

Arthroscopic Synovectomy and Removal of Loose Bodies in Synovial Osteochondromatosis of the Knee



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Abstract: Synovial osteochondromatosis is a benign process that most commonly affects the knee joint (70%). It is characterized by proliferative metaplasia of synovial membrane into chondrocytes, resulting in the formation of multiple cartilaginous nodules, which can detach from the synovium to become multiple intra-articular loose bodies. It usually involves the anterior compartment, including infrapatellar fat pad, suprapatellar pouch, and anterior interval, and rarely involves the posterior compartment of the knee. Treatment for synovial osteochondromatosis usually involves surgery, especially in the presence of locking symptoms or decreased range of motion. Arthroscopy has gradually replaced a traditional open approach, resulting in low morbidity, low postoperative pain, better cosmetic results, early recovery of range of motion, short rehabilitation course, and an early return to previous function. In case of involvement of the posterior compartment of the knee joint, arthroscopic access may be difficult. In this Technical Note, the technical details of arthroscopic synovectomy and removal of loose bodies in synovial osteochondromatosis of the knee is described. This arthroscopic technique can deal with the disease, involving both the anterior and posterior compartments of the knee joint.

Introduction

Synovial osteochondromatosis is a benign process that most commonly affects the knee joint (70%).^{1,2} It is characterized by proliferative metaplasia of synovial membrane into chondrocytes, resulting in the formation of multiple cartilaginous nodules.¹⁻³ These nodules enlarge and can detach from the synovium to become multiple intra-articular loose bodies.^{1,2}

Synovial osteochondromatosis of the knee can present with pain and swelling of the joint, stiffness,

crepitus, giving away, catching or locking symptoms.¹⁻⁴ It usually involves the anterior compartment, including infrapatellar fat pad, suprapatellar pouch, and anterior interval, and it rarely involves the posterior compartment of the knee.^{1,3-6}

Primary synovial chondromatosis can occur in 3 phases. Phase I includes active intrasynovial disease with no free bodies, phase II involves transitional lesions with active intrasynovial proliferation plus loose bodies, and phase III occurs when there are multiple loose bodies with no intrasynovial disease.^{6,7} Owing to the metaplastic nature of the disease, there is a small risk of transformation to chondrosarcoma.⁴

Diagnosis and treatment of synovial osteochondromatosis at its early phase are crucial to prevent the occurrence of secondary osteoarthritis and malignant transformation.^{4,8} The differential diagnosis for synovial osteochondromatosis should include any condition that may present with either the presence of intra-articular loose bodies or joint effusions, such as crystal deposition diseases, psoriatic arthritis, rheumatoid arthritis, pigmented villonodular synovitis, infective arthritis, and osteochondritis dissecans.^{1,8}

Treatment for synovial osteochondromatosis usually involves surgery, especially in the presence of locking symptoms or decreased range of motion.^{1,4} Other

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Table 1. Indications and Contraindications of Arthroscopic Synovectomy and Removal of Loose Bodies in Synovial Osteochondromatosis of the Knee

Indications	Contraindications
1. Diffuse type of synovial osteochondromatosis involving both the anterior and posterior compartment of the knee joint	1. There is no posterior compartment involvement. 2. There is severe osteoarthritic change of the knee joint, especially in an elderly patient.

nonoperative treatment, such as chemotherapy and radiotherapy, usually has no role in the treatment of synovial osteochondromatosis.^{3,4} Surgical options include arthroscopic versus open removal of loose bodies and synovectomy with the aims of symptoms control, prevention of recurrence, and further joint destruction.¹⁻⁴

Arthroscopy has gradually replaced a traditional open approach, resulting in low morbidity, low postoperative pain, better cosmetic results, early recovery of range of motion, short rehabilitation course, and an early return to previous function.²⁻⁴ In cases of involvement of the posterior compartment of the knee joint, arthroscopic access may be difficult. The posterior compartment of the knee is divided into the posteromedial and posterolateral sites by a septum, which makes this space not readily accessible through conventional anterior arthroscopic portals.⁴ In the literature, different arthroscopic posterior portal approaches have been reported for the management of synovial osteochondromatosis of posterior compartment of the knee.^{4-6,9-12} The purpose of this Technical Note is to describe the details of arthroscopic synovectomy and removal of loose bodies in synovial osteochondromatosis of the knee. It is indicated for diffuse type of synovial osteochondromatosis, involving both the anterior and posterior compartment of the knee joint. It is contraindicated if there is no posterior compartment

involvement or there is severe osteoarthritic change of the knee joint, especially in an elderly patient, as total knee arthroplasty may be a better option (Table 1).

