Total Knee Arthroplasty in Patients with a Previous Patellectomy

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Abstract
Post-patellectomy patients represent a specific subgroup of patients that may develop arthritis and persistent knee pain and potentially require treatment with total knee arthroplasty. This article reviews the treatment and functional outcomes following total knee arthroplasty in patients with prior patellectomy. A case report is presented as an example of the clinical management of a post-patellectomy patient with significant knee pain and disability treated with total knee arthroplasty. Emphasis will be placed in decision-making, specifically with the use of a posterior stabilized implant. In addition, postoperative strengthening of the quadriceps is essential to compensate for the lack of the patella and increase the success of total knee arthroplasty in this subgroup of patients.

The patella is largest sesamoid bone in the body and plays an important role in the function of the extensor mechanism of the knee. It primarily functions as a fulcrum to increase the angle of the quadriceps pull and thus adds 30% to 50% strength to knee extension. In addition, the patella provides protection to the anterior surface of the distal femur from injuries that can occur as a result of a direct blow. Because of its integral role in normal function, the patella is generally preserved whenever possible. Although patellectomy has been used more frequently in the past, it is now used primarily for patients with comminuted fractures that cannot be reconstructed, osteomyelitis, and neoplastic conditions. Patellectomy has been shown to result in a 15% to 30% decrease in quadriceps force during active knee extension. At the time of patellectomy, a transverse incision and repair of the extension mechanism has been recommended because it is shown to result in a 15% decrease in quadriceps strength compared to a longitudinal incision which resulted in a 40% decrease. Patellectomy has been reported to result in knee instability, decreased flexion in the stance phase of gait, and difficulty ascending and descending stairs. Altered forces and increased quadriceps tendon excursion within the trochlear groove may also predispose the development of degenerative arthritis in the knee resulting in pain and disability. As a result of compromised extensor mechanism function following patellectomy, postoperative clinical management has focused on increasing quadriceps strength.

Following patellectomy, the altered magnitude and direction of forces can result in increased stress to the knee and lead to degenerative changes. When the symptoms and degenerative changes become disabling total knee arthroplasty is considered. Historically, prior patellectomy has not been considered a contraindication to total knee arthroplasty although functional outcomes in these patients may vary. Results of total knee arthroplasty in post-patellectomy patients are generally inferior to total knee arthroplasty in patients with an intact patella because of residual anterior knee pain and instability. However, the overall functional improvement compared with the preoperative status has been significant and justifies the use of total knee arthroplasty as a treatment for degenerative arthritis in patients with prior patellectomy.

The functional outcomes of total knee arthroplasty in post-patellectomy patients may vary depending upon different factors, including the type of implant used, the preoperative diagnosis, and the time between the patellectomy and arthroplasty. Sledge described the knee as a four-bar linkage system in which the patella tendon is parallel to the
posterior cruciate ligament and the quadriceps tendon is parallel to the anterior cruciate ligament. When the patella is removed, this system is disrupted, and the cruciates become increasingly important to maintain stability. Therefore, it has been suggested that preservation of the cruciate ligaments is important to preserve this linkage system. More recently, the value of retaining the posterior cruciate ligament has been questioned, in part, because in patellectomy patients, the patella ligament does not restrain the femur from anterior translation in the same manner as it does in patients with an intact patella. This limited reinforcement results in increased stress on the compensating posterior cruciate ligament, thereby resulting in less predictable results when posterior cruciate ligament retaining implants are used. This has resulted in concerns that the use of a posterior cruciate ligament retaining implant in patients with previous patellectomy carries a higher risk of implant failure. As a result, posterior stabilized implants have been used and have resulted in improved success rates and less instability in post-patellectomy patients compared with posterior cruciate ligament retaining designs.

**Case Report**

An 81-year-old female presented for evaluation of left knee pain of 4 years duration that had not responded to nonoperative management, including use of anti-inflammatory medication, physical therapy, or intra-articular steroid injections. The patient reported that walking stairs was particularly difficult. She also described pain at night that interfered with sleep. The patient underwent a left patellectomy for patella instability 47 years prior, from which she recovered reasonably well. She did well up until the onset of left knee symptoms 4 years ago. On examination, she was found to walk with an antalgic gait referral for the left lower extremity. Examination of the knee showed neutral alignment. There was a small effusion present and range of motion was 0° to 130° of flexion with discomfort at the extremes of flexion. There was a well-healed transverse incision. The patient had full active knee extension without an extension lag. Absence of the left patella was noted on palpation. Radiographs revealed advanced degenerative arthritis of the left knee with significant involvement of the medial compartment and less significant lateral compartment changes. The absence of the patella was noted (Fig. 1). Based upon the significant left knee pain and disability, a total knee arthroplasty was recommended and the patient decided to proceed.

