Intercruciate trans-septal arthroscopic approach to the posterior compartment of the knee joint

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ABSTRACT

Approach to the posterior compartment of the knee joint and working within it has been made assessable since the trans-septal approach was established. Herein, the authors describe a simple intercruciate trans-septal approach to the posterior compartment of the knee joint. This technique allows a direct visualization to the posterior septum (septum), creating a safer trans-septal portal and easier separation of the septum. The authors have used this approach in conditions such as the posterior cruciate ligament (PCL) reconstruction, PCL avulsion repairs, popliteus tendon reconstruction, posterior compartment synovectomy, hardware removal, loose bodies removal, meniscus ramp lesion repair, and others. No complications such as femoral condyle damage, meniscus damage, or neurovascular bundle injuries has occurred with this approach.

Video to this article can be found online at 10.1016/j.jisako.2023.07.004.
Inter cruciate trans-septal approach to the posterior compartment of the knee joint

- Approaching the posterior septum through an inter cruciate approach.
- Between the septum adjacent to superomedial aspect of anterior cruciate ligament and superolateral aspect posterior cruciate ligament.
- Two apertures are created on the posterior septum—posterolateral and posteromedial.
- These apertures will aid in creating the posterosmedial and posteroslateral portals.
- Via these two posterior portals, the posterior septum is separated and debrided.
- Once adequate space achieved in the posterior compartment of the knee joint, further planned procedures can be carried out, e.g., posterior cruciate ligament reconstruction (PCLR), ramp repair, etc.

Advantages

- Simple and safe.
- No vital structures are located within intercruciate areas.
- No obstructing structures.
- Reduces risk of injuring surrounding structures, e.g., femoral condyles, meniscus.
- Direct posterior septum visualization
- Vision is not blinded while creating the apertures through the septum

Disadvantages

- In smaller-size knee with narrow intercondylar width, working with this technique may find some difficulties as this may lead to overcrowding and movement limitation of the arthroscopic instruments

Outline of clinical problem

Arthroscopic surgery is evolving within the orthopedic fraternity especially among sports surgeons. In knee arthroscopy, the anterior compartment is easier to maneuver than the posterior one, due to its near proximities from the portals, and has lesser barriers to overcome. Few approaches to the posterior compartment were well described in the literature, e.g., intercondylar notch posterior compartment assessment [1] or anterior and posterior triangulation via the transnotch approach. However, structures such as cruciate ligaments, femoral condyles’ curvature, and tibial spine limit the arthroscope and its instruments to maneuver around [2]. Lesions in the posterior horn of medial meniscus

Fig. 1. Patient’s position in lateral (A) and anteroposterior (B) view. The affected limb is positioned with the knee at 90° flexion off the table. The unaffected limb is placed in a lithotomy position.

Fig. 2. Left knee joint (A): (1) anterolateral portal skin marking, (2) anteromedial portal skin marking. (B): routine arthroscopic examination via anterolateral and anteromedial portals.

Fig. 3. (1) anterior cruciate ligament, (2) posterior cruciate ligament, (3) lateral femoral condyle, (4) medial wall of lateral femoral condyle, (5) medial femoral condyle, and (6) lateral wall of medial femoral condyle.
might be missed, femoral condyles’ posterosuperior compartment exposure might be inadequate, limitations to certain components of the posterior cruciate ligament (PCL) with poorly visualized posterior meniscofemoral ligament, septum, and posterior capsule [3].

**Current surgical technique**

Working around a divided posterior compartment of the knee joint arthroscopically is difficult due to its limited space and surrounding obstructing structures. Several techniques have been described in the literature to battle these difficulties [3,5,6]. Anterior and posterior triangulation via a transnotch approach, but presence of osteophyte at the femoral condyle, prominent tibial spine, or small knee joint, limits the arthroscope in the intercondylar notch. Lewicky and Abeshaus described a simpler anteromedial—posteromedial and anterolateral—posterolateral triangulation by introducing the arthroscope through the patella tendon [7]. Few disagree as this may cause tendinitis.

Kim et al [4] described a trans-septal technique in 1997, bridging the posterior compartments of the knee joint. This technique completely removed the arthroscope’s blind spot and provides an excellent field of the posterior compartment. Since then, many authors have described many innovative trans-septal techniques. Ahn et al. [5] described
penetrating the septum from posteromedial to posterolateral trans-septal approach by using a rod and shaver. Ohishi et al. [3] described a posterolateral-to-posteromedial trans-septal approach using Kischner wire. All these methods require a mandatory trans-notch approach [5]. Difficulties mentioned earlier might hinder the simplicity of this technique. The technique described only allows visualization at one side of the septum, while the other side is blinded.