Surgical Technique

Preoperative Planning and Patient Positioning

As the symptoms are nonspecific and insidious in onset, the diagnosis is usually delayed.^{3,4,8} In the initial stage of the disease, cartilaginous nodules are not yet calcified and, therefore, a plain radiograph may be completely normal; sometimes, only nonspecific findings are present, such as soft-tissue mass surrounding the joint or widening of the joint space.^{3,8} If the nodules are calcified, plain radiographs can be diagnostic.² Magnetic resonance imaging (MRI) and computed tomography (CT) are important to the investigation for preoperative planning.⁴ A CT scan, especially with three-dimensional (3D) reconstruction can detect the ongoing calcification and help the surgeon to understand the distribution of the loose bodies (Fig 1). A CT scan can reveal the typical aspect of rings and arcs calcifications.⁸ MRI is the investigative tool of choice for early detection and allows better details of the free fluid amount, cartilaginous erosions and, when present, of the injuries to the joints' ligaments.^{3,8} Bone erosion can be seen on all imaging modalities and ranges from 30% to 50% of cases.¹ Bone erosion is theorized to be more

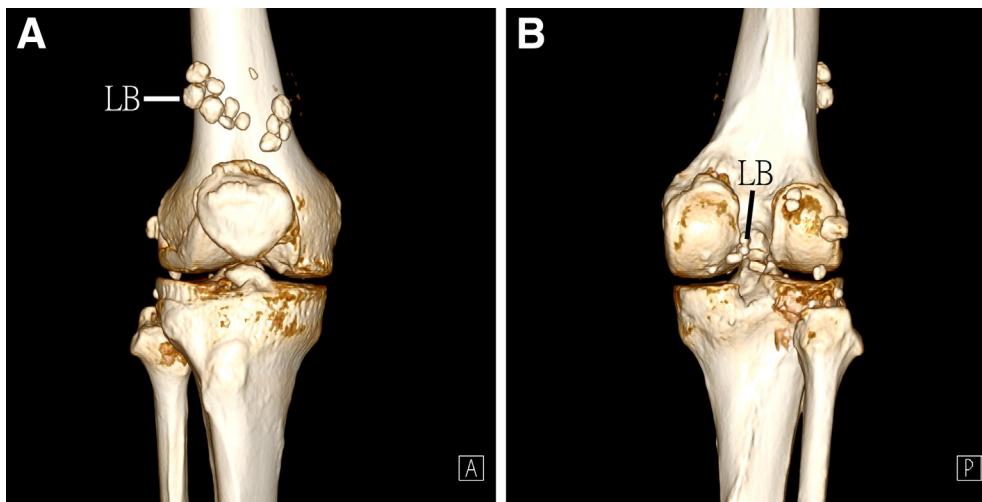


Fig 1. Arthroscopic synovectomy and removal of loose bodies in synovial osteochondromatosis of the right knee. The patient is in the supine position. The hip and knee are flexed and supported by a triangular supporting frame underneath the knee. Three-dimensional computed tomography of the illustrated case showed the distribution of the loose bodies. (A) Anterior knee. (B) Posterior knee. (LB, loose bodies.)

