Revision Knee Arthroplasty Including Reconstruction of the Lateral Collateral Ligament by Allograft: A Case Report

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Abstract A 53-year-old woman presented with an unstable and painful total knee arthroplasty 6 months after the index procedure. Disruption of both collateral ligaments as a young adult and the subsequent development of traumatic arthritis required repeated surgical and extensive conservative treatment before a prosthesis was implanted. Examination disclosed marked instability of the lateral collateral ligament (LCL) and loosening of the tibial and the femoral components. Review of the MRI obtained prior to the total knee replacement revealed discontinuity of the LCL with intense scarring of the posterolateral ligament complex. Definitive management of this twofold problem was not helped by literature review, which failed to reveal a gold standard or a broad consensus as a rationale for treatment. Consequently, an individual approach to the problem was defined: A one-stage revision arthroplasty was performed using a modular non-articulated constrained prosthesis and a bone–tendon–bone allograft to reconstruct the LCL in a one-stage operation. Postoperative rehabilitation included continuous passive motion, which was begun immediately after surgery and was gradually increased to 90° of flexion. The LCL reconstruction was initially protected in a hinged

knee brace and weight-bearing was initially limited to toe-touch and gradually increased over 6 weeks. Pain-free motion to 0–115° flexion was achieved at 3 months after surgery and the patient had returned to her normal activities. The 4-year-follow-up displayed a stable and functional knee with no evidence of loosening or wear.

Keywords revision TKA · LCL graft

Introduction

The combination of loose TKA components combined with complete disruption of the lateral collateral ligamentous structures in a young and active patient presents a rare challenge for revision surgery. The orthopedic literature contains reports favoring either soft-tissue reconstruction [1–3] or revision arthroplasty [4, 5], but no consensus exists as to the best approach for reconstruction. Simultaneous reconstruction of a medial collateral ligament during primary TKA has been described [6–10], but there is no reference regarding the lateral complex and revision TKA. In this case report, simultaneous revision total knee replacement (TKR) using constrained modular components combined with allograft reconstruction of the posterolateral structures led to a successful resolution for this unusual problem.

Case report

A 53-year-old female patient presented initially with an unstable and painful knee. Her knee history began at age 23, when she had a sports-related injury that required her to undergo a reconstruction of both the medial collateral ligament and lateral collateral complex. She had few symptoms until she reached her early 40s, at which point she began developing a sense of instability and pain in the knee. She underwent two arthroscopic procedures with partial meniscal debridements performed each time. Unfortunately, she continued to complain of pain and instability that was not relieved with bracing, physical therapy, or non-steroidal anti-inflammatory drugs (NSAIDs).

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Each author certifies that his or her institution has approved the reporting of this case and that all investigations were conducted in conformity with ethical principles of research.

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Approximately 6 months prior to her presentation, she was evaluated at another institution and underwent a TKR. The total knee arthroplasty was performed using a NexGen LPS system (Zimmer, Warsaw, IN, USA). That operative note described excellent stability and excellent range of motion after balancing the extension and flexion gaps. The patient, however, stated that, as she recuperated, she again noted similar instability and a recurrence of pain.

We evaluated her 6 months after her index knee replacement. On clinical examination, the knee was equally painful with weight bearing and passive motion. The range of motion was from 0° to 115° of flexion. There was anterior–posterior laxity of 5–10 mm, a negative pivot shift, and a slight opening of the medial joint space with valgus stress. With varus stress, however, there was a marked lateral instability of more than 15° and a gapping of approximately 1 to 1 1/2 cm when the knee was examined under the image intensifier (Fig. 1). The conventional radiographs showed an excellent alignment of the implants, but also revealed a radiolucent line measuring 1–2 mm extending from zones I to IV under the tibial component. There was a radiolucent line of about 1 mm in the posterior lateral femoral condyle as well. There were no immediate postoperative radiographs to compare with.

