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Arthroscopic treatment of total knee arthroplasty complications

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- The most frequent indications for arthroscopy in patients with total knee arthroplasty (TKA) are soft-tissue impingement, arthrofibrosis (knee stiffness), periprosthetic infection and removal of free bodies or cement fragments.

- When performing a knee arthroscopy in a patient with a symptomatic TKA, look for possible free/retained bone or cement fragments, which can be anywhere in the joint.

- Patellar tracking should be evaluated and soft-tissue impingement under the patella or between the femoral and tibial prosthetic components should be ruled out.

- Current data suggest that knee arthroscopy is an effective procedure for the treatment of some patients with symptomatic TKA.

- The approximate rates of therapeutic success vary according to the problem in question: 85% in soft-tissue impingement; 90% in arthrofibrosis; and 55% in periprosthetic infections.

- More clinical studies are needed to determine which patients with symptomatic TKA can be the best candidates for knee arthroscopy.

Introduction

The prevalence of total knee arthroplasty (TKA) is increasing and considerable growth in TKAs is foreseen in coming decades as society ages; the development of advanced surgical techniques and ameliorations in implant designs have contributed to the improvement in satisfaction after TKA; however, the incidence of complications is also increasing as the frequency of TKA increases.[1] More and more patients with symptomatic TKA will require the evaluation of an orthopaedic surgeon. In this subgroup of patients, arthroscopy has the potential to diagnose and treat the causes of post-arthroplasty pain.

Knee arthroscopy is one of the most common procedures in orthopaedic surgery. It is particularly useful in a wide range of pathologies, such as meniscus, cruciate ligament and cartilage lesions. Although the role of arthroscopy in TKA has been evaluated less exhaustively, it is an accepted procedure as a method of treating TKA complications.

Arthroscopy has the advantage that it is less painful than open surgery and provides a faster recovery and greater patient satisfaction. The arthroscopic procedure is safe if the surgeon is experienced in arthroscopic surgery. The percentage of complications published after knee arthroscopy is < 2%.[2]

In this article, we review the complications of TKA that can be treated effectively by arthroscopy.

Soft-tissue impingement

With regard to intra-articular pathologies that cause pain the first year after a TKA, the most common are infection, instability, poor position of the prosthetic components and soft-tissue impingement.

Patellar clunk syndrome (PCS) has traditionally been associated with posterior-stabilised (PS) implants. PCS typically occurs within the first year after prosthetic surgery. There are several publications on PCS rates with various designs. The symptoms are secondary to the formation of a fibrous nodule in the upper pole of the patella that collides with the femoral shield when extending the knee. Patients present with pain and audible sound when extending the knee from 30° to 45° of flexion. As the knee is moved from flexion to full extension, it is believed that this nodule jumps abruptly from the intercondylar notch in PS knee designs, resulting in the clicking sound (Fig. 1). Open surgical excision of this nodule is successful in relieving symptoms, but carries a risk of infection and wound complications, which would delay post-operative mobilization.[3] Table 1 summarizes the main articles published on the arthroscopic treatment of PCS.[4-10]

Although PCS is not a complication as devastating as infection and loosening of the components, it is a
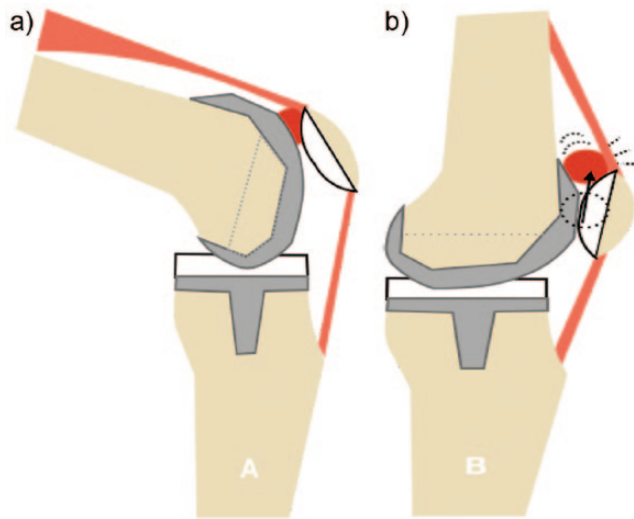
Fig. 1. Patellar clunk syndrome: a) a fibrous nodule on the posterior aspect of the quadriceps tendon near the upper pole of the patella is entrapped within the femoral notch during knee flexion; b) when the knee is extended within 30° to 45° of full extension the nodule dislodges, resulting in an audible and often painful clunk.

significant complication in well-functioning TKAs that can lead to dissatisfaction and a new surgery. PCS is one of the main reasons for reoperation without revision in TKA. The incidence of PCS is relatively low. If it occurs, arthroscopic excision is effective in terms of symptom resolution, with low recurrence rate and high rates of patient satisfaction in most cases.[4-10] It is also a safe technique, with no documented complications with arthroscopic treatment in this subgroup of patients.