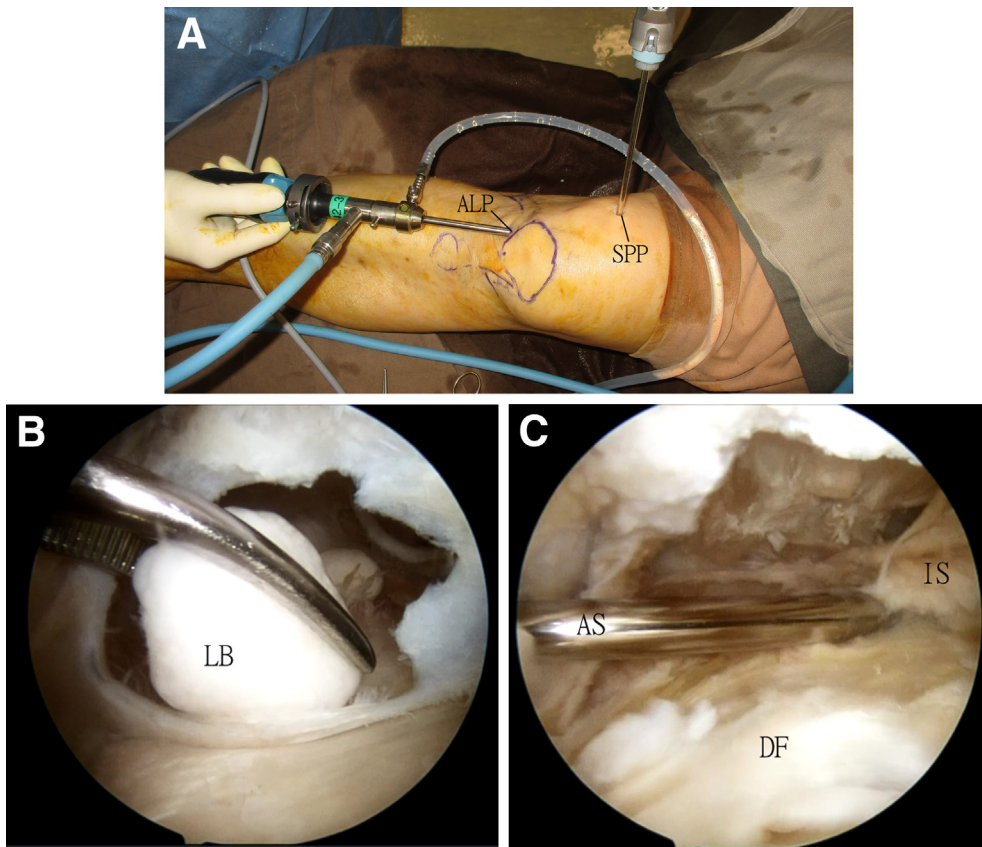


Fig 2. Arthroscopic synovectomy and removal of loose bodies in synovial osteochondromatosis of the right knee. The patient is in the supine position. The hip and knee are flexed and supported by a triangular supporting frame underneath the knee. (A) The anterolateral portal is the viewing portal, and the suprapatellar portal is the working portal. (B) The loose bodies are removed by a hemostat. (C) The inflamed synovium is resected by the arthroscopic shaver. (ALP, anterolateral portal; AS, arthroscopic shaver; DF, distal femur; IS, inflamed synovium; LB, loose bodies; SPP, suprapatellar portal.)

common in joints with tightly adherent joint capsules, that is, the hip, and is less common in the knee joint.¹

The patient is in the supine position. The hip and knee are flexed and supported by a triangular supporting frame (Innomed, Savannah, GA) underneath the knee. An ipsilateral thigh tourniquet is used to provide a bloodless surgical field. Fluid inflow is driven by gravity, and an arthro-pump is not used. A 4.0-mm, 30° arthroscope (Dyonics; Smith and Nephew, Andover, MA) is used for this procedure.

Portal Placement

Anterior knee arthroscopy is performed via the anteromedial, anterolateral, and suprapatellar portals. Posterior knee arthroscopy is performed via the coaxial posteromedial and posterolateral portal.

The standard anteromedial and anterolateral portals are at the soft spots at the medial and lateral side of the patellar tendon, respectively. The suprapatellar portal is at the lateral side of the suprapatellar pouch. The posterolateral portal is located at the posterolateral corner of the knee joint, posterior to the lateral collateral ligament and anterior to the biceps femoris tendon. The posteromedial portal is at the posteromedial corner of the knee joint and is created by inside-out technique.

Anterior Knee Arthroscopy: Removal of Loose Bodies and Synovectomy

Five-millimeter skin incisions are made in the anteromedial, anterolateral, and suprapatellar portal sites. Subcutaneous tissue is bluntly dissected down to joint capsule by a hemostat, and the capsule is pierced by the tip of the hemostat.

