Review Article

Knee Arthroscopy After Prior Total Knee ArthroplastyType of Study: Narrative Review

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ABSTRACT

Total knee arthroplasty (TKA) results in substantial improvement for most patients with end-stage arthritis of the knee; however, approximately 20% of patients have an unsatisfactory result. Although many problems contributing to an unsatisfactory result after TKA are best addressed by revision TKA, some problems may be effectively addressed with arthroscopic treatment. The categories of pathology that can be addressed arthroscopically include peripatellar soft-tissue impingement (patellar clunk syndrome and patellar synovial hyperplasia), arthrofibrosis, and popliteus tendon dysfunction. Recognizing these disease entities and the role of arthroscopic surgery in the treatment of these lesions may be helpful in achieving a good outcome in certain patients who are unsatisfied with their knee arthroplasty.

The number of total knee arthroplasties (TKAs) conducted in the United States continues to rise each year, with primary TKA projected to reach 1.26 million annually by 2030.[1] With this notable volume, improving patient satisfaction after TKA remains an important area of focus. An estimated 5% to 9% of patients complain of persistent pain after TKA without a clearly identifiable cause.[2] Soft-tissue impingement is a potential etiology of continued pain after TKA, once infection, aseptic loosening, polyethylene wear, and implant malpositioning have been ruled out. Various forms of soft-tissue impingement after TKA have been described in the literature including impinging hypertrophic synovitis, impinging posterior cruciate ligament stump, soft-tissue impingement in the intercondylar notch, and patellar clunk syndrome (PCS).

Indications for knee arthroscopy after TKA are still evolving, but the utility of arthroscopy is widely recognized in the literature, and its use after knee arthroplasty surgery will likely only continue to grow in parallel with increasing TKA procedures conducted. Potential indications for arthroscopic intervention after TKA include soft-tissue impingement conditions, arthrofibrosis, biopsy in periprosthetic infection, débridement in periprosthetic infection, removal of intra-articular bodies (cement, bone, etc), and treatment of periprosthetic fractures.[3] Arthroscopy for soft-tissue impingement is becoming one of the more widely accepted indications for

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arthroscopy after TKA. In this review, we will discuss the pathology and arthroscopic management of soft-tissue impingement after TKA with a focus on PCS/patellar clunk and/or crepitus, popliteus tendon impingement, and arthrofibrosis.

Peripatellar Soft-Tissue Impingement

PCS and patellar synovial hyperplasia are the most commonly described of these soft-tissue impingement lesions and can be categorized together as peripatellar fibrosis/impingement or patellar clunk and/or crepitus.[4,5] These forms of soft-tissue impingement that occur after TKA when posterior stabilized implants are used and occur by way of a similar pathologic process of soft-tissue hyperplasia. Whereas PCS is characterized by a hypertrophic suprapatellar fibrous nodule that develops on the undersurface of the quadriceps tendon, patellar synovial hyperplasia occurs at the superior aspect of the patella but without a discrete nodule. An additional form of patellar fibrosis has been recently described as tethered patellar syndrome, in which fibrous bands connect the inferior pole of the patellar implant to the intercondylar notch.[5] This results in tethering of the patella that restricts patellar motion and may produce anterior knee pain.

The defining clinical feature of PCS is a painful clunk experienced by the patient as the affected knee is brought from flexion to extension. This occurs because the suprapatellar nodule lodges in the intercondylar notch as knee extension is initiated from a flexed position, and then, the nodule subsequently dislodges, usually between 30° and 45° of flexion during the arc of motion, resulting in a painful clunk.[3,6-14] This is a clinical diagnosis made based on a patient's description of symptoms (ie, pain/impingement with flexion-extension) and demonstration of a reproducible, painful clunk with physical examination. The diagnosis is typically made between 3 and 12 months postoperatively, although some studies report PCS developing up to a couple of years after primary TKA.[7,12,13] By contrast, patients with patellar synovial hyperplasia will experience entrapment of the hypertrophic tissue when extending from a 90° flexed position, resulting in crepitus and pain, but no discrete clunk or pop.[2,15]