Another type of soft-tissue impingement of the patellofemoral joint in the PS TKA is the so-called synovial hypertrophy described by Pollock et al.[11] With synovial hypertrophy, the symptoms are observed at 90° of flexion and there is no clicking (Fig. 2). However, the aetiology of synovial hypertrophy may be similar to that of PCS, without the formation of a nodule or clinical evidence of a snap. In 26 patients who presented pain or crepitus, but not clicks when climbing stairs or getting out of a chair, an arthroscopic debridement was performed with good results. Debridement of hypertrophic synovial tissue in the distal aspect of the quadriceps tendon relieved symptoms in all patients. There were no infections or complications related to the arthroscopic procedure.

Takahashi et al classified the complications of patellofemoral soft-tissue impingement after TKA into three types: type I, PCS, an isolated fibrous nodule located in the suprapatellar region, without other fibrous tissues that cause the impingement; type II, generalized hypertrophic synovitis without fibrous nodule; and type III, the combination of types I and II. The therapeutic efficacy of arthroscopy was better in type I.[12]

Sekiya has described a new impingement that occurs in the medial and/or lateral tibiofemoral space due to scar tissue in continuity with the infrapatellar fat pad.[13] Patients have marked discomfort in the medial and/or lateral tibiofemoral joint space and also pain when walking, with or without pain at rest. Of 30 patients treated with arthroscopic debridement, 63% were free of pain, 3% had marked improvement, 20% moderate improvement, 3% slight improvement and 11% had no improvement. The conclusion was that in a painful knee, arthroscopic debridement appears to be a good resolution option after TKA, once infection and aseptic loosening have been ruled out.

When the pain is located in the posterolateral area of the knee after TKA, a possible popliteal dysfunction should be investigated. Pain related to the popliteus tendon after TKA is a rare but well-known cause of early pain after arthroplasty.[14] It has been suggested that the pain may be due to a pinching or protrusion of the popliteus tendon from anterior to posterior caused by a residual lateral osteophyte, by the lateral prominence of the femoral component or by a posterior prominence during the extension of a tibial tray of inadequate size. Surgical release of the popliteal tendon can be performed by open surgery or arthroscopy.

Westermann et al have described a technique of arthroscopic release of the popliteus tendon after TKA using an anterolateral portal and an accessory lateral vision portal created under direct visualization, approximately 4 cm posterior to the anterolateral portal.[15] With this technique, the arthroscopic release immediately alleviated pain.

The incidence of recurrent haemarthrosis after TKA is 0.3% to 1.6%. The most frequent cause of haemarthrosis after TKA is the impingement of a synovial proliferation. There are several articles that recommend arthroscopy when the symptoms cannot be resolved with conservative treatment, provided that angiography or magnetic resonance angiography have not shown pseudoaneurysms, arteriovenous fistulas or a vascular injury.

Kawata et al have reported one case of recurrent haemarthrosis after the fifth post-operative month.[16] Due to recurrent pain and swelling, the patient underwent an arthroscopy 14 months after TKA. During surgery, a posterior remnant of the external meniscus was found between the femoral component and the polyethylene, which had caused a synovial hypertrophy around the remaining meniscus. The meniscus remnant and the synovial membrane were cauterized and completely removed. After the arthroscopy, the haemarthrosis did not reappear. The authors concluded that a remnant of lateral meniscus could be a cause of recurrent haemarthrosis after TKA. Consequently, in such cases, arthroscopic examination should be considered.

Another less frequent cause of haemarthrosis that can be treated by arthroscopy is post-TKA pigmented