In this illustrated case, the loose bodies at the suprapatellar pouch are bounded by the suprapatellar plica. The anterolateral portal is the viewing portal, and the suprapatellar portal is the working portal. The suprapatellar plica is resected with an arthroscopic shaver (Dyonics; Smith and Nephew) to expose the loose bodies and diseased synovium. The loose bodies are removed by a hemostat, and the inflamed synovium is resected by the arthroscopic shaver (Fig 2). The rest of the anterior compartment, medial compartment, and lateral compartment can be examined via the standard anteromedial and anterolateral portals, and removal of loose bodies and synovectomy is performed.

Posterior Knee Arthroscopy: Creation of Coaxial Posterolateral and Posteromedial Portals

The hip and knee are further flexed. A 5-mm skin incision is made at the posterolateral portal site. Subcutaneous tissue is bluntly dissected down to joint

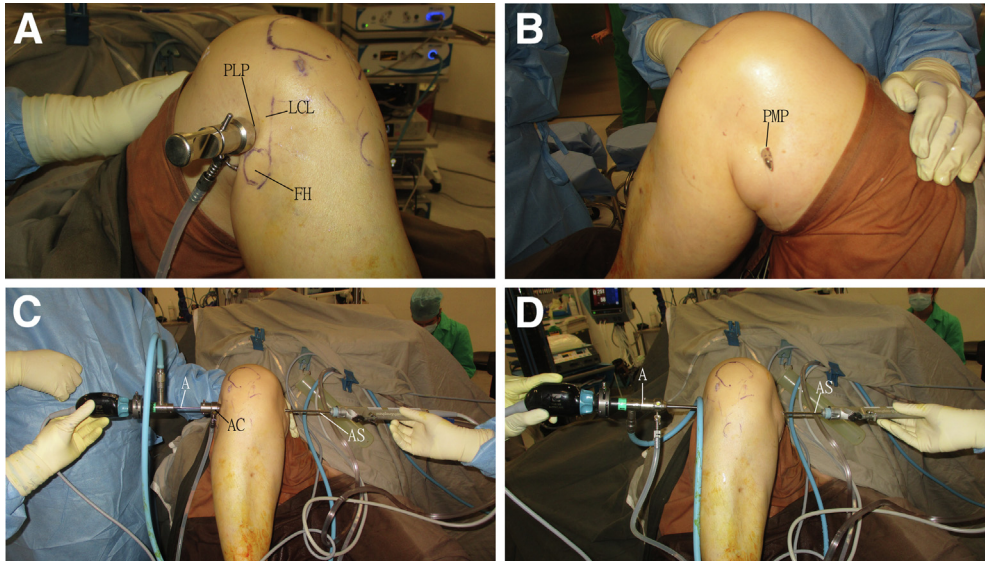


Fig 3. Arthroscopic synovectomy and removal of loose bodies in synovial osteochondromatosis of the right knee. The patient is in supine position. The hip and knee are flexed and supported by a triangular supporting frame underneath the knee. (A) The cannula-trocar passes through the posterolateral portal. (B) The cannula-trocar exits through the posteromedial portal. (C) The trocar is removed, and the cannula is left in situ connecting the posteromedial and posterolateral portals. The arthroscope is introduced halfway into the cannula, and the arthroscopic shaver is introduced into the posteromedial compartment of the knee through the other end of the cannula. (D) The shaver and scope are kept in situ, and the cannula is withdrawn until it is incorporated with the scope. (A, arthroscope; AC, arthroscopic cannula; AS, arthroscopic shaver; FH, fibular head; LCL, lateral collateral ligament; PLP, posterolateral portal; PMP, posteromedial portal.)

capsule by a hemostat, and the capsule is pierced by the tip of the hemostat. The arthroscope is introduced into the posterolateral compartment, and the intra-articular position of the scope is confirmed under arthroscopic visualization. The cannula is kept in situ, and the scope is replaced by the trocar. The cannula-trocar is then

advanced medially along the femoral condyles and passes through the septum to the posteromedial compartment and finally perforates the posteromedial capsule. A 5-mm skin incision is then made at the trocar tip, and this creates the posteromedial portal. The trocar is removed, and the cannula is left in situ,