Regarding imaging, radiographs of the knee are important to rule out other causes of a painful TKA, but cannot diagnose PCS or patellar synovial hyperplasia because the fibrous nodules are not seen on radiographs. When anterior knee pain is present without clear crepitus or a patellar clunk, a CT scan could be considered to further assess for implant malrotations.[5] There is some evidence that ultrasonography or metal artifact reducing MRI protocols can allow for visualization of the suprapatellar fibrous nodule, which can aid in making the diagnosis.[16-18] These imaging modalities are not routinely used because the diagnosis is usually made clinically as described earlier.

PCS tends to occur with posterior stabilized total knee implants, but the etiology is multifactorial and risk factors are still an active area of study. A few studies have examined preoperative alignment, postoperative implant positioning, patellar implant dimensions/characteristics, femoral implant dimensions/characteristics, tibial polyethylene size, etc., but no clear risk factors have emerged.[13,14,16,19] Patellar synovial hyperplasia is less well-studied; however, this has been suggested to occur more often in a posterior stabilized TKA with a proximally positioned or wide femoral box.[15] The incidence of PCS varies quite widely in the literature with a range of 0% to 20% after TKA.[12–14,19–21]

Arthroscopic Treatment of Peripatellar Soft-Tissue Impingement

Conservative management with anti-inflammatories and physical therapy focusing on quadriceps strengthening is the initial treatment of newly diagnosed soft-tissue impingement after TKA, but is not always successful. If a patient fails to improve with conservative management, surgical intervention is the next step. In the 1980s and early 1990s, surgical intervention for PCS usually involved arthrotomy with open excision of the fibrous nodule. Arthroscopic intervention for PCS was introduced in the late 1980s and slowly began to become more popular despite only case report–level evidence of the success of treating PCS at the time.[7,16,21] Lower theoretical risks of infection and bleeding with arthroscopy compared with arthrotomy without clear evidence showing superiority of one intervention over the other likely led to arthroscopy gaining favor in the community. Currently, arthroscopic intervention is accepted as an appropriate treatment option for PCS and other forms of soft-tissue impingement not responsive to conservative measures.

When conducting arthroscopy for peripatellar soft-tissue impingement that occur after TKA that are potentially indicated for arthroscopy, the surgeon must consider a number of alterations to standard arthroscopic techniques used for the native knee. General considerations when conducting arthroscopy on a prosthetic knee include alteration of native anatomic

landmarks affecting portal placement; damage to implant surfaces, which can accelerate implant wear; creation of loose bodies; destabilizing a well-balanced prosthetic knee with excessive force used during the procedure; and risk of periprosthetic joint infection (PJI).[3,7,8,10,22]

Preoperative positioning and other immediate preoperative considerations are poorly described in the limited reporting of arthroscopic débridement of PCS and other forms of peripatellar soft-tissue impingement in the literature. Given the general similarity of débridement of a hypertrophic nodule to other well-described arthroscopic procedures in the native knee, such as synovectomy and plica excision, it is reasonable to place the patient in the supine position using standard arthroscopic leg holders if desired. Leg holders and/or posts may not be necessary because access to medial and lateral compartments is not required. Tourniquet use is not reported to have any detrimental effects on conducting arthroscopic débridement of PCS and can, therefore, be used at the discretion of the treating surgeon.[10,22]

Evidence on the use of antibiotic prophylaxis at the time of arthroscopic intervention for peripatellar soft-tissue impingement is limited, but it is important to consider because there is a risk of developing PJI. Current American Academy of Orthopaedic Surgeons guidelines report limited evidence for the use of a single dose of perioperative antibiotics in reducing risk of PJI with joint arthroplasty procedures.[23] The Centers for Disease Control (CDC) 2017 guidelines for prevention of surgical site infections and PJIs and total joint arthroplasty recommend against the use of additional postoperative doses of antibiotics after the surgical incision has been closed.[24] No postarthroscopy surgical site infections or PJIs have been reported after intervention for PCS in many smaller studies[3,6–10,12–14,16,19–22,25,26]; however, a larger and more recent cohort study reported a 4.1% rate of PJI for knee arthroscopy after TKA.[5]

Portal placement must be scrutinized when treating peripatellar soft-tissue impingement in a prosthetic knee to both protect implants and provide adequate visualization and instrument access. The total number and location of portals are controversial with combinations of 2, 3, or 4 of the standard peripatellar portals (anterolateral, anteromedial, superolateral, and superomedial). In studies providing a description of the arthroscopic technique, nine of 10 used a standard anterolateral viewing portal in combination with other portals.[3,6,8,10,16,19,22,25,26] Although most viewing is done through the anterolateral portal, moving the arthroscope to a superior portal (medial or lateral) can potentially provide improved visualization of hypertrophic scar tissue directly adjacent to the superior pole of the patella. The trajectory of instruments through a superolateral (lateral suprapatellar) portal is ideal for débridement of the suprapatellar nodule seen in PCS and is often implemented for this reason.[3,6–8,10,16,19,22,25,26] As with other arthroscopic procedures, intraoperative factors may necessitate additional/alternative portal selection. Despite this, it is important to understand which portals are most beneficial in treating PCS with the goal of minimizing the number of portals used and, thus, risk of damage to total knee implants and risk of PJI.

Postoperatively, patients can be allowed to weight-bear to tolerance on the affected lower extremity with full active range of motion. This may be supplemented with specific exercise programs for quadriceps strengthening, continuous passive motion machines, and/or formal physical therapy, although the latter two are not frequently indicated.[8,10,20] Studies show no notable differences in preoperative and postoperative knee range of motion after arthroscopic débridement for PCS/patellar synovial hypertrophy.[6,12,20,21,25,26] This is important for counseling patients with motion deficits preoperatively because arthroscopy will likely relieve the pain and mechanical clunk without affecting range of motion.

Outcomes of Arthroscopic Treatment of Peripatellar Soft-Tissue Impingement

Patient outcomes after arthroscopic débridement for PCS/patellar synovial hypertrophy are overall quite good based on existing data (Supplemental Table 1, http://links.lww.com/JAAOS/A860). The primary outcomes of interest are reduction in the pain level, resolution of mechanical symptoms (ie, clunk), and recurrence rates. Other important outcomes including postarthroscopic infection rates and range of motion have been mentioned previously.

In studies reporting outcomes for patients specifically diagnosed with PCS who underwent arthroscopic débridement (Supplemental Table 1, http://links.lww.com/JAAOS/A860), 100% of patients had short-term resolution of the mechanical clunk with a notable decrease in pain levels.[6,9] Long-term outcomes showed rates of recurrent pain and/or clunk ranging from 0% to 36.4%, with recurrence occurring 4 to 48 months after arthroscopic débridement.[6,8,9,12,13,22,26] Knee Society Score (KSS) objective knee scores, KSS functional knee scores, Western Ontario and McMasters Universities

Arthritis Index (WOMAC), 12-Item Short Form Survey (SF-12) physical scores, and SF-12 mental scores were all noted to improve after arthroscopy, and in one study, WOMAC, SF-12 physical, and SF-12 mental scores were no different from a matched cohort of patients who had undergone TKA without developing PCS.[6,8,13] Of patients with recurrent PCS, most underwent repeat intervention (arthroscopic or open débridement), with treatment success ranging from 66% to 100%.[8,12]

Similarly, in studies with mixed cohorts of PCS/patellar synovial hypertrophy (see Supplemental Table 1, http://links.lww.com/JAAOS/A860), 100% of patients had resolution or notable improvement of pain and clunk/crepitus in short-term results that were reported.[7,10] Long-term follow-up results show recurrence rates ranging from 0% to 16.7% after a single arthroscopic débridement.[7,8,10,19,21] Mixed PCS/patellar synovial hypertrophy groups also showed improvements in KSS knee, KSS functional, and WOMAC scores after intervention.[7,10,14]

Popliteus Tendon Impingement

Soft-tissue impingement after TKA can occur with anatomic structures of the knee in addition to the fibrous tissue pathologies described earlier. The medial collateral ligament, iliotibial band, popliteus and patellar tendons, and medial and lateral patellar retinaculum may all potentially impinge on retained osteophytes or TKA implants, particularly when excess implant overhang is present. The presence of popliteus impingement posterolateral after TKA was first described by Barnes et al in 1995.[27] The popliteus tendon inserts deep, anterior, and distal to the lateral condyle and glides over the lateral femoral condyle when moving from full extension to flexion until approximately 100° of flexion is met, at which point the popliteus is seated within the popliteus sulcus. Lateral translation of the femoral implant or oversizing of femoral or tibial implants has been suggested to be risk factors of popliteus impingement or snapping; however, even a well-sized tibial implant may alter tracking of the popliteus.[28,29] Patients with symptomatic popliteus tendon impingement will present with pain and sometimes snapping at the posterolateral aspect of the knee. An examination maneuver to reproduce these symptoms has been described in which the patient is positioned in the decubitus position with the affected leg facing upward and then is asked to abduct the affected thigh into the air with the knee in extension and to then flex the knee to 90° of flexion while maintaining an abducted position with the leg.[30] Ultrasonography-guided cortisone injections can also be used as a diagnostic tool for popliteus tendon dysfunction.[29]

Arthroscopic Treatment of Popliteus Tendon Impingement

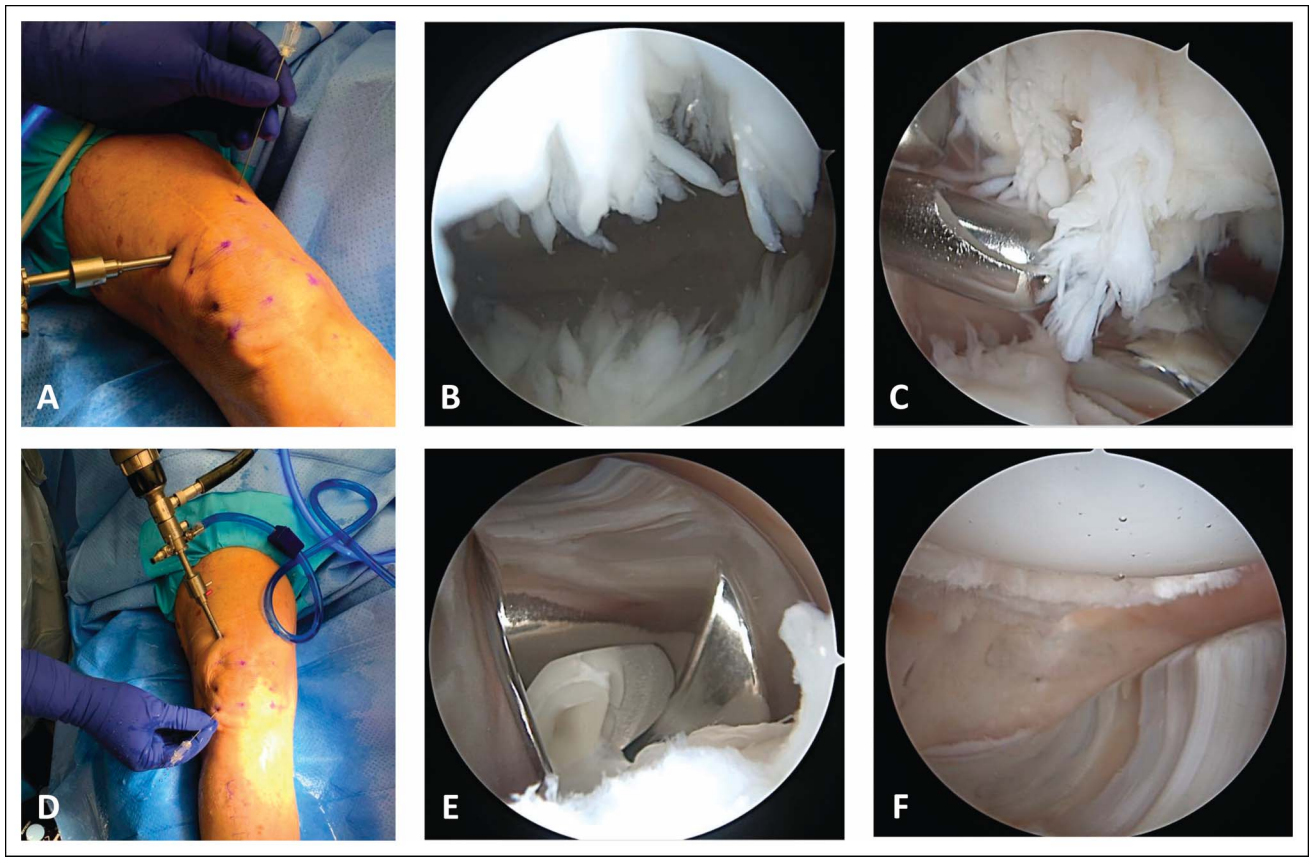
Those who fail to improve with conservative treatment including physical therapy may be considered for arthroscopic release of their tendon. When conducting arthroscopic release, the use of an anterolateral viewing portal is recommended in addition to an accessory lateral working portal positioned approximately 4 cm posterior to a standard anterolateral viewing portal, using direct needle visualization to optimize portal placement.[29] The arthroscope can be placed within the lateral gutter and lateral compartment to evaluate the popliteus. There may be overlying fibrous scar that has to be débrided to access the popliteus, which can then be transected using arthroscopic scissors or biters.[29] There are limited data regarding outcomes of this procedure, but small case series have suggested good outcomes with this procedure,[29,31] and a blinded study showed no difference in patient outcomes with intraoperative release of the popliteus during TKA, suggesting that TKA patients can be expected to have a good outcome even without an intact popliteus tendon.[32]

Arthrofibrosis

Athrofibrosis (AF) is pathologic stiffening that can be seen after TKA where patients present with knee pain, restricted knee ROM, and impaired activities of daily living.[33] The pathologic process of AF is the result of an abnormal fibroblastic response leading to formation of diffuse fibrous adhesions of the knee joint and is estimated to affect 3% to 10% of knees after TKA.[33–35] AF is typically diagnosed on clinical examination with a notable loss of knee extension (>10° loss of extension) or impaired flexion (<90° flexion) and may be accompanied by pain with motion and/or palpable crepitus.[33]

Nonsurgical measures to combat AF include strict management of pain and inflammation with diligent, supervised physical therapy. Physical therapy and mitigation of inflammation may have some benefit in earlier stages of AF, but once the fibrous scar tissue has matured, the ability to achieve additional ROM gains with physical therapy alone may stall.[33,36] Current procedural treatment options for AF after TKA are manipulation under

Figure 1



A, Photograph showing a demonstration of creating a superomedial portal by needle localization. **B,** Image showing a suprapatellar fibrous nodule obscuring the view of a patellar implant. **C,** Image showing careful positioning of a shaver to avoid damage to the patellar implant during débridement. **D,** Photograph showing a demonstration of creating an anterolateral portal by needle localization. **E,** View of a femoral box through the anterolateral portal. **F,** Image showing direct visualization of the area where the suprapatellar nodule was débrided.

anesthesia (MUA) alone, arthroscopic lysis of adhesions (LOA) ± MUA, and open LOA.[33,34,36,37] The decision to intervene on AF after TKA focuses on the patient's degree of disability (from the pain, decreased ROM, etc), response to nonsurgical measures, and the potential risks/benefits of the proposed procedural intervention.

Arthroscopic Treatment of Arthrofibrosis

Arthroscopic LOA in the setting of AF provides a number of theoretical benefits. It is a minimally invasive procedure that allows for direct visualization of the scar tissue burden and/or identification of other pathologic processes (hypertrophic synovitis, soft-tissue impingement, etc.) that may be contributing to a painful TKA. In the same setting that the pathologic tissue is visualized, it can be removed using a combination of motorized shavers and radiofrequency ablation devices.[33,34,38] Therefore, arthroscopy provides both diagnostic and therapeutic values. Arthroscopic intervention potentially provides additional benefits of faster recovery, minimal infection risk, and decreased wound complications.

The surgical technique for arthroscopic LOA in AF is fairly consistent in the literature (Figure 1). This is typically conducted supine with standard arthroscopic leg holders and a tourniquet. Antibiotic prophylaxis with administration of a first-generation cephalosporin is conducted before beginning the procedure. Most commonly, a two- or three-portal technique is used with standard anterolateral and anteromedial portals plus or minus a superolateral or superomedial portal for additional instrumentation access to pathologic tissues. Inspection of the knee is done with care to protect implant surfaces and attention paid both to the location and amount of pathologic tissue as well as the condition of the implants. Depending on the degree of scar tissue present, intermittent débridement of fibrous tissue may be necessary to facilitate complete visualization of the joint. The posterior capsule, infrapatellar fat pad, medial/lateral gutters, and pretibial recess are primary

areas of scar tissue formation in AF and, therefore, require careful attention. Débridement of fibrous tissue and other pathologic tissue (eg, synovitis) are done with motorized shavers and radiofrequency ablation with periodic assessment of ROM. Dynamic assessment of the soft tissues during ROM may provide additional guidance on the location and degree of tissue resection/release. Meticulous hemostasis is desired to decrease postoperative pain, infection risk, and potential reformation of pathologic scar tissue. Drains are commonly used and removed within 24 hours after arthroscopic LOA for AF.[33,35,39,40]

Most studies of arthroscopic LOA for arthrofibrosis after TKA are retrospective case series or cohort studies. When arthroscopic LOA is done, current literature suggests that the extension lag may worsen by up to 3° or improve by up to 23° and flexion may improve by 5° to 58.4° at the final follow-up.[34,37,39,41] These same studies show that total ROM may increase from 18.5 to 60 after arthroscopic LOA for AF.[34,37,39,42] Notable improvements in KSS knee scores have been documented after arthroscopic LOA. The rate of conducting revision LOA/additional procedures for recurrence of AF or failure to improve is reported to be 0% to 25%.[34,39,40]

There is controversy over whether arthroscopic LOA alone is superior to MUA alone. A systematic review of MUA and arthroscopic LOA suggested that MUA compared with arthroscopy (± MUA) was similar for improvements in ROM. However, 75% of the arthroscopic studies reviewed included MUA as part of their procedure at the type of LOA, which limits direct comparison of MUA alone and arthroscopic LOA alone.[37] A recent cohort study examined arthroscopic LOA plus MUA versus MUA alone for the treatment of AF and found statistically significant increases in ROM with MUA done in conjunction with arthroscopic LOA as compared with only MUA.[43] Without additional high-quality evidence, there seems to be a beneficial role of arthroscopic LOA and MUA in the treatment of AF. Combining the two techniques may further add to this benefit, but additional prospective study is needed to truly characterize the differences between MUA, arthroscopic LOA, and arthroscopic LOA plus MUA.

Summary

There are various indications for the utilization of arthroscopy after TKA. The most common indications are peripatellar soft-tissue impingement, arthrofibrosis, and popliteus tendon impingement. Arthroscopy has been efficacious for these and other indications and has shown a low complication rate of 0.5%[4]; however, there is a lack of high-quality data regarding arthroscopy in TKA because this does represent a relatively rare surgical procedure. Important considerations for the surgeon conducting knee arthroscopy in the setting of prior TKA includes portal placement, static/dynamic assessment of the prosthetic knee, minimizing risk of damage to implants, and minimizing risk of postoperative infection.

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