Table 1. Patellar clunk syndrome after total knee arthroplasty

Author	Year	Comments
Wong et al[4]	2002	This study included 21 patients with patellar symptoms, all of whom had TKA with PS design, who had arthroscopic treatment. The average onset of symptoms following TKA was 17 months (3 to 75). The average duration of symptoms before arthroscopic treatment was 23 months (4 to 92). All patients were satisfied with resolution of symptoms at average follow-up of 32 months (12 to 52) without recurrence. No infection or significant complications were associated with the arthroscopic treatment in this series.
Koh et al[5]	2008	Cohort of 1020 cases treated with a PFC Sigma fixed bearing PS prosthesis (DePuy Orthopaedics, Warsaw, Ind), giving an incidence of approximately 1.4%. Twelve patients (12 knees) who underwent arthroscopic treatment. The minimum follow-up was one year; the average KSS knee score improved from 63.8 to 90.9, whereas the average KSS function score improved from 65.4 to 90.4. There was no recurrence. Arthroscopic debridement for soft-tissue impingement at the patellofemoral joint following total knee arthroplasty showed satisfactory results.
Dajani et al[6]	2010	These authors performed a retrospective review of 25 patients who underwent arthroscopic excision after primary TKA to treat PCS (15 knees) or patellofemoral synovial hyperplasia (10 knees). After surgery, patient-reported knee pain and crepitus as well as Knee Society Score (KSS) improved in both groups. Post-operative ROM remained unchanged. Arthroscopic excision of symptomatic patellofemoral synovium after TKA was a safe and effective surgical technique. There were no intra-operative complications or post-operative haemarthroses. Two patients (13%) with patellar clunk required a second, open debridement for recurrent mechanical symptoms.
Choi et al[7]	2013	These authors reviewed 580 patients who had 826 PS TKAs involving five different designs. PCS incidence was higher in the Press-Fit Condylar(®) Sigma(®) Rotating Platform/Rotating Platform-Flex Knee System (11/113 knees, 9.7%) than in the others (7/713 knees, 1.0%). Increased risk of PCS was associated with using a specific prosthesis and patellar retention. PCS occurred in all cases within one year after TKA. Arthroscopic treatment (16 knees) and patellar replacement (two knees) improved knee scores, with no recurrence found over an average follow-up of 29 months. Prosthesis design and patellar retention were associated with PCS. Surgery resolved the PCS.
Snir et al[8]	2014	Some 188 mobile- and 223 fixed-bearing TKAs were reviewed for complications, incidence of patellar clunk, treatment, recurrence rates, ROM and patient satisfaction. PCS developed in 22 knees of the mobile- (11.7%) and in 4 (1.8%) of the fixed-bearing group. Out of 26 cases, 23 resolved with a single arthroscopic treatment and 2 (7.7%) resolved with a second procedure. All but one patient reported overall satisfaction with the arthroscopic excision. In contrast with other recent studies, these authors found a significant incidence of PCS in high-flex mobile bearings. Despite the high rate of PCS, overall patients did well and were satisfied with their outcomes.
Costanzo et al[9]	2014	Seventy-five knees in 68 patients were treated arthroscopically for PCS after TKA. Average follow-up was 4.2 years. Four patients developed recurrence at an average of 19 months (8 to 33) after initial arthroscopy. PCS patients had a significantly more valgus pre-operative alignment, greater change in posterior femoral offset and smaller patellar component size.
Gholson et al[10]	2017	In a series of 1488 TKA cases, 46 (3.1%) patients were identified to have clinical signs and symptoms of PCS during postoperative clinical follow-up. The incidence of PCS requiring arthroscopic excision with the Sigma PS design was relatively low, at 1.2% of the patients. Patients who underwent arthroscopic excision for PCS had high patient satisfaction and there was recurrence of PCS symptoms in 3/18 cases (16.67%), requiring repeat arthroscopic excision rates. In recurrent cases, repeat excision also resolved symptoms. Thus, arthroscopic excision was an effective treatment option for PCS in symptomatic patients.

TKA, total knee arthroplasty; PS, posterior-stabilised; PCS, patellar clunk syndrome; ROM, range of motion

villonodular synovitis (PVNS), also called tenosynovial giant cell tumour. PVNS is a relatively rare proliferative disorder of the synovial membrane that causes inflammation and deposition of hemosiderin in the synovial membrane. There is a localised form (a lobular pedunculated lesion generally in the anterior compartment) and another diffuse form that is more common, which is characterized by the participation of extensive areas. Three cases have been published in the literature.

Ballard et al presented a diffuse PVNS case with spontaneous haemarthrosis nine years after TKA.[17] Arthroscopy revealed a very extensive PVNS, so that after a few weeks an open synovectomy was performed. Bunting et al presented a case of focal PVNS 15 months after TKA.[18] They resected the lesion located in the anteromedial part of the knee by arthroscopy, improving pain and with no new episodes of inflammation.

Oni et al reported a case of diffuse PVNS 18 months after TKA.[19] They performed a complete arthroscopic synovectomy without complications, resolving pain and the recurrent effusions of the joint. A new type of soft-tissue impingement has recently been described. Klaassena and Aikins presented the first report of cyclopean lesions in three TKAs with preservation of the cruciate ligaments.[20] The classic cyclopean lesion occurs after reconstruction of the anterior cruciate ligament (ACL). A fibrous nodule is fixed just anterolateral to the tibial insertion of the ACL graft.[21] This lesion should be suspected after a TKA that preserves the cruciate ligaments when full extension cannot be achieved despite physical therapy, especially if extension was achieved initially and then lost. Arthroscopic removal of the cyclops eliminated symptoms in two of the presented knees and significantly improved the third.

Surgical technique
In addition to the classic arthroscopic, anterolateral and anteromedial portals, the proximal superolateral or superomedial portals might be necessary; these are created approximately 4 cm proximal to the superior border of the
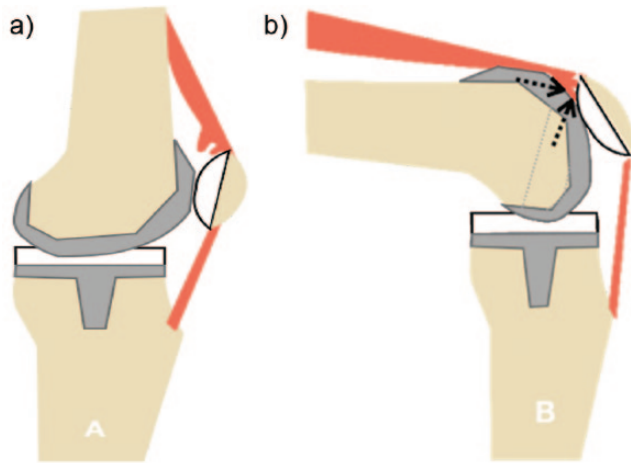
Fig. 2. a) Hypertrophic synovium proximal to the patella causing b) impingement during active knee flexion from 90°. It can happen in posterior stabilised (PS) total knee arthroplasties (TKAs).