The patient was evaluated to rule out infection. The knee was aspirated preoperatively. There was no bacterial growth in the aspirate. Likewise, the C-reactive protein and erythrocyte sedimentation rate were normal.

Magnetic resonance imaging prior to the index TKR had shown that the lateral stabilizing structures of the knee had remodeled into a dense scar with no visible insertion of the fibular collateral ligament. The medial collateral ligament and the extensor mechanism were both intact (Fig. 2).

Fig. 1. In the image intensifier views, a lateral gapping of the components is displayed with varus stress, suggesting gross lateral instability

Fig. 2. The MRI prior to the index total knee arthroplasty shows severe signs of osteoarthritis and the lateral stabilizing structures of the knee are remodeled into a dense scar with no visible insertion of the fibular collateral ligament

At surgery, the lateral joint space opened up widely on varus stress in flexion and extension. The tibial and femoral components were both grossly loosened. The patient requested that a hinged prosthesis not be used so the combined problem of lateral instability and implant loosening was addressed by one-stage revision arthroplasty using a non-linked prosthesis with both varus–valgus and posterior constraint and a patellar bone–tendon–bone allograft to reconstruct the lateral collateral ligament (LCL) (Fig. 3). After removal of the loose femoral and tibial components, trial posterior-stabilized implants of the Genesis II system (Smith & Nephew, Memphis, TN, USA) were inserted. It was ascertained that the flexion and extension spaces were filled properly to give medial stability by

Fig. 3. For replacement of the LCL, a patellar bone–tendon–bone allograft has been placed and fixed in the tibial canal (*down-right*) and is about to be inserted into the slot created in the lateral femoral epicondyle. Deep in the ligament, the GCK TKR prosthesis is visible

balancing them against the competent medial collateral ligamentous structures. However, due to the gross instability laterally, a constrained condylar type of prosthesis was necessary as to avoid failure of a biologic reconstruction. No stem was used on the femur in order to leave room for the proximal plug of the allograft. The permanent implants were cemented in place and a GCK constrained condylar polyethylene insert was placed in the modular base plate.

For adequate exposure, a large lateral flap was produced rather than a second incision. Wires in the femur and the tibia were used to determine the attachment points of the graft. After drilling a tunnel in the respective bone, the bony parts of the graft serving as dowels were passed and fixed with an absorbable interference screw on the femoral side. On the tibial side, the lead sutures were tied over a button. The graft in place was stable in both flexion and extension.

The knee was protected postoperatively in a hinged brace. Continuous passive motion was started immediately after surgery and gradually increased to 0–90° of flexion. The patient was discharged on the sixth post-operative day with instructions for toe touch weight bearing in the brace. Five weeks after surgery, the X-rays revealed excellent position of the implants. The patient had no complaints and was able to easily flex the knee to 80°. Physical therapy stressed gentle range of motion and strengthening exercises with no forced flexion. She gradually resumed full weight bearing with a cane over the next few weeks. Three months after surgery, the brace was removed and active pain-free motion of 0–115° was achieved with complete stability. At 4 months, the patient had returned to full activity without the brace or cane. At 2 years, the knee was fully stable and the patient was pain-free.

Discussion

Symptomatic loosening of an implant by itself generally requires revision surgery. Disruption of a collateral ligament of the knee generally calls for reconstruction. Both problems existed in this patient. Whereas bracing may be adequate to compensate for a lack of stability, it cannot address pain from a loose component. Exchanging the implants alone with a persisting collateral instability in a young and high-demand patient risks early failure [7]. Indeed, this is what happened after this case after the index arthroplasty.

Using a thicker tibial insert alone cannot stabilize the asymmetric instability present in this case. Likewise, performing a medial release so as to increase the medial potential space to equal that laterally is obviously contraindicated in the setting of a completely absent lateral ligament. We did not feel that using a hinged device would adequately meet the demands of a young, high-demand patient fearing a significant risk of early mechanical failure.