Novelty of the new technique

Herein, the authors described their technique of trans-septal approach, which is simple and safe. They perform their technique routinely in PCL reconstruction, popliteus tendon reconstruction, PCL avulsion fixation, medial meniscus ramp lesion repair, hardware removal such as screws and loose bodies removal, and posterior compartment synovectomy.

Patients lie supine with the affected knee joint flexed at 90° on the table [Fig. 1]. The unaffected limb is in lithotomy position. The patient is put under spinal anesthesia. Tourniquet is inflated at 300 mmHg, and arthropump is used at 40 mmHg. Routine arthroscopic examination is performed via standard anterolateral and anteromedial portals using a 30° arthroscope. Both portals are 1 cm above the joint line, adjacent to lateral and medial border of the patella tendon [Fig. 2]. Once routine examination is performed, approach to the posterior compartment is established by these following steps.

Step 1 – Identifying the femoral insertions and borders of anterior cruciate ligament (ACL) and PCL [Fig. 3]. Intercruciate area is bounded—laterally: medial border of ACL, medially: lateral border of PCL, superiorly: intercondylar notch, and inferiorly: intersection between the medial border of ACL and lateral border of PCL [Fig. 4].

Step 2 – Soft tissue within the intercruicate area is removed using a motorized shaver (shaver) until the anterior border of the intercondylar fossa is visualized. The shaver’s tooth and probe are maintained in the upward direction and close to the bone to avoid injuring the cruciate ligaments. The shaver is then replaced by a radiofrequency ablation (probe) to cauterize soft tissues within the intercruicate area. The probe is used to obtain better soft tissue clearance off the bone for better bony visualization. Soft tissues are cauterized from 11 to 1 o’clock of the intercondylar fossa while advancing 1 cm posteriorly until the superior attachment of the posterior septum is identified [Fig. 5].

Step 3 – Two apertures are created at the septum [Fig. 6]. Firstly, the posterolateral aperture, which is located between 4 and 5 o’clock (8 and 9 o’clock in right knee) of the septum, is created. The shaver is used to shave off a small portion of the septum until it bridges into the posterolateral compartment of the knee joint. Second, the posteromedial aperture, which is located between 8 and 9 o’clock (4 and 5 o’clock in right knee) of the septum, is created. Similar process is repeated for the posteromedial aperture.

Step 4 – The arthroscope is advanced into the posteromedial compartment looking toward the posteromedial joint capsule. The

Fig. 7. Passing of Wissinger rod from medial to lateral. (A) Through the posteromedial aperture of the septum. (B) Passing anterior to the septum. (C) Passing into the posterolateral aperture of the septum.

Fig. 8. Skin marking on the lateral aspect of the left knee joint (1) lateral epi-condyle. (2) lateral collateral ligament. (3) head of fibula. (4) biceps femoris tendon. (5) posterolateral portal landmark.
capsule is palpated from the outside to locate a proper posteromedial portal—the soft spot between medial collateral ligament, medial head of the gastrocnemius muscle and semimembranosus tendon. Under direct visualization from inside of the joint, a 18 g spinal needle is inserted percutaneously from outside about 5 mm proximal to the medial meniscus, into the posteromedial compartment until the tip of the needle is seen. Transillumination technique is used to confirm the needle placement being away from crossing veins in the posteromedial aspect of the knee joint. A longitudinal stab incision is made alongside the needle by a number-11-size blade into the knee joint until the tip of the blade is seen penetrating the capsule. A straight hemostat is used to enlarge the stab wound. A Wissinger rod (rod) is inserted into the posteromedial compartment via the posteromedial portal. The arthroscope is now positioned viewing the anterior aspect of the intercondylar notch, and the rod is guided into the posterolateral compartment by passing through the posteromedial and posterolateral apertures of the septum [Fig. 7].

**Step 5** – The skin is marked on the lateral aspect of the knee joint illustrating the lateral collateral ligament (LCL), biceps femoris tendon

![Fig. 9](image_url)

(A) View from the posterolateral compartment into the posterolateral and posteromedial aperture of the posterior septum. (B) Similar view from the posterolateral compartment after the septum is partially removed.

![Fig. 10](image_url)

Anatomical position of the popliteal artery and middle genicular Artery—the posterior cruciate ligament is omitted for better viewing (Aldridge et al.).
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(BFT), and head of fibula. A soft spot within these borders is the landmark of the postero-lateral portal [Fig. 8]. The rod is then advanced laterally until it resists against the postero-lateral capsule. A protruded skin can be seen externally within the LCL, BFT, and 2 cm proximal to the head of fibula. While maintaining the tension against the capsule with the rod, blade number 11 is used to incise the skin until the tip of it is visualized. The rod is further advanced laterally. When the rod passes through these two portals (posteromedial and postero-lateral) and anterior to the septum via the two apertures, it pushes to the septum more posteriorly. An arthroscopy sheath is placed into the rod from lateral to medial and vice versa, to enlarge the posterior portals and windows of the septum.