patella (Fig. 3). Through the anterolateral vision portal, the routine examination is performed: patellofemoral joint; medial recess; anterior portion of the medial tibiofemoral joint; intercondylar region; posterior aspect of the infrapatellar fat and lateral recess. Sometimes it is difficult to visualize the scar tissue from the anterior part because it is very close, having to then use a proximal portal of vision and the classic portals for work.

Arthrofibrosis

Arthrofibrosis is defined as knee stiffness after TKA, which is a serious complication. The loss of movement, mainly in extension, is poorly tolerated, especially in younger and more active patients. The prevalence is not well known. In addition, there is no consensus on its treatment; the aetiology is multifactorial. The main risk factors are pre- and intra-operative mobility, technical errors of poor positioning of the components, lack of motivation of the patient and inadequate post-operative rehabilitation.

Many authors have reported that arthroscopy in the management of arthrofibrosis after TKA is an efficient treatment modality (which improves range of motion (ROM) and reduces subjective pain), as well as being relatively economical and safe (Table 2).[22-27]

Manipulation under anaesthesia (MUA) can cause patellar tendon rupture, intra-articular injuries and complex regional pain syndrome.[28] Arthroscopic release allows haemostasis, preventing the formation of haematomas and the recurrence of arthrofibrosis, with lower morbidity than the open procedure, and an easier and faster rehabilitation. There are authors who defend the triad of treatment, which consists of arthroscopic release,
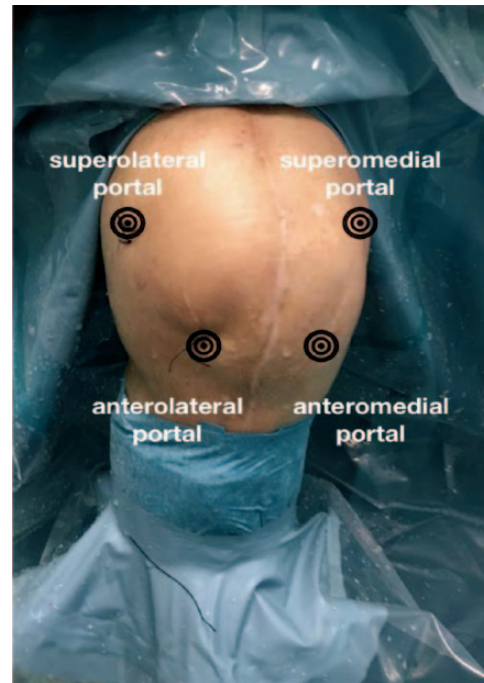

Fig. 3. Illustration showing arthroscopic portals. In addition to the classic arthroscopic anterolateral and anteromedial portals, superolateral and superomedial proximal portals might be necessary, which are created about 4 cm proximal to the superior pole of the patella.

pain management and intense physical therapy. Arthroscopic release is indicated in the first eight weeks up to six months after arthroplasty.[29]

Surgical technique
Before starting surgery or before leaving the operating room, a femoral catheter is placed to achieve a regional blockade of pain, reducing post-operative pain and allowing the patient to maintain the mobility achieved intra-operatively. The patient is placed in the supine position with an ischaemia cuff in the thigh. The arthroscope is introduced through the classic anterolateral portal to visualize and evaluate the location and type of arthrofibrosis. The implants and other structures of the knee are then palpated and inspected through the anteromedial portal. Establishing portals is not always easy, especially if there is a patella baja. To do so, the arthroscope is placed in the intercondylar area and a synoviotome begins to resect the fibrous tissue. The synoviotome then continues through the anteromedial portal, resecting the suprapatellar fibrous tissue, the medial and lateral recesses, the cyclops tissue and the pseudomeniscal remains, restoring the mobility of the femoropatellar joint until the knee reaches full extension. If the patella is tight but centred, a medial and lateral release is made. If the patella is lateralized with tension only on the lateral side, only a lateral release is made.