A total knee replacement was performed using a midline incision oriented perpendicular to the previous transverse incision. A posterior stabilized implant (Genesis, Smith & Nephew, Memphis, Tenn.) was used. Postoperative management focused on physical therapy for range of motion, quadriceps strengthening, and ambulation. The patient was discharged 4 days following the procedure. Six weeks following the procedure the patient was ambulating without the

![Figure 1](image_url) Anteroposterior (A) and lateral (B) radiographs demonstrating advanced degenerative arthritis of the left knee with significant medial compartment involvement and absence of the patella.
use of assisted devices and was able to walk up and down stairs in a reciprocal manner. She was increasing her daily activities, although she did report some minor residual discomfort about the knee. Range of motion at that time was 0° to 125° of flexion without evidence of an extension lag. At 1-year follow-up the patient had regained range of motion of 0° to 130°. She was able to walk up and down stairs but had not yet regained a fully reciprocal pattern. Two years following surgery, the patient was doing well with minimal discomfort about the left knee. She was able to ambulate without difficulty including walking up and down stairs in a reciprocal manner.

**Discussion**

Patellectomy patients represent a specific subset of patients that may develop degenerative arthritis with the associated pain and functional compromise. These patients have compromise of the knee extensor mechanism and require a focused exercise program to maintain knee extensor strength. The functional outcome of total knee arthroplasty in post-patellectomy patients is more variable than in patients without patellectomy, and therefore perioperative clinical management is particularly important.

There is evidence in the literature that the results of total knee arthroplasty in post-patellectomy patients are inferior to those with an intact patella. Joshi and coworkers\(^\text{11}\) evaluated pain relief and knee stability in 19 patellectomy patients following total knee arthroplasty. Twenty-one percent reported incomplete pain relief, and 16% had some degree of instability. They reported a “poor outcome” in 26% of the knees with previous patellectomy. The comparison group, with intact patella, reported excellent pain relief; a poor outcome was reported in only 5%. Overall, the investigators noted a higher complication rate in total knee arthroplasty in post-patellectomy patients, including subluxation of the extensor mechanism, infection, and supracondylar fractures.\(^\text{11}\)

There has been some debate over the type of implant that should be used in patellectomy patients because the patella was perceived essential for stability.\(^\text{7,12}\) Paletta and Laskin\(^\text{8}\) retrospectively compared patients treated with a posterior stabilized implant with those receiving a posterior cruciate retaining implant and showed that the mean postoperative knee scores were significantly greater in patients with a posterior stabilized implant. In addition, of the seven knees that had a measurable loss of active extension, six were in patients with a posterior cruciate retaining implant. The investigators concluded that the results of total knee arthroplasty in post-patellectomy patients are similar to the results of total knee arthroplasty in patients with intact patella if a posterior stabilized implant is utilized.

As demonstrated by Martin and colleagues,\(^\text{12}\) there is a direct correlation between postoperative knee scores and the number of years that have elapsed since the patient’s patellectomy. A longer elapsed time period between patellectomy and knee arthroplasty is associated with a higher probability of a successful outcome. Similarly, fewer than three previous knee operations is another prognostic factor that has been shown to correlate with a more successful outcome in patellectomy patients.\(^\text{13}\)

**Conclusion**

Patellectomy patients represent a subset of patients who may require total knee arthroplasty for the treatment of degenerative arthritis. The results of total knee arthroplasty in post-patellectomy patients have generally been less successful than in patients with an intact patella. However, the
literature indicates that these patients can recover well with excellent pain relief and improved functional outcomes. The use of a posterior stabilized implant is now recognized as the implant of choice. Postoperative management should focus on quadriceps strengthening exercises to compensate for the lack of the fulcrum and mechanical advantage provided by the patella.

**Disclosure Statement**
None of the authors have a financial or proprietary interest in the subject matter or materials discussed, including, but not limited to, employment, consultancies, stock ownership, honoraria, and paid expert testimony.

**References**