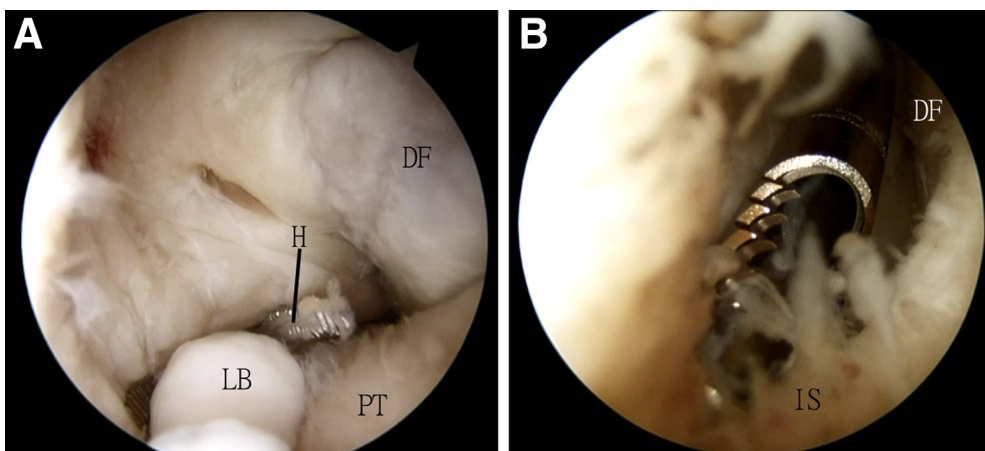


Fig 4. Arthroscopic synovectomy and removal of loose bodies in synovial osteochondromatosis of the right knee. The patient is in the supine position. The hip and knee are flexed and supported by a triangular supporting frame underneath the knee. The posterolateral portal is the viewing portal, and the posteromedial portal is the working portal. (A) The loose bodies are removed by a hemostat. (B) The inflamed synovium is resected by the arthroscopic shaver. (DF, distal femur; H, hemostat; IS, inflamed synovium; LB, loose bodies; PT, proximal tibia.)