Table 2. Arthroscopic arthrolysis for the treatment of knee stiffness after total knee arthroplasty

Author	Year	Comments
Court et al[22]	1999	Four men (mean age 54 years) were studied. In two cases, the arthrofibrosis had appeared after a primary TKA performed for limited ROM; in two other cases, it had followed a revision TKA. The indication for arthroscopy was a painless limited ROM of the knee. The arthroscopy was performed six months after the TKA. With two peripatellar portals the adhesions in the suprapatellar pouch, the two retinaculars and the adhesive bands in the two gutters were sectioned. Two anterior additional portals were used in case of extension lag. A suction drain was placed and the portals were sutured. A CPM machine was started in the recovery room. There were no complications. These authors stated that arthrolysis should be performed 3 to 6 months after the TKA for better results. The conclusion was that arthroscopy for the treatment of knee stiffness due to arthrofibrosis following TKA was a useful, reliable and safe technique.
Teng et al[23]	2002	Arthroscopic arthrolysis was performed in 11 patients. Good results were achieved in eight patients. However, the benefits declined with time. The conclusion was that to avoid the potential complications of MUA and open arthrotomy, arthroscopic surgery is an option for treating a painful, stiff knee joint.
Fitzsimmons et al[24]	2010	This systematic review showed that stiffness after TKA can be improved with MUA and/or arthroscopic lysis of adhesions with few complications. The conclusion was that arthroscopy combined with MUA is still useful one year after the index TKA.
Schwarzkopf et al[25]	2013	The authors studied 19 patients. The criterion for lysis was the inability to flex to 90° at three months. The authors recommended arthroscopic lysis of adhesions as a treatment option for stiff knees after TKA that fails after at least three months of non-operative treatment.
Tjoumakaris et al[26]	2014	These authors stated that patients can reliably expect an improvement; however, patients achieved approximately half of the improvement that was obtained at the time of surgery.
Bodendorfer et al[27]	2017	Eighteen patients underwent arthroscopic LOA for stiff TKA. Improvements in flexion contracture, flexion, ROM arc, WOMAC scores and pain were all statistically significant. Age, weight, body mass index and time to LOA were found to be statistically significant predictors of results. Pre-TKA and pre-LOA ROM parameters were found to be statistically significant predictors of post-LOA ROM results.

TKA, total knee arthroplasty; ROM, range of motion; CPM, continuous passive motion; MUA, mobilization under anaesthesia; LOA, lysis of adhesions; WOMAC, Western Ontario and McMaster Universities Osteoarthritis Index scores.

Fig. 4. Arthrofibrosis (knee stiffness) following total knee arthroplasty (TKA). After arthroscopic treatment, early rehabilitation is paramount. A continuous passive motion (CPM) device must be used.

No formal MUA is performed. After deflating the ischaemia cuff, we must document the ROM achieved. The patient then receives intense post-operative physiotherapy with the help of a continuous passive motion (CPM) machine at 0° to 90° that is increased progressively (Fig. 4). Muscle strengthening (quadriceps and hamstrings) and assisted early weight bearing should also be performed until reaching the full weight bearing according to tolerance.

Periprosthetic infection

Arthroscopy in TKA can play a diagnostic and/or therapeutic role in periprosthetic infection. Arthroscopic biopsy can help confirm or exclude TKA infection in selected patients. For example, in cases of low-grade infection, in which clinical examination, conventional inflammatory serological markers and joint aspiration are frequently normal, it can be difficult to differentiate infection, arthrofibrosis and early loosening of the prosthesis. Arthroscopic biopsies allow microbiological analysis and a histological evaluation, which can clarify the diagnosis.[30]

According to Claassen et al, arthroscopic knee biopsy in the diagnosis of periprosthetic joint infection has a sensitivity of 0.88 (95% confidence interval (CI) 0.47 to 1.0), a specificity of 0.88 (95% CI 0.7 to 0.98), a positive predictive value of 0.7. (95% CI 0.35 to 0.93) and a negative predictive value of 0.96 (95% CI 0.65 to 1.0).[30]

Arthroscopic biopsy in periprosthetic hip infection has shown a sensitivity of 87.5% and a specificity of 100%, which is superior to the erythrocyte sedimentation rate (ESR), C-reactive protein (CRP), joint aspiration and a combination of the three.[31] The arthroscopic biopsy of shoulder prostheses with suspected infection has a sensitivity and specificity of 100%, whereas the glenohumeral aspirate has a sensitivity of 16.7% and a specificity of 100%.[32]

Arthroscopic knee biopsy in periprosthetic infection appears to be an effective technique in patients with low-grade infection. However, additional studies in this area are needed to establish the exact role of arthroscopy in periprosthetic knee infection. Arthroscopy can also be used to take biopsies and perform microbiological analyses (in order to identify the causal agent and offering the
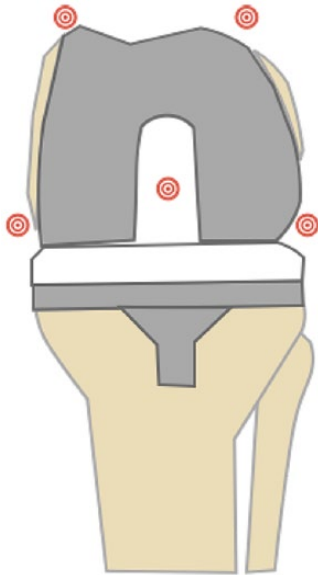
Fig. 5. Illustration showing the five points of arthroscopic biopsies (for specimen culture and histology).

