Technical Note

Four-Tunnel Double-Bundle Posterior Cruciate Ligament Reconstruction With Remnant Preservation

Jinzhong Zhao, M.D.

Abstract: The clinical results of posterior cruciate ligament reconstruction (PCL) still leave much room for improvement. To get better knee stability, the double-bundle reconstruction, the use of strong grafts, and the preservation of the remnant have been applied. However, the combination of the 3 measures has seldom been reported. Thus I introduce a 4-tunnel double-bundle PCL reconstruction technique, in which I combine the use of strong grafts and preservation of the remnant. The critical point of this technique is manipulating skillfully across the femoral notch with the preservation, as well as the hindrance to operation of the PCL remnant. My clinical experience indicates this technique is somewhat complicated but most effective. I believe the introduction of this technique will provide an additional choice when PCL reconstruction is to be performed.

The incidence of PCL injury is relatively low. However, PCL reconstruction causes constant concern because the clinical results of PCL reconstruction lag behind anterior cruciate ligament reconstruction. To improve the clinical results of PCL reconstruction, double-bundle PCL reconstruction techniques, with a single tibial tunnel or tibial inlay technique mostly, have been reported.[1-3] PCL reconstructions with remnant preservation are also valuable attempts.[4-6] Furthermore, previous studies indicate that the use of stronger grafts in PCL reconstruction lead to better clinical results.[7,8] Thus, in my clinical practice, I combine a 4-tunnel double-bundle PCL reconstruction, remnant preservation, and the use of strong grafts to form the current technique. The indication of the current technique is the to-be-operated PCL injury with residual fibers that connect the femur and the tibia.

Surgical Technique

The patient is in the supine position, with the knee flexed 90° and with the leg leaning against a laterally positioned post.

Graft Preparation

The semitendinosus tendon (ST), the gracilis tendon (GT), and the anterior half of the peroneus longus tendon (AHPLT)[9] are harvested and prepared (Table 1, Video 1). The GT and the AHPLT are used to make a 6-stranded graft to reconstruct the anterolateral (AL) bundle, and the ST is used to make a 4-stranded graft to reconstruct the posteromedial (PM) bundle (Fig 1). The PM-bundle graft is pretensioned until graft implantation.

Creation of Posteromedial and Posterolateral Portals

The AL and anteromedial (AM) portals are fashioned, and combined lesions are treated. The arthroscope is placed into the PM compartment through the AL portal, and the PM portal is created. The arthroscope is placed through the PM portal, pushed against the center of the posterior septum, and changed with an obturator. The trocar with the obturator is pushed through the posterior septum into the posterolateral (PL) compartment. The arthroscope is placed into the PL compartment, and the PL portal is created (Fig 2).

Exposing PCL Tibial Insertion Site

A shaver is placed into the PL compartment through the PL portal. Along with the retrieval of the arthroscope

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Table 1. Step-by-Step Procedures of Four-Tunnel Double-Bundle Posterior Cruciate Ligament Reconstruction With Remnant Preservation

The semitendinosus tendon the gracilis tendon and the AHPLT are harvested.
A 6-stranded graft is made from the gracilis tendon and the AHPLT to reconstruct the AL bundle. A 4-stranded graft is made from the semitendinosus tendon to reconstruct the PM bundle.
The AL and AM arthroscopy portals are fashioned, and combined lesions are treated.
The PM and the PL portals are created.
Part of the posterior septum is removed to expose the PCL at insertion.
A PCL tibial tunnel locator is placed through the AM portal and the lateral side of the PCL remnant to the posterior compartments.
The PCL tibial tunnel locator is set at the AL part of the PCL tibial insertion site. A K wire is drill for later creation of the AL tibial tunnel.
The PCL tibial tunnel locator is placed through the AM portal and the medial side of the PCL remnant to the posterior compartments.
The tibial tunnel locator is set at the PM part of the PCL tibial insertion site, a K wire is drilled in for later creation of the PM tibial tunnel.
The two femoral tunnels are marked and created with inside-out method.
A switching stick is placed through the PL portal to push the posterior capsule backwards to increase the buffer space for the drilling.
The tibial tunnels are created with corresponding cannulated drills over the K wires.
One guide suture loop is placed through the AL portal and the lateral side of the PCL remnant to the posterior compartments and pulled through the AL-bundle tibial tunnel.
Another guide suture loop is placed through the AL portal and the medial side of the PCL remnant to the posterior compartments and pulled through the PM-bundle tibial tunnel.
An incision is made over the medial femoral epicondyle.
The proximal end of the guide suture loop for the AL bundle is passed through the AL-bundle femoral tunnel.
The proximal end of the guide suture loop for the PM bundle is passed through the PM-bundle femoral tunnel.
A switching stick is placed through the PL portal to the anterior inferior side of the guide suture loop for the PM bundle.
The fixing sutures on the proximal end of the graft of the PM bundle are pulled through the tibial and the femoral tunnels.
The graft of the PM bundle is levered into the posterior compartment and pulled to the femoral tunnel.
An obturator is placed at the inferior posterior side of the proximal fixing sutures at the inner orifice of the PM-bundle femoral tunnel. The PM-bundle graft is pulled into the femoral tunnel.
The proximal fixing sutures from the PM-bundle graft are fixed onto a cortical fixation button over the outer orifice of the PM-bundle femoral tunnel.
A switching stick is placed through the PL portal to the anterior inferior side of the guide suture loop for the AL bundle.
The fixing sutures on the proximal end of the graft of the AL bundle are pulled through the tibial and the femoral tunnels.
The graft of the AL bundle is levered into the posterior compartment and pulled to the femoral tunnel.
An obturator is placed at the inferior posterior side of the proximal fixing sutures at the inner orifice of the AL-bundle femoral tunnel. The AL-bundle graft is pulled into the femoral tunnel.
The proximal fixing sutures from the AL-bundle graft are fixed onto a cortical fixation plate over the outer orifice of the AL-bundle femoral tunnel.
Interference screws are placed into the tibial tunnels to the inner orifices for primary fixation at knee extension.
A transtibial ridge tunnel is created at a plane distal to the outer orifices of the tibial tunnels.
A cortical suspensory fixation device with an adjustable suture loop is set through this transtibial ridge tunnel.
The sutures from the distal ends of the graft are fixed to the adjustable loop.