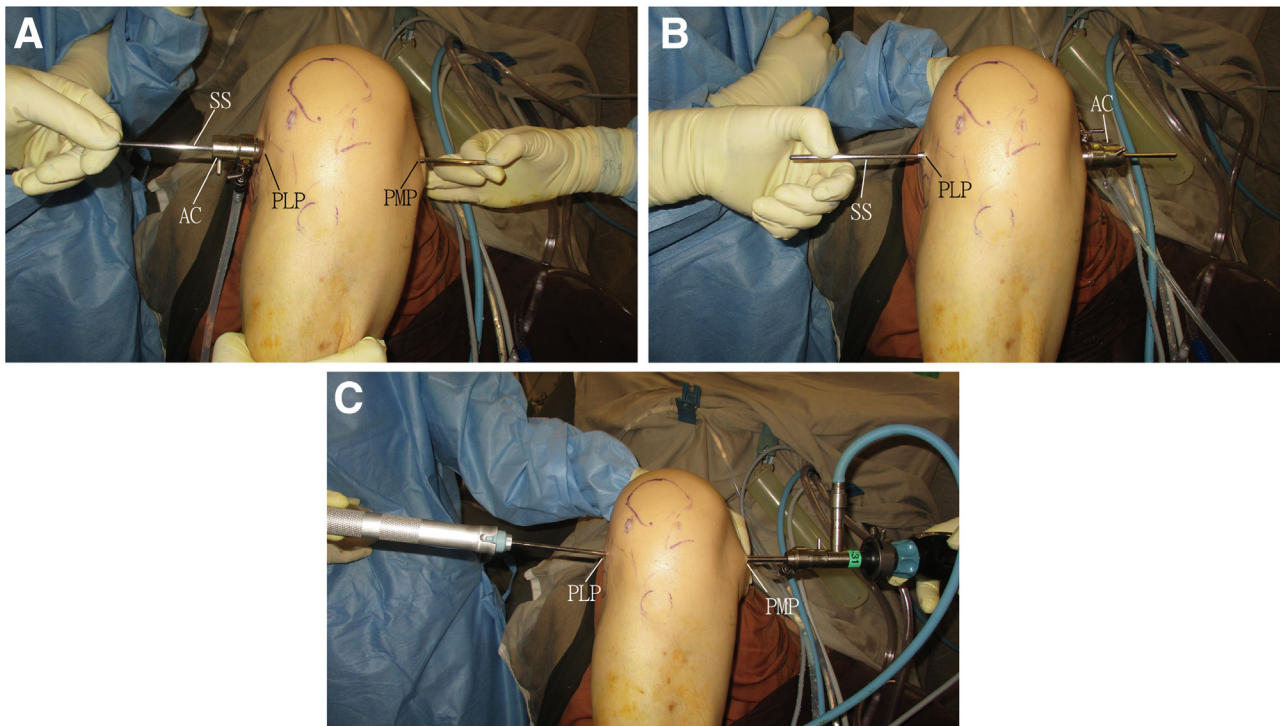


Fig 5. Arthroscopic synovectomy and removal of loose bodies in synovial osteochondromatosis of the right knee. The patient is in the supine position. The hip and knee are flexed and supported by a triangular supporting frame underneath the knee. (A) The arthroscope is advanced through the posteromedial portal, and the scope is replaced by a 4-mm switching stick. (B) The stick is kept in situ and the cannula is removed and reinserted through the posteromedial portal. (C) By this maneuver, the viewing portal is switched to the posteromedial portal. (AC, arthroscopic cannula; PLP, posterolateral portal; PMP, posteromedial portal; SS, switching stick.)

connecting the posteromedial and posterolateral portals. The arthroscope is introduced halfway into the cannula, and the arthroscopic shaver is introduced into the posteromedial compartment of the knee through the other end of the cannula. The shaver and scope are kept in situ, and the cannula is withdrawn until it is incorporated with the scope (Fig 3). This maneuver helps proper positioning of the shaver.

Posterior Knee Arthroscopy: Removal of Loose Bodies, Synovectomy of the Posteromedial Compartment

The posterolateral portal is the viewing portal, and the posteromedial portal is the working portal. The loose bodies are removed by a hemostat and the inflamed synovium is resected by the arthroscopic shaver (Fig 4). During synovectomy of the posterior capsule, the shaver blade should be faced anteriorly, and sucking should be kept to a minimum in order to minimize risk of injury to the popliteal neurovascular bundle.

Posterior Knee Arthroscopy: Switching Stick Technique

The arthroscope is advanced through the posteromedial portal, and the scope is replaced by a 4-mm switching stick (Dyonics; Smith and Nephew). The

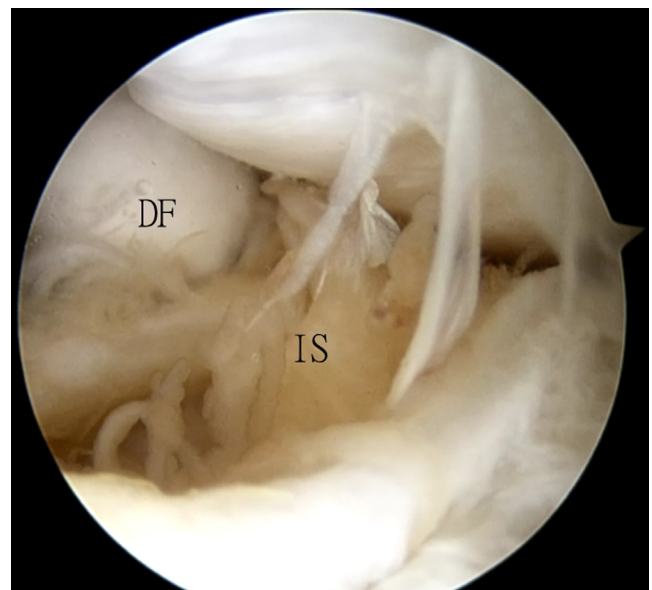


Fig 6. Arthroscopic synovectomy and removal of loose bodies in synovial osteochondromatosis of the right knee. The patient is in supine position. The hip and knee are flexed and supported by a triangular supporting frame underneath the knee. The posteromedial portal is the viewing portal. Arthroscopic view of the posterolateral compartment shows the inflamed synovium. (DF, distal femur; IS, inflamed synovium.)