Fig. 6. Ischaemia must be performed, simply by elevation of the lower limb.

appropriate antibiotic). Ideally it must be performed 14 days before a revision TKA (in one or two stages).

We have found no published complications after arthroscopic biopsy. Although it is a more invasive technique than inflammatory serum markers and joint aspiration, given it requires anaesthesia, it is a safe diagnostic test. On the other hand, during knee arthroscopy we can identify potential intra-articular mechanical failures, such as polyethylene wear or arthrofibrosis.

During arthroscopy, it is necessary to take five samples from five locations for the microbiological and histological study (Fig. 5). Infection is diagnosed when two or more samples have a microorganism or when the histological study has type 2 or 3 membranes according to the Morawietz classification.[33]

Arthroscopic debridement in the treatment of TKA infection aims to reduce the bacterial load to allow the host's immunity, together with antibiotics, to overcome the infection.

Arthroscopic 'debridement and implant retention' (DAIR) is a good alternative to open DAIR, with lower morbidity (avoiding an arthrotomy with damage to the extensor apparatus and possible wound healing problems) and a faster recovery. Also, it helps avoid revision surgery, reducing bone loss and mechanical problems.

Arthroscopic debridement can be considered in a small number of patients who meet the following criteria:

- Acute infections: time is crucial; many authors recommend that it should be performed within the first seven days from the onset of symptoms, with success rates of 38% to 100%.[34-39]

- Radiographically stable prosthetic components without signs of osteolysis, loosening or osteomyelitis.
- Local soft tissues in good condition, without fistulae or abscesses.
- Patients without a compromised immune system.
- Identification of the pathogen. The microbiological diagnosis of the species and the sensitivities of the microorganism are important because these influence the decision to maintain the prosthesis. Arthroscopic debridement can be effective in streptococcal species that have a low capacity for biofilm formation compared with staphylococcus. Methicillin-resistant *Staphylococcus aureus* and Gram-negative bacteria are more resistant and are unlikely to respond to arthroscopic debridement.

In case of failure, it is not indicated to repeat the arthroscopic lavage in TKA infection. It should never be used in chronic infections. Arthroscopic debridement is only the beginning of treatment, given the patient must follow a prolonged antibiotic treatment. There are only six case series in the literature (level IV evidence), with a small number of patients and variable surgical technique and methodology, which unfortunately prevent an adequate comparison (Table 3).[34-39]

Surgical technique
The ischaemia cuff is inflated by elevation (Fig. 6). At first, the standard anterolateral and anteromedial portals are used. A fluid sample is taken for microbiological study before the irrigation of serum. At least five samples are collected with an arthroscopic clamp, ideally from areas of bone–prosthesis interface. A superolateral portal for high volumes of irrigation and a superomedial portal can be used to maximize the visualization of the knee.

Extensive debridement must be performed in the suprapatellar pouch, medial recess, intercondylar area, infrapatellar fat and lateral recess, with special interest in

Table 3. Arthroscopic debridement for the treatment of infection after total knee arthroplasty

| Author	Year	Knees	Duration of symptoms	Success rate (%)	Technique
Flood et al[34]	1988	2	< 12 hours	100	- One patient had three portals; the other patient had two portals (anterior) - 10 L of saline irrigation
Waldman et al[35]	2000	16	< 7 days	38	- Only three patients with > 2 portals (anterior) - Minimum 10 L of saline irrigation without antibiotics - Recommendation: only in medically unstable patients
Dixon et al[36]	2004	15	Not mentioned	60	- Four or five portals (anterior and posterior) - No drains - Better results in non-cemented prostheses
Ilahi et al[37]	2005	5	< 7 days	100	- Minimum three anterior portals - Minimum 12 L saline irrigation with bacitracin (50 000 units every 3 L) intra-operatively - Drain at least for 48 hours or up to < 20 mL/8 hours
Liu et al[38]	2013	17	< 7 days	88	- Minimum three anterior portals - Continuous irrigation-suction of vancomycin
Chung et al[39]	2014	16	< 72 hours	62.5	- At least four portals (three anterior, at least one posterior) - Minimum 10 L saline irrigation without antibiotics - Two drains (superolateral and posterolateral) < 50 mL/day
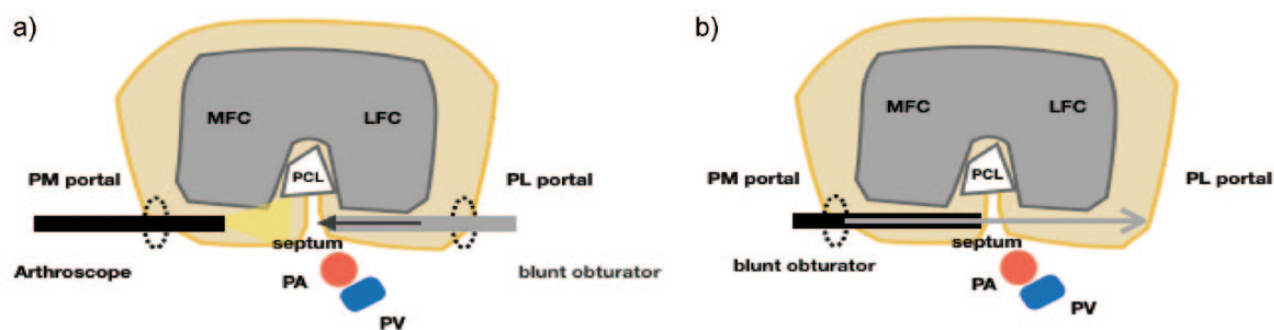
Fig. 7. Two methods to create a posterior trans-septal portal in the presence of a total knee arthroplasty (TKA): a) viewing the septum through the posteromedial portal and perforating it with a rod from the posterolateral portal; b) establishing the posterolateral portal exactly opposite the posteromedial portal using a blunt obturator to perforate the septum. PM, posteromedial; PL, posterolateral; PA, popliteal artery; PV, popliteal vein; MFC, medial femoral condyle (of the femoral prosthetic component); LFC, lateral femoral condyle (of the femoral prosthetic component); PCL, posterior cruciate ligament.

