, previous graft substitutes have not been entirely successful. During the 1980s and early 1990s, Gore-Tex was the synthetic graft of choice [1]; however, these grafts were susceptible to mechanical failure and associated with synovial reaction [3, 6, 7]. The primary mechanism for failure was attributed to mechanical fatigue secondary to a lack of graft ingrowth and presence of wear debris contributing to osteolysis leading to withdrawal of the graft from the market in 1993 [1]. Notably, tibial osteolysis and tunnel osteolysis along with the development of arthritis were noted in the majority of patients managed with Gore-Tex grafts [4, 5].

In a series of 123 patients, Fukubayashi et al. [8] demonstrated a high rate of graft loosening and failure using Gore-Tex grafts for ACL reconstruction. They found tibial osteolysis in the majority of patients who had received a Gore-Tex graft and the development of osteoarthritic change in 62% of patients. Muren et al. [5] also reported on tunnel osteolysis in 17 patients following Gore-Tex ACL reconstruction with tunnel diameters reaching 26 mm from an initial tunnel of 7.9 mm and 15 of the patients demonstrating widening of tunnels.

Furthermore, previous studies have demonstrated that the Gore-Tex graft is not an inert material within the synovial cavity and amongst other complications results in synovitis and recurrent sterile effusions [1, 5, 9, 10]. The only previous case report on TKA in a patient with a Gore-Tex ACL graft in situ demonstrated early aseptic loosening within 2 years of the index TKA [11]. The authors described a case of gross osteolysis with histological examination revealing particulate debris following TKA with retention of the intraosseous component.
of the Gore-Tex graft. The inflammatory reaction and associated osteolysis that occurs with particulate debris is primarily due to a macrophage response and in the setting of removal of the intra-articular portion of the Gore-Tex graft only, with retention of the intraosseous portion, the authors hypothesized that this generated particulate debris causing the significant early osteolysis. The authors thus recommended complete removal of the Gore-Tex graft to avoid potential osteolysis secondary to the graft.

These findings suggest that there will be a cohort of patients with Gore-Tex ACL grafts likely to require TKA secondary to the development of osteoarthritis with a high proportion of patients demonstrating significant tunnel widening and osteolysis and a risk of early aseptic loosening of the TKA. In this case, we recognized significant tibial osteolysis and tunnel widening preoperatively secondary to the Gore-Tex graft and recognized the need for removal of the synthetic graft and bone grafting of the in situ defect. With this technique, we were able to preserve bone stock and achieve a stable mantle for implantation of the TKA components. Thus, our recommendations for undertaking arthroplasty with a Gore-Tex graft in situ are as follows: (1) thorough preoperative workup including computed tomography imaging to identify tunnel widening and osteolysis; (2) ensure that additional bone allograft is available for the procedure; (3) use of cemented implants where there has been significant osteolysis; (4) removal of the entire synthetic graft with copious irrigation post-removal to ensure the joint does not remain exposed to particulate debris; (5) grafting of the tunnels and bone defects post-removal of synthetic graft; (6) use of a stemmed prosthesis to bypass any cortical defects and reduce the risk of subsidence of the component.

**Statement of Ethics**

Ethical approval was not required for this case report in accordance with Austin Health Ethics Committee guidelines. Written informed consent was obtained from the patient for publication of this case report and any accompanying images.

**Conflict of Interest Statement**

The authors have no conflicts of interest to declare.

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**Author Contributions**

Filip Cosic and Matthew Alexander were involved in the case and contributed to writing of the manuscript.

**Data Availability Statement**

All data generated or analysed during this study are included in this article. Further enquiries can be directed to the corresponding author.
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