Table 2. Pearls and Pitfalls of Arthroscopic Synovectomy and Removal of Loose Bodies in Synovial Osteochondromatosis of the Knee

Pearls	Pitfalls
1. Anterior knee arthroscopy is performed before posterior knee arthroscopy.	1. Percutaneous introduction of the cannula-trocar from posterolateral portal to the posteromedial portal may injure the popliteal neurovascular bundle.
2. The knee and hip are flexed during the posterior knee arthroscopy.	2. During synovectomy of the posterior joint capsule, knee flexion cannot reduce the risk of injury to the popliteal neurovascular bundle.
3. The entry of the arthroscope into the posterolateral compartment via the posterolateral portal should be confirmed by arthroscopic visualization before further advancement of the scope medially.	
4. The advancement of the cannula-trocar from the posterolateral compartment to the posteromedial compartment should be done along the femoral condyles with the knee maximally flexed.	
5. The cannula can serve a conduit for introduction of the arthroscopic shaver into the posterior knee joint.	
6. The coaxial posteromedial and posterolateral portals can be exchanged as the viewing and working portals by the switching stick technique.	
7. During synovectomy of the posterior joint capsule, the shaver blade should face anteriorly, and suction should be kept to a minimum.	

stick is kept in situ, and the cannula is removed and reinserted through the posteromedial portal. By this maneuver, the viewing portal is switched to the posteromedial portal (Fig 5).

Posterior Knee Arthroscopy: Removal of Loose Bodies, Synovectomy of the Posterolateral Compartment

The posteromedial portal is the viewing portal, and the posterolateral portal is the working portal. The loose bodies are removed by a hemostat, and the inflamed synovium is resected by the arthroscopic shaver (Fig 6, Video 1, Table 2). During synovectomy of the posterior capsule, the shaver blade should be faced anteriorly and sucking should be kept to a minimum in order to minimize risk of injury to the popliteal neurovascular bundle.

Discussion

An early presentation of synovial chondromatosis generally responds favorably to arthroscopic management. Although a late presentation with a delayed diagnosis is often associated with irreversible joint damage and may present a poor outcome, even after an adequate arthroscopic synovectomy, an initial joint-saving surgical intervention should be offered first, especially for young patients.^{3,8,13}

In this reported technique, the anterior knee arthroscopy is performed before the posterior knee arthroscopy. During anterior knee arthroscopy, some loose bodies may drop into the posterior knee, especially the posteromedial compartment, owing to the gravity effect.⁴ These can be removed by the subsequent posterior knee arthroscopy. The use of coaxial posteromedial, the trans-septal, and the posterolateral portals allow for the full exploration of the posterior

compartment and to perform a meticulous debridement and loose bodies excision.⁵ We make the posterolateral portal first by direct exploration anterior to the biceps femoris tendon instead of by an inside-out approach from the posteromedial portal. This can minimize the risk of injury to the common peroneal nerve. The flexed position of the hip and knee during the posterior knee arthroscopy can allow instrumentation freedom at the posteromedial portal without hindrance of the contralateral lower limb. Moreover, this positioning can relax the posterior joint capsule, increase the working area, and displace the popliteal neurovascular bundle posteriorly. However, this may not reduce the risk of neurovascular injury during the capsular procedure. Therefore, the surgeon should follow the safety precaution during synovectomy of the posterior capsule. The recurrence rate after loose body removal alone is high, and we recommend synovectomy in order to avoid recurrence.^{3,4}

This minimally invasive technique has the advantage of better cosmetic result, less soft tissue trauma, less wound complications, complete synovectomy and

Table 3. Advantages and Risks of Arthroscopic Synovectomy and Removal of Loose Bodies in Synovial Osteochondromatosis of the Knee

Advantages	Risks
1. Better cosmetic result	1. Cutaneous nerve injury
2. Less soft tissue trauma	2. Injury to the common peroneal nerve
3. Less wound complications	3. Injury to the popliteal neurovascular bundle
4. Complete synovectomy and removal of loose bodies	4. Incomplete removal of loose bodies
5. Less postoperative pain	5. Recurrence of the disease
6. Quicker recovery	
7. Faster return to function	
8. Less chance of infection	

removal of loose bodies, less postoperative pain, quicker recovery, faster return to function and less chance of infection. The potential risks of this technique include cutaneous nerve injury, injury to the common peroneal nerve, injury to the popliteal neurovascular bundle, incomplete removal of loose bodies, and recurrence of the disease (Table 3). This is not technically demanding and can be attempted by averaged knee arthroscopists.

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