the bone–prosthesis interface, and finally the posterior capsule.

For the debridement of the posterior compartment, the posteromedial and posterolateral portals are used; in cruciate retaining (CR) prostheses, the portals are established under direct visualization after passing the arthroscope through the intercondylar notch; in PS prostheses in which the polyethylene central peg prevents the advance of the arthroscope through the intercondylar area, the portals are established by palpation of the posteromedial and posterolateral corners.

To make the posteromedial portal, a needle is introduced behind the posterior border of the medial femoral component, approximately 0.5 to 1 cm above the joint line, taking care not to injure the saphenous nerve. The output of irrigation serum confirms the correct position. An incision is made in the skin and capsule and the arthroscope is inserted without direct visualization. The posterolateral portal is created in the same manner. The fibular head must be palpated to prevent common peroneal nerve injury. A needle is then inserted behind the posterior edge of the lateral femoral component.

With vision from the posteromedial portal, we have to drill an eyelet with a rod in the septum to communicate the two posterior compartments and be able to complete the synovectomy of this compartment under direct vision (Fig. 7a).[40] Another alternative to perform the technique is the 'back and forth' technique described by Louisia et al,[41] in which the arthroscope is introduced through the posteromedial portal and pushed until it touches the septum and is then replaced by a blunt obturator to perforate the septum. The obturator is pushed from the medial to the lateral side of the posterolateral compartment and a cutaneous incision is made in the obturator tip (Fig. 7b).

The use of electrocautery should be minimized to reduce thermal damage and necrotic debris in the joint.
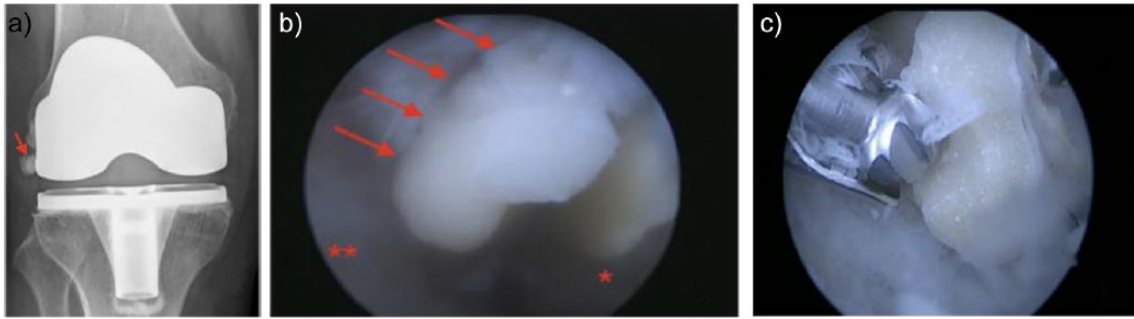
Fig. 8. a) Anteroposterior radiograph showing impinging cement (arrow) after a total knee arthroplasty (TKA); b) arthroscopic view showing bone cement extrusion (arrows) lateral to the femoral component (*) and the polyethylene (**); c) arthroscopic removal of the impinging cement was performed with success.

Care must be taken not to damage the metal surfaces of the implant and the polyethylene. Irrigation should be in the range of 10 to 12 L of saline. It should be noted that this typically takes 45 to 60 minutes. The treatment must be completed with at least six weeks of intravenous antibiotic treatment.

Arthroscopic DAIR can be used as an adjunct in cases in which antibiotic suppression will be used. Some authors do not defend the arthroscopic DAIR because it does not allow the changing of the polyethylene for the elimination of microorganisms present between the tibial tray and the polyethylene.[42]

Foreign intra-articular bodies free or retained

Arthroscopic removal of foreign bodies of various origins (cement fragments, bone fragments) has been reported after unicompartmental knee arthroplasty and TKA.[43-45] Extraction relieves mechanical symptoms and reduces damage to prosthetic components.