AHPLT, anterior half of the peroneus longus tendon; AL, anterolateral; PM, posteromedial; AM, anteromedial; PL, posterolateral; PCL, posterior cruciate ligament.

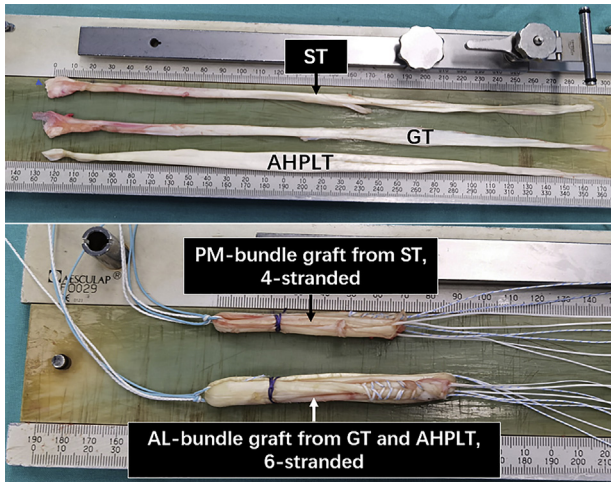

Fig 1. Illustration of the preparation of the grafts. The gracilis tendon and the anterior half of the peroneus longus tendon are used to make a 6-stranded graft to reconstruct the anterolateral bundle of the posterior cruciate ligament. The semitendinosus tendon is used to make a 4-stranded graft to reconstruct the posteromedial bundle of the posterior cruciate ligament. ST, the semitendinosus tendon. GT, the gracilis tendon. AHPLT, the anterior half of the peroneus longus tendon.

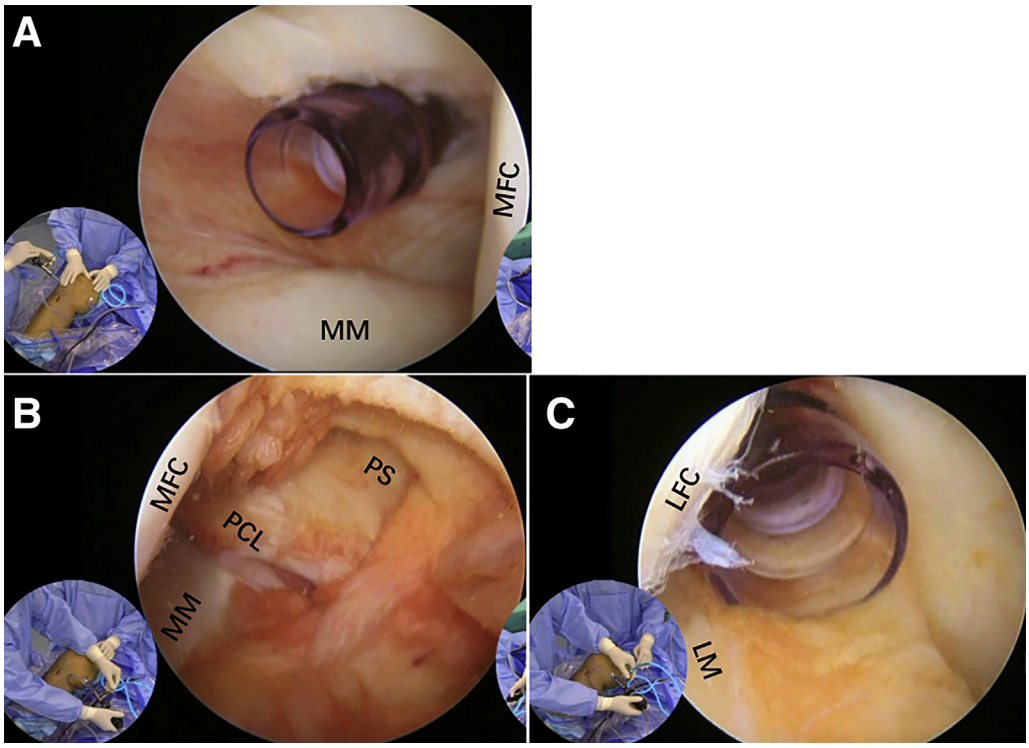

Fig 2. Creating the posteromedial portal (A, arthroscopic view of the posteromedial compartment of the right knee through the anterolateral portal), locating the posterior septum (B, arthroscopic view of the posteromedial compartment of the right knee through the posteromedial portal), and creating the posterolateral portal (C, arthroscopic view of the posterolateral compartment of the right knee through the posteromedial portal and the posterior septum). MFC, medial femoral condyle; LFC, lateral femoral condyle; MM, medial meniscus; LM, lateral meniscus; PS, posterior septum; PCL, the remnant of the posterior cruciate ligament.

back to the PM compartment, the shaver is placed into the posterior septum. Part of the posterior septum is removed to expose the PCL at the tibial insertion (Fig 3).

Placing Guidewires for the Tibial Tunnels

The arthroscope is placed through the AL portal. A PCL tibial tunnel locator (Smith & Nephew, Andover,

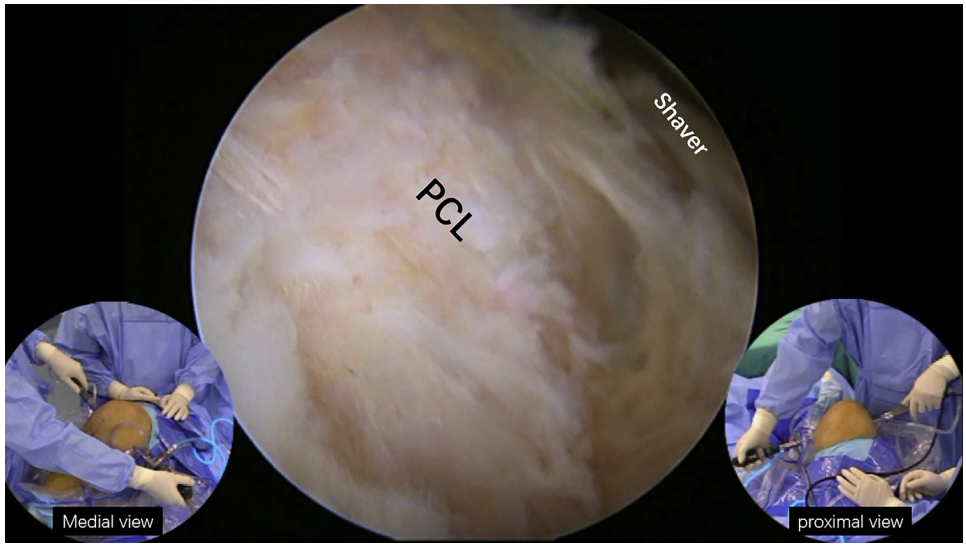

Fig 3. Part of the posterior septum is removed to expose the remnant of the posterior cruciate ligament at the tibial insertion (Arthroscopic view of the posterior compartments of the right knee through the posteromedial portal). PCL, remnant of the posterior cruciate ligament.