**Step 6** – Once the trans-septal portal is established, the arthroscope is placed via the postero-lateral portal looking into the posteromedial aperture of the septum [Fig. 9]. The shaver is inserted via the posteromedial portal. Maintaining the shaver's tooth anteriorly, the posterior septum's lining is shaven off in an up-and-down manner. Caution is maintained not to shave off the superior insertion of the posterior septum to avoid injuring the middle geniculate vessels [3]. The posterolateral septum's lining is shaven off in a similar manner. The probe is used for further soft tissue clearance. Further planned procedures may proceed the after septum is shaven off.

Special attention should be given to avoid injuring the middle geniculate artery (MGA). This artery originates from the popliteal artery, where it enters the proximal portion of the septum [Fig. 10]. It distributes richer vasculature proximally than the distal portion of the septum. Therefore, it's advisable to initiate from the distal portion rather than the proximal portion to reduce MGA injury complications [8] while creating the trans-septal portal. The popliteal artery lies immediately behind the septum outside of the posterior capsule and with the knee in 90° flexion, the popliteal artery to falls more posteriorly, providing greater distance from the PCL [3]. This allows us to safely perforate the septum anteriorly when creating the apertures.

Few advantages of the authors’ technique [Fig. 11] include simple direct inter-cruciate approach with no obstructing obstacles and lesser

<table>
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<th>TECHNIQUE ADVANTAGES</th>
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<td>Direct visualisation of the posterior septum of the knee joint</td>
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<td>Safe. No vital structures within the inter-cruciate area.</td>
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<td>Easy. No obstacles or tight spaces to overcome in order to reach the posterior septum</td>
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<td>Allows direct visualisation of Wissinger rod passing Through the posterior septum</td>
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<td>No blunt penetration of the posterior septum</td>
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<td>No blinded vision while working with the posterior septum</td>
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<td>No injuries to the surrounding structures while manoeuvering the Arthroscope intro the posterior compartments. Eg. Femoral condyles, meniscus</td>
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**Operative Procedures**

- Posterior Cruciate Ligament Reconstruction [13]
- Popliteus Tendon Reconstruction [2]
- Medial Meniscus RAMP lesion repair [5]
- Posterior compartment loose bodies removal [4]
- Hardware removal eg: screw in post Posterior Cruciate Ligament avulsion fixation [1]
- Posterior compartment synovectomy in Pigmented Villonodular Synovitis [2]

**Fig. 11.** Advantages of the inter-cruciate trans-septal approach to the posterior compartment of the knee joint.

**Fig. 12.** List and number [ ] of procedures routinely done by the authors using the inter-cruciate trans-septal approach.
risk of injuring surrounding structures. It is safe as no vitals structures are located within the intercruicate area, and no blind penetration of the septum is done. The rod is guided visually in passing through the septum from the posteromedial to posterolateral compartment. The posterolateral portal blind penetration is considered safe as the exit point (soft spot) is between the LCL, BFT, and fibula head, where no important structures are located within. However, be cautious not to injure the posterolateral capsule as the popliteal artery runs 10 mm laterally to the septum. In cases where the rod is not protruded in the safe posterolateral soft spot, an outside-in posterolateral portal creation via the safe soft spot should be performed. Pitfall of this approach is seen in smaller knee joints with shorter intercondylar width. This may cause some difficulties in maneuvering the arthroscope or the instruments due to tight space of the notch causing overcrowding.

Outcomes

The authors have performed this approach on 24 patients with pathologies in the posterior compartment of the knee joint [Fig. 12] and have not encountered any complications such as vascular injuries (popliteal artery, MGA, saphenous veins) or nerve injuries (posterior tibial nerve, saphenous nerve). On follow ups with minimum of 6 months, no active complaints are seen, and patients were able to return to their daily activities after undergoing their scheduled rehabilitation program.

Conclusion

This technique of approaching the posterior compartment of the knee joint via an intercruicate trans-septal approach, for the pathologies in the posterior compartment of the knee joint is a safe and reliable technique.

Author contributions

Bancha Chernchujit: Conceptualization, Methodology, Writing - Review and Editing, Supervision, Validation.
Ling Jian Loong: Writing - Original Draft, Visualization, Data Curation, Investigation.
Sagar Chaudhari: Visualization, Data Curation.

Conflict of interest

The authors have no financial disclosure or conflicts of interest with the presented materials.

References