In Figure 8, we show the case of a patient with iliotibial band syndrome caused by a fragment of cement retained in the lateral femoral condyle. The patient was placed in supine position and the affected knee flexed at 30°. We identified the fragment. Since it was palpable, an anterolateral vision portal was created and the lateral proximal portal was located using a needle. With a scalpel, we created the portal with longitudinal incisions of the iliotibial band. After introducing the resecting device, we performed bursectomy and then haemostasis with the vaporizer. The cement fragment was firmly adhered and was removed by reaming, until a smooth surface was achieved (Fig. 8c). If the cement is loose, it can be removed in a block with chisel and hammer, and then extracted in one piece with a grasper through the portal. Afterwards, an abundant wash of the joint must be made to eliminate all the cement particles.

Krüger et al have published two cases of recurrent knee blockage, with suspicion of intra-articular foreign bodies of uncertain origin in which arthroscopy revealed a polyethylene fracture of the tibial component after TKA.[46]

Polyethylene wear after TKA can also be evaluated arthroscopically. Kondo et al performed eight arthroscopies in patients with TKA who presented effusions and instability.[47] Arthroscopy was successful in all the knees without causing any damage to the components; polyethylene delamination was observed under direct vision, which in all cases was more severe than expected.

Delamination of the polyethylene can lead to mechanical instability; if untreated, it could cause metallosis by metal-to-metal contact. For this reason, the immediate and accurate detection of wear by visualization is necessary.

Evaluation of this problem using conventional radiographs or stress radiographs is difficult. Arthroscopy can detect and evaluate the wear of polyethylene in patients with mild symptoms after TKA.

Periprosthetic fractures

The incidence of periprosthetic knee fracture is increasing. The most frequent location is the femur and the most common pattern is the supracondylar area.[48] In the case of displaced fractures with a stable and well-aligned prosthesis, osteosynthesis is required, although implants can interfere with the fracture fixation devices.

If the fracture is reducible, a minimally invasive surgery with a retrograde nailing or locking plate can be performed (the choice is controversial). Interest in retrograde nailing with new, more distal locks has recently resurfaced. In addition, the nail causes less bleeding and prevents irritation of the iliotibial band that could make it necessary to remove the locking plate.[49]

The intra-operative localization of the nail entry point is complicated by the superposition of the femoral

Fig. 9. The 'mirror phenomenon' is shown. It can cause disorientation of the orthopaedic surgeon during arthroscopy, leading to damage of the prosthetic components or the arthroscope itself.

component in the fluoroscopic image and by the tip of the tibial insert in the case of PS prostheses.

To avoid an arthrotomy, Udagawa et al have used arthroscopy.[50] In addition, for fractures with a small distal fragment, the end of the nail should be as distal as possible, and arthroscopy allows it to be flush with the surface of the intercondylar notch.

Complications of arthroscopy in TKA

In a systematic review of arthroscopies in symptomatic patients after TKA, the complication rate was only 0.5%. Although in the majority of the series reported there were no complications related to arthroscopic procedures,[51] arthroscopic surgery is not risk-free. In fact, two cases of acute TKA infection after arthroscopy have been reported.[52]

In addition to the complications inherent to knee arthroscopy, there are exclusive aspects of TKA arthroscopy, such as handling the arthroscope carefully to avoid excessive contact of the cannula with the components. Micro-abrasions have been described in the components of the arthroplasty that could adversely affect the material properties of the prosthetic components. Raab et al have reported that the use of a plastic cannula can reduce this risk.[53]

The careful manoeuvrability of the arthroscope can be difficult in the presence of adhesions, increasing the level of technical difficulty. Furthermore, during arthroscopy, there can be some reflection in the components and the 'mirror phenomenon' (Fig. 9), which can cause disorientation and cause damage to the components or the arthroscope. Dallari et al have described a case of instrument breakage during the arthroscopy of a hip prosthesis.[54] The level of training and the skill of the surgeon in this technique is especially important to minimize these potential complications.

Conclusions

Knee arthroscopy is a safe procedure in the diagnosis and/ or treatment of complications after TKA, associated with a low rate of adverse effects. The most common indications for arthroscopy after TKA in order of decreasing frequency are soft-tissue impingement, arthrofibrosis, periprosthetic infection and the removal of free bodies or cement fragments. When an arthroscopy is performed in TKA, it is necessary to be systematic and rule out potentially adverse factors in the knee, such as free or retained bone fragments or cement in any part of the joint. It is necessary to assess patellar tracking and rule out soft-tissue impingement under the patella or between the femoral and tibial components. Current data suggest that arthroscopy is an effective procedure for the treatment of patients with symptomatic knee after TKA. The approximate percentages of effectiveness vary according to the indication: 85% in soft-tissue impingement; 90% in arthrofibrosis; and 55% in periprosthetic infection. Additional clinical studies are needed to determine in which populations and patient contexts knee arthroscopy after TKA can be applied more appropriately and effectively.

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ICMJE CONFLICT OF INTEREST STATEMENT
None declared.

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