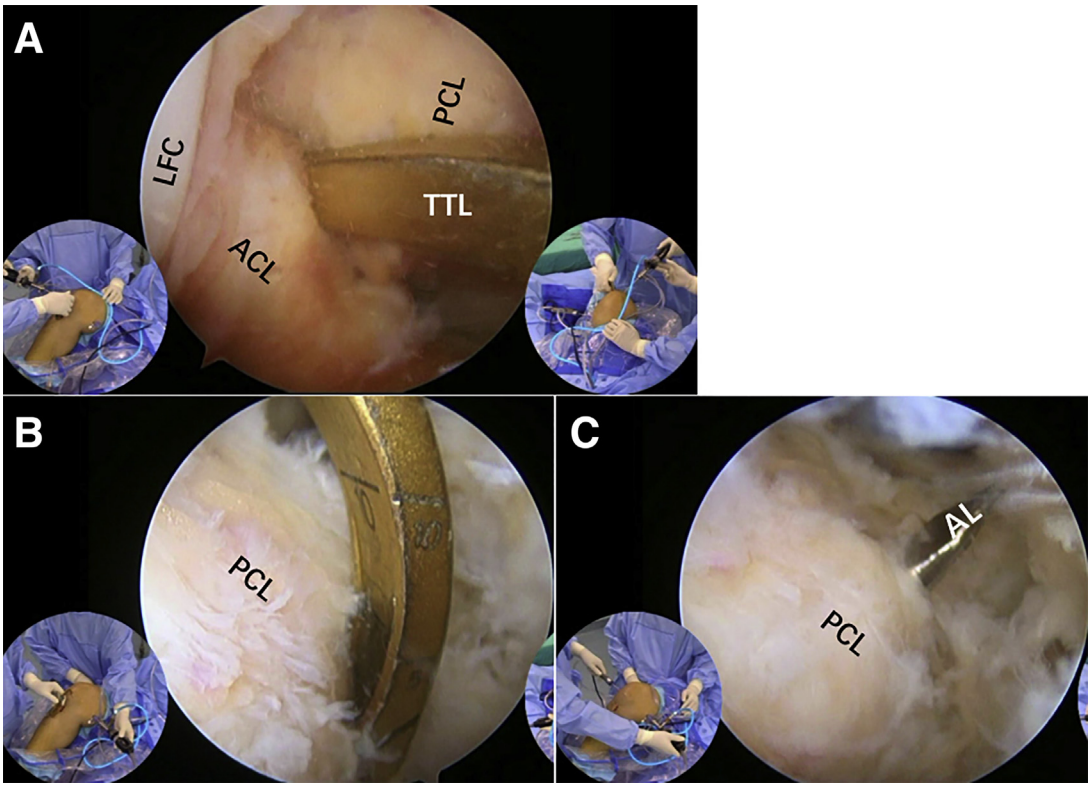

Fig 4. Placement of the guidewire to create the anterolateral-bundle tibial tunnel. (A) A tibial tunnel locator for posterior cruciate ligament reconstruction (Smith & Nephew, Andover, MA) is placed through the anteromedial portal and the lateral side of the remnant of the posterior cruciate ligament, to the posterior compartments (Arthroscopic view of the femoral notch of the right knee through the anterolateral portal). (B and C) The tibial tunnel locator is set at the anterolateral part of the tibial insertion site of the posterior cruciate ligament, approximately 10 mm anterior to the posterior capsule insertion on the tibia and a K wire is drilled in (Arthroscopic view of the posterior compartments of the right knee through the posteromedial portal). AL, the guidewire to create the anterolateral-bundle tunnel; ACL, anterior cruciate ligament; PCL, the remnant of the posterior cruciate ligament; TTL, tibial tunnel locator for PCL reconstruction; LFC, lateral femoral condyle.

MA) is placed through the AM portal and the lateral side of the PCL remnant, to the posterior compartments (Fig 4A). The arthroscope is placed through the PM portal. The PCL tibial tunnel locator is set at the AL part of the PCL tibial insertion site, approximately 10 mm anterior to the posterior capsule insertion on the tibia (Fig 4B). A K wire is drilled in from the medial edge of the tibial tubercle at an angle of 45° to the tibial axis for later creation of the AL-bundle tibial tunnel (Fig 4C).

The arthroscope is placed through the AL portal. The PCL tibial tunnel locator is placed through the AM portal and the medial side of the PCL remnant to the posterior compartments (Fig 5A). The arthroscope is placed through the PM portal. The tibial tunnel locator is set at the PM part of the PCL tibial insertion site (Fig 5B), approximately 7 mm anterior to the posterior capsule insertion on the tibia. Another K wire is drilled in for later creation of the PM-bundle tibial tunnel, parallel to the K wire for the AL bundle (Figs 5C and 6).

Creating Femoral Tunnels

The femoral tunnels are created in an inside-out manner. The AL bundle is located 12 mm posterior to anterior cartilage edge and 7 to 8 mm proximal to the distal cartilage edge. The PM bundle is in the most posterior part of the PCL footprint (Fig 7). The 2 femoral tunnels are created sequentially with a K wire, a cannulated drill, and a 4.5 mm cannulated drill for each tunnel (Figs 8 and 9).

Creating the Tibial Tunnels

A switching stick is placed through the PL portal to push the posterior capsule from the PCL tibial insertion to increase the buffer space for the drilling. The tibial tunnels are created with corresponding cannulated drills over the K wires (Figs 10 and 11).

Placing Guide Suture Loop for Graft Implantation

With the arthroscope placed through the AM portal, the PCL remnant and the meniscofemoral ligament are separated with an obturator. A guide suture loop

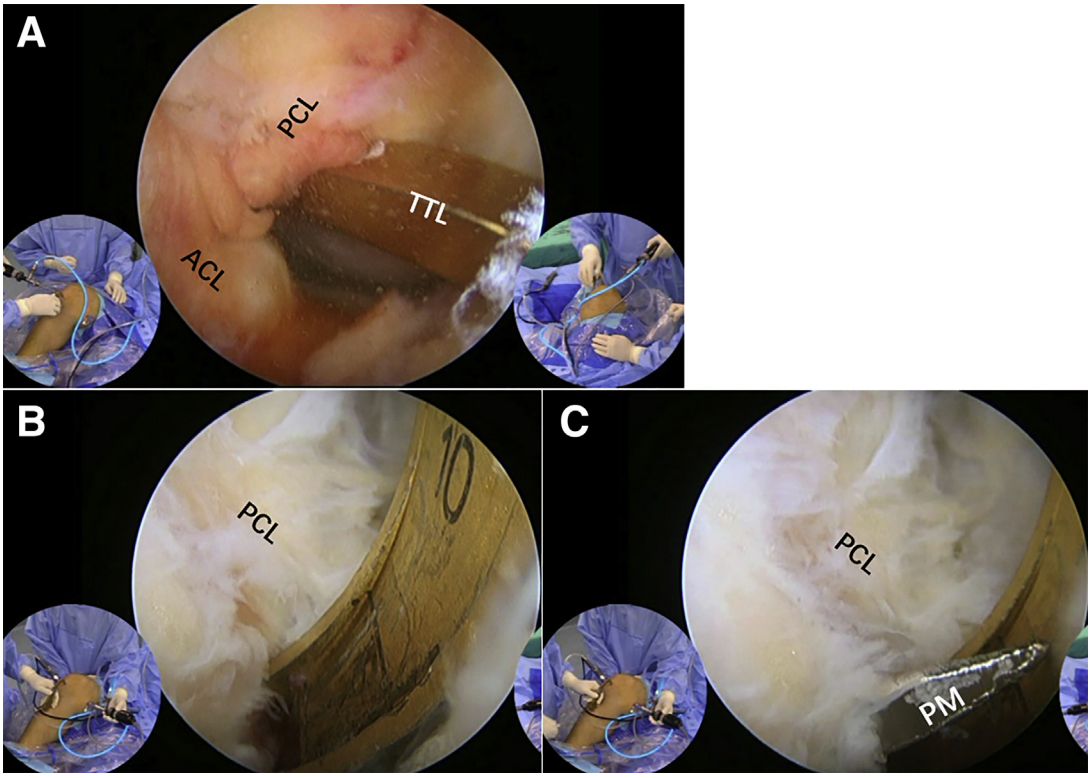

Fig 5. Placement of the guidewire to create the posteromedial-bundle tibial tunnel. (A) A tibial tunnel locator for posterior cruciate ligament reconstruction (Smith & Nephew, Andover, MA) is placed through the anteromedial portal and the medial side of the remnant of the posterior cruciate ligament, to the posterior compartments (Arthroscopic view of the femoral notch of the right knee through the anterolateral portal). (B and C) The tibial tunnel locator is set at the posteromedial part of the tibial insertion site of the posterior cruciate ligament, approximately 7 mm anterior to the posterior capsule insertion on the tibia, and a K wire is drilled in (Arthroscopic view of the posterior compartments of the right knee through the posteromedial portal). PM, the guidewire to create the anterolateral-bundle tunnel; ACL, anterior cruciate ligament; PCL, the remnant of the posterior cruciate ligament. TTL, tibial tunnel locator for PCL reconstruction.

for the AL-bundle reconstruction is passed from the AL portal through the lateral side of the PCL remnant to the PM compartments. The arthroscope is placed through the PM portal. The guide suture loop is pulled through the AL bundle tibial tunnel (Fig 12). Then the guide suture loop for PM-bundle reconstruction is

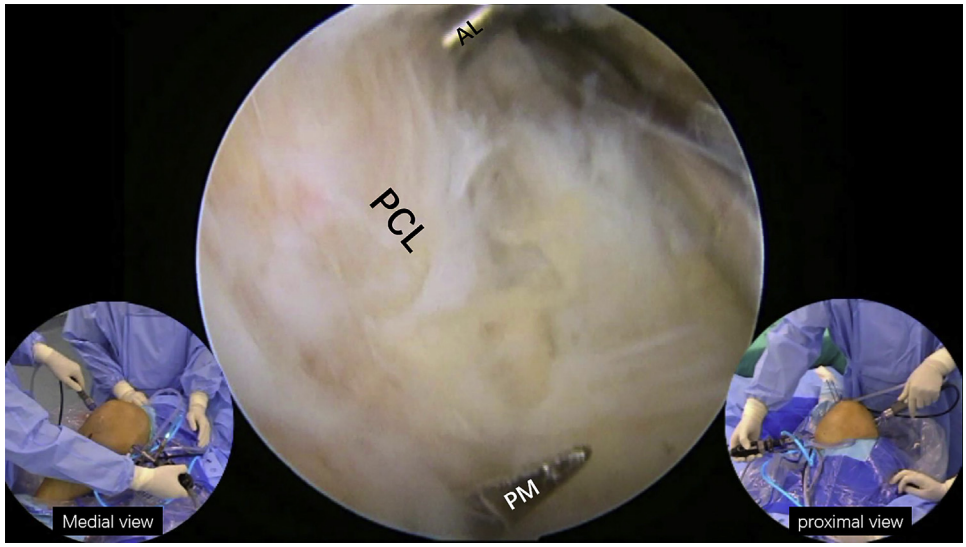

Fig 6. The location of the 2 guidewires for tibial tunnel creation. (Arthroscopic view of the posterior compartments of the right knee through the posteromedial portal). AL, guidewire for the anterolateral-bundle tibial tunnel; PM, guidewire for the posteromedial-bundle tibial tunnel.

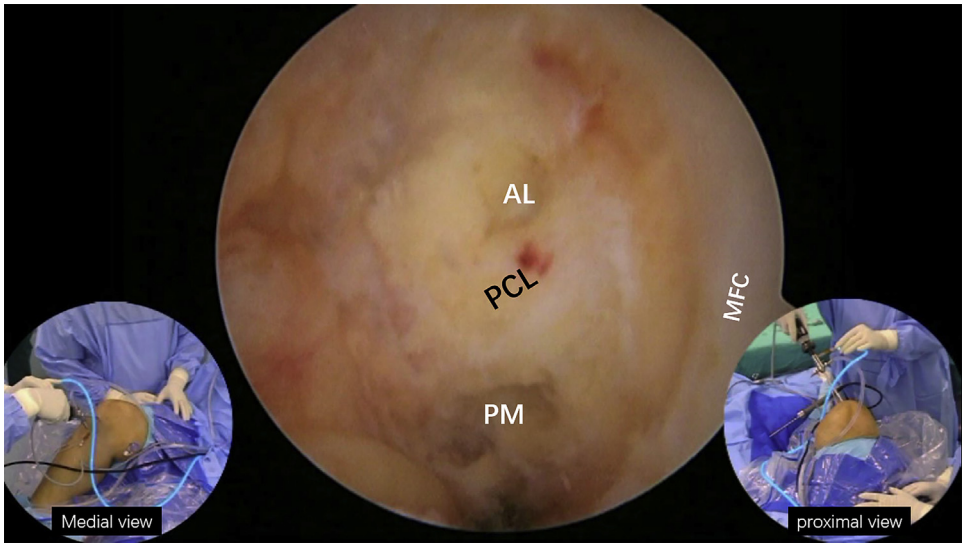

Fig 7. The locations of the femoral tunnels are marked (Arthroscopic view of the medial wall of the femoral notch of the right knee through the anterolateral portal). AL, location of the anterolateral bundle; PM, location of the posteromedial bundle; PCL, the remnant of the posterior cruciate ligament.

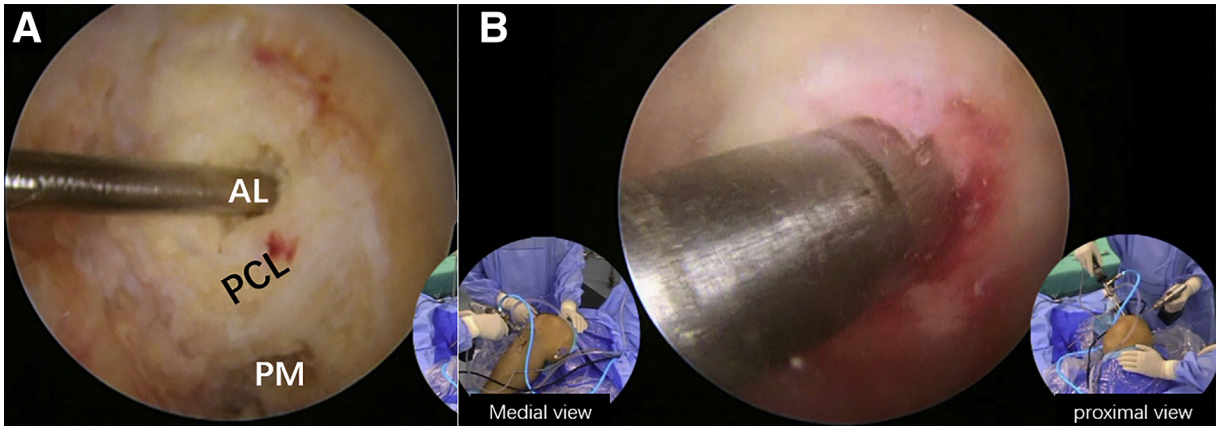

Fig 8. Creation of the femoral tunnel for the anterolateral bundle of the posterior cruciate ligament sequentially with a K wire (A) and a cannulated drill (B) (Arthroscopic view of the medial wall of the femoral notch of the right knee through the anterolateral portal). AL, location of the anterolateral bundle; PM, location of the posteromedial bundle; PCL, the remnant of the posterior cruciate ligament.

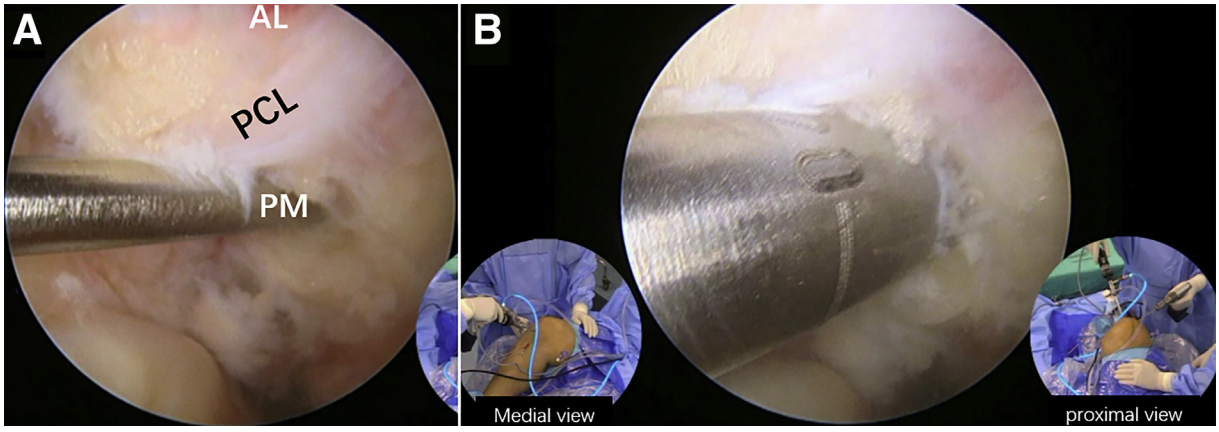

Fig 9. Creation of the femoral tunnel for the posteromedial bundle of the posterior cruciate ligament sequentially with a K wire (A)and a cannulated drill (B) (Arthroscopic view of the medial wall of the femoral notch of the right knee through the anterolateral portal). AL, location of the anterolateral bundle; PM, location of the posteromedial bundle; PCL, the remnant of the posterior cruciate ligament.

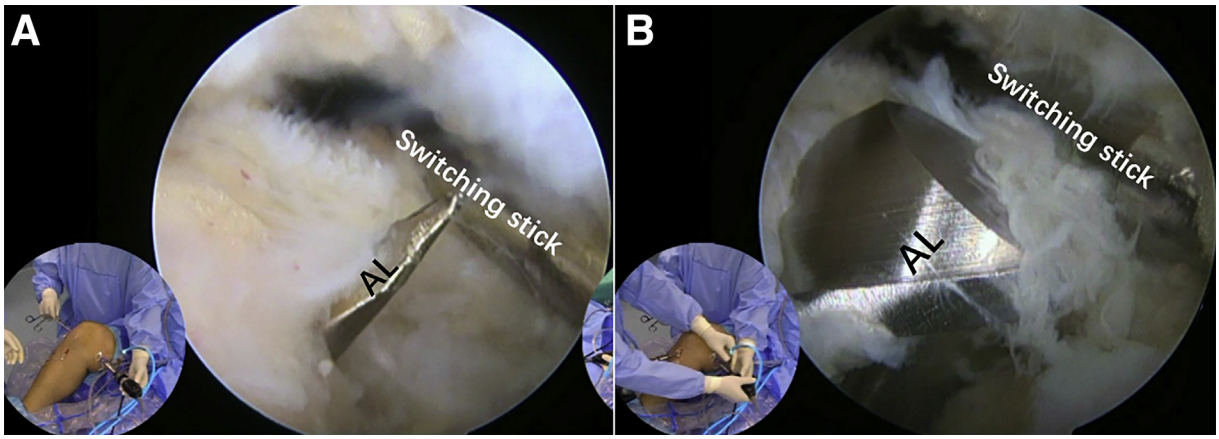

Fig 10. Creation of the tibial tunnel for the anterolateral bundle (Arthroscopic view of the posterior compartments of the right knee through the posteromedial portal). (A) A switching stick is placed through the posterolateral portal to push the posterior capsule backward to increase the buffer space for the drilling. (B) The anterolateral-bundle tibial tunnel is created with a cannulated drill. AL, the K wire, and the drill for anterolateral-bundle tunnel creation.

passed from the AL portal through medial side of the PCL remnant and pulled through the PM-bundle tibial tunnel (Fig 13).

An incision is made over the medial femoral epicondyle. The arthroscope is placed through the AM portal, and 1 guide pin with a tailing suture loop is passed inside-out through the femoral tunnels to pull the proximal ends of the guide suture loops through the corresponding femoral tunnels (Fig 14).

Implantation and Proximal Fixation of the Grafts

The arthroscope is placed through the PM portal. A switching stick is placed through the PL portal to the anterior inferior side of the guide suture loop for the PM bundle as a pulley. The fixing sutures on the proximal end of the PM-bundle graft are pulled through the tibial and femoral tunnels with the guide suture (Fig 15). With constant pulling of the fixing sutures, the graft is levered into the posterior compartment. The arthroscope is placed through the AL portal. An obturator is placed at the inferior posterior side of the fixing sutures at the inner orifice of the femoral tunnel and used as a pulley. The graft is pulled into the femoral tunnel (Fig 16). The proximal fixing sutures are fixed to a cortical fixation button (Smith & Nephew) that lies over the outer orifice of the PM-bundle femoral tunnel. The PL-bundle graft is pulled through the tibial tunnel into the femoral tunnel and fixed onto a cortical fixation button similarly (Figs 17 and 18).

Distal Fixation of the Grafts

The tibial ends of the 2 grafts are tensioned (Fig 19). Interference screws are placed into the tibial tunnels to the inner orifices for primary fixation (Fig 20). A transtibial ridge tunnel is created at a plane distal to

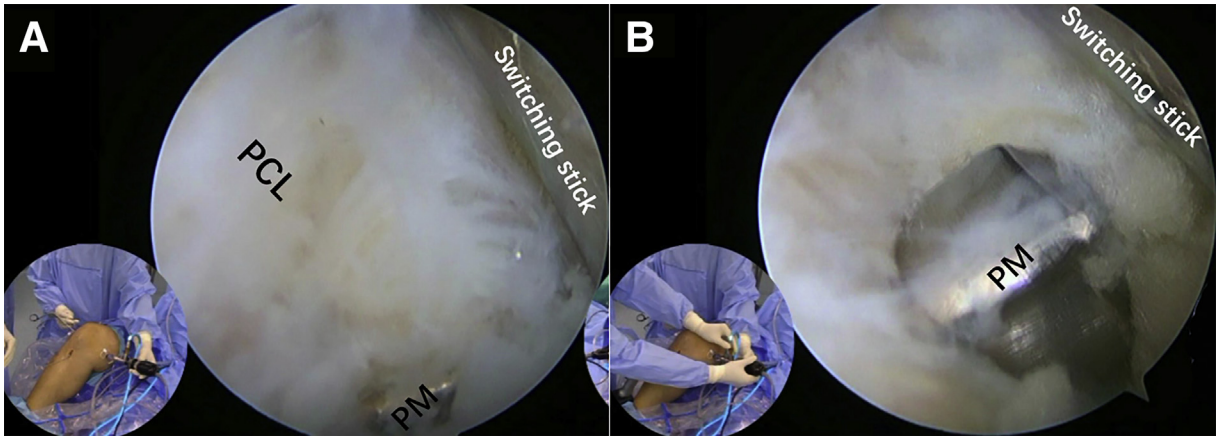

Fig 11. Creation of the tibial tunnel for the posteromedial bundle (Arthroscopic view of the posterior compartments of the right knee through the posteromedial portal). (A) A switching stick is placed through the posterolateral portal to push the posterior capsule backward to increase the buffer space for the drilling. (B) The posteromedial-bundle tibial tunnel is created with a cannulated drill. PM, the K wire, and the drill for posteromedial-bundle tunnel creation.

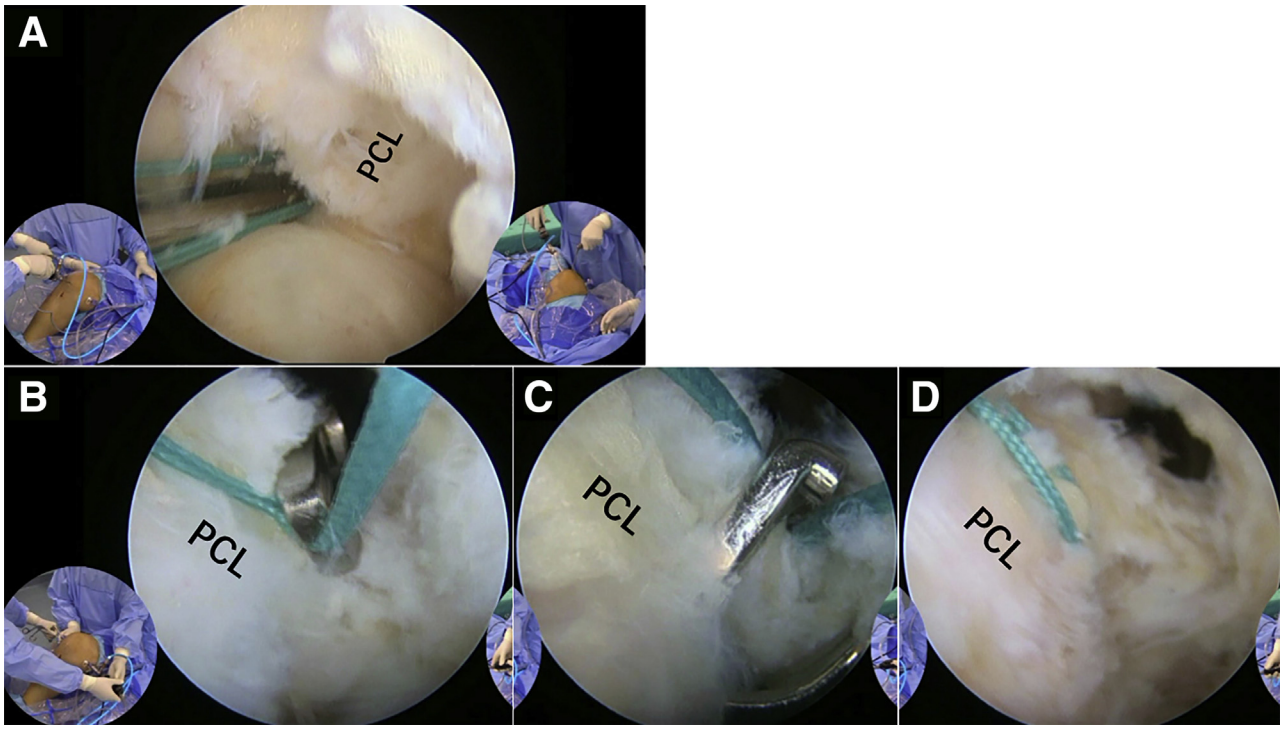

Fig 12. Placement of the guide suture for anterolateral-bundle graft placement. (A) A guide suture loop is placed through the anterolateral portal and the lateral side of the remnant of the posterior cruciate ligament, to the posterior compartments (Arthroscopic view of the femoral notch of the right knee through the anteromedial portal). (B-D) The guide suture loop is held with a suture retriever from the posterolateral portal to the anterolateral-bundle tibial tunnel and retrieved through the tunnel (Arthroscopic view of the posterior compartments of the right knee through the posteromedial portal). PCL, the remnant of the posterior cruciate ligament.

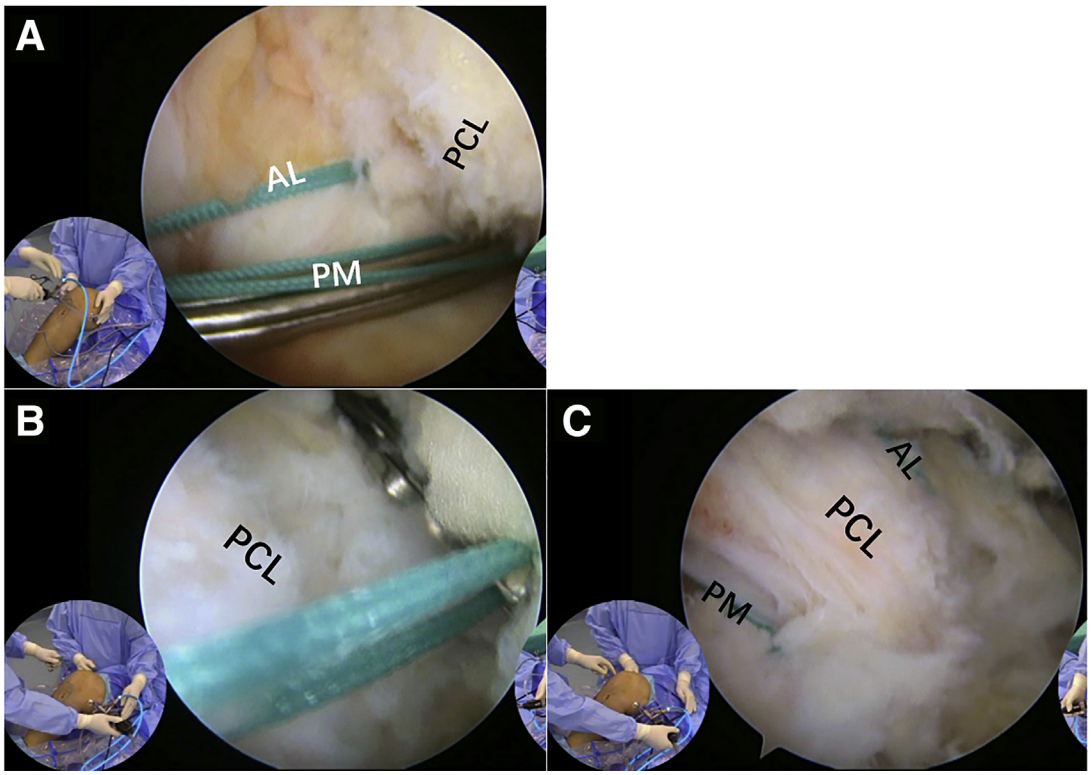

Fig 13. Placement of the guide suture for posteromedial-bundle graft placement. (A) A guide suture loop is placed through the anterolateral portal and the medial side of the remnant of the posterior cruciate ligament, to the posterior compartments (Arthroscopic view of the femoral notch of the right knee through the anteromedial portal). (B and C) The guide suture loop is held with a suture retriever from the posterolateral portal to the posteromedial-bundle tibial tunnel and retrieved through the tunnel (Arthroscopic view of the posterior compartments of the right knee through the posteromedial portal). PCL, the remnant of the posterior cruciate ligament; AL, guide suture for the anterolateral bundle; PL, guide suture for the posteromedial bundle.

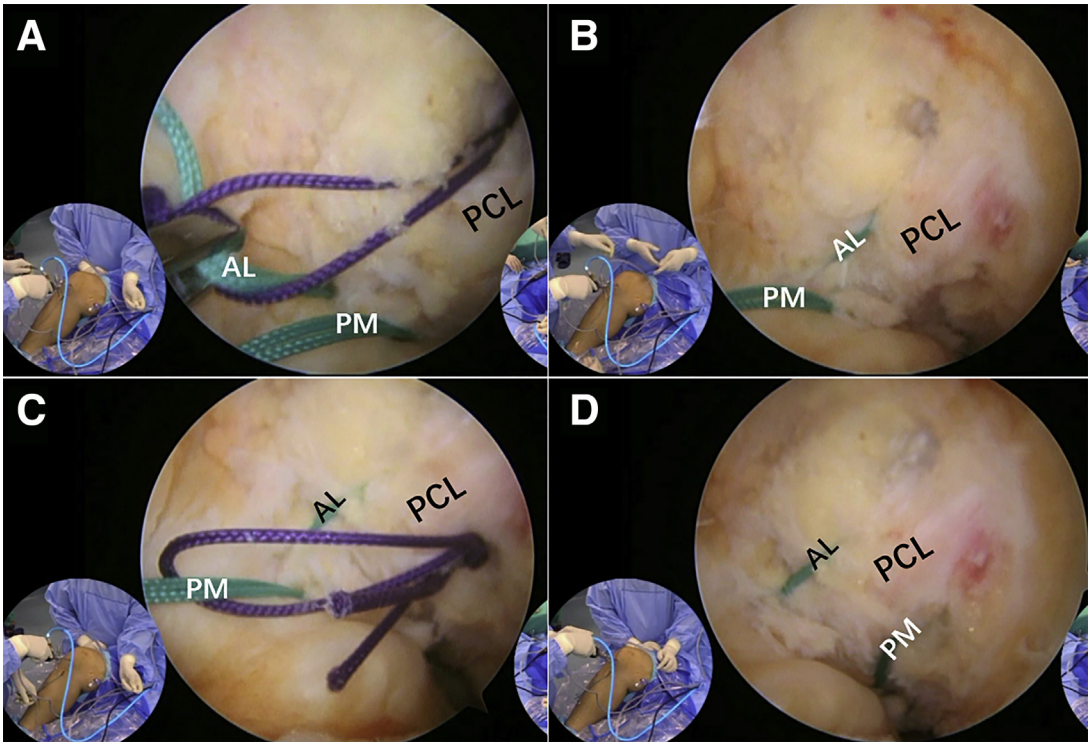

Fig 14. Placement of the guide suture through the femoral tunnels (Arthroscopic view of the right knee through the anteromedial portal). A, retrieving the guide suture loop for the anterolateral bundle through the suture loop tailing a guide pin through the anterolateral-bundle femoral tunnel. (B) Passing the guide suture through the anterolateral-bundle femoral tunnel. (C) Retrieving the guide suture loop for the posteromedial bundle through the suture loop tailing a guide pin through the posteromedial-bundle femoral tunnel. (D) Passing the guide suture through the posteromedial-bundle femoral tunnel. PCL, the remnant of the posterior cruciate ligament; AL, guide suture for the anterolateral bundle; PM, guide suture for the posteromedial bundle.

the outer orifices of the tibial tunnels. A cortical suspensory fixation device with an adjustable loop (Mitek, Raynham, MA) is set through this transtibial ridge tunnel. The sutures from the distal ends of the graft are fixed at the adjustable loop (Fig 21).

Postoperative Treatment and Rehabilitation

A PCL protecting brace (MEDI, Bayreuth, Germany) is used for the first 6 weeks, which allows immediate range-of-motion exercises with support at the posterior side of the proximal leg. Partial to full weightbearing is

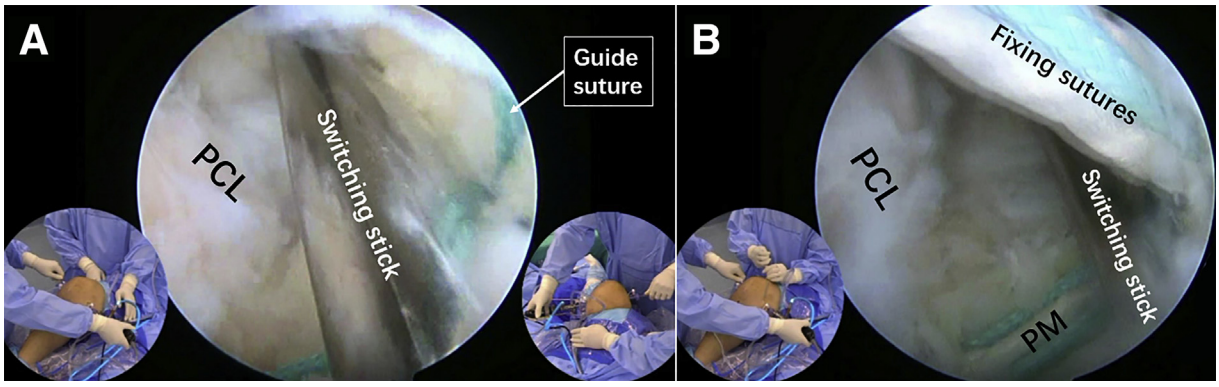

Fig 15. Placing the fixing sutures from the posteromedial bundle into the joint (Arthroscopic view of the posterior compartments of the right knee through the posteromedial portal). (A) Switching stick is placed through the posterolateral portal to the anterior inferior side of the guide suture loop. (B) The fixing sutures from the posteromedial bundle is pulled into the joint and through the corresponding femoral tunnel. PCL, the remnant of the posterior cruciate ligament; PM, fixing sutures for the posteromedial bundle.