In this particular case, where revision of the components and reconstruction of the altered soft-tissues was required, a decision had to be made whether both issues should be addressed at one time or consecutively. Unfortunately, there is limited evidence to support the best practice. Only a few papers quote reconstruction of the MCL during primary total knee arthroplasty [8–10]. No references, however, reflect on revision arthroplasty and LCL reconstruction.

One option would be to do a two-staged procedure. This could first involve the reconstruction of the ligament and, after appropriate recuperation, the revision arthroplasty. The downside of this approach would be possible disruption of the repair at the time of the revision arthroplasty. The other method of a two-stage revision would be to perform the revision arthroplasty first, followed by bracing of the patient and a subsequent lateral ligamentous reconstruction. The downside of this approach would be the requirement for continuous bracing and how the lack of lateral stabilizing soft tissues (despite the use of a more constrained polyethylene insert) would adversely affect the kinematics in the knee and the patient's recuperation.

A one-stage procedure would, in theory, overcome both of these problems. Performing the revision first allowed us to balance the flexion and extension gaps. Using a constrained insert gave us the immediate varus stability we required to allow a proper reconstruction, tensioning, and especially undisturbed healing of the lateral graft. Restoration of more normal anatomy enabled by the ligament reconstruction allowed use of a smaller insert with better joint line restitution, which has advantages for better tracking of the patella compared to a very thick tibial component. The selection of greater constraint with the GCK implant permitted the patient to start CPM and physical therapy early without fear of overstretching the allograft.

In this case, range of motion and stability were satisfactory shortly after the operation and complete after 3 months. Once completely healed, the ligament is expected to serve as the main lateral stabilizer. The internal stability of the constrained polyethylene insert may then not be required. Although there is evidence to support a theoretical advantage to change the constrained insert to a posterior stabilized one, it remains questionable if it should be recommended in this now asymptomatic patient.

References

1. Safran MR (1995) Graft selection in knee surgery. Current concepts. *Am. J. Knee Surg.* 8 no. 4, 168–180
2. Buzzi R, Aglietti P, Vena LM, Giron F (2004) Lateral collateral ligament reconstruction using a semitendinosus graft. *Knee Surg. Sports Traumatol. Arthrosc* 12 no. 1, 36–42
3. Pritsch M, Fitzgerald RH, Jr, Bryan RS (1984) Surgical treatment of ligamentous instability after total knee arthroscopy. *Arch. Orthop. Trauma. Surg* 102 no. 3, 154–158
4. Barrack RL (2001) Evolution of the rotating hinge for complex total knee arthroplasty. *Clin. Orthop* 392:292–299
5. Naudie DD, Rorabeck CH (2004) Managing instability in total knee arthroplasty with constrained and linked implants. *Instr. Course. Lect* 53:207–215

6. Vince KG (2003) Why knees fail. *J. Arthroplasty* 18 no. 3 Suppl 1, 39–44
7. Kluster MS, Bitschnau B, Votruba T (2004) Influence of collateral ligament laxity on patient satisfaction after total knee arthroplasty: a comparative study. *Arch. Orthop. Trauma. Surg* 124 no. 6, 415–417
8. Healy WL, Iorio R, Lemos DW (1998) Medial reconstruction during total knee arthroplasty for severe valgus deformity. *Clin. Orthop* 356:161–169
9. Leopold SS, McStay C, Klafeta K, Jacobs JJ, Berger RA, Rosenberg AG (2001) Primary repair of intraoperative disruption of the medial collateral ligament during total knee arthroplasty. *J. Bone Joint Surg. Am* 83-A no. 1, 86–91
10. Peters CL, Dienst M, Erickson J (2004) Reconstruction of the medial femoral condyle and medial collateral ligament in total knee arthroplasty using tendoachilles allograft with a calcaneal bone block. *J. Arthroplasty* 19 no. 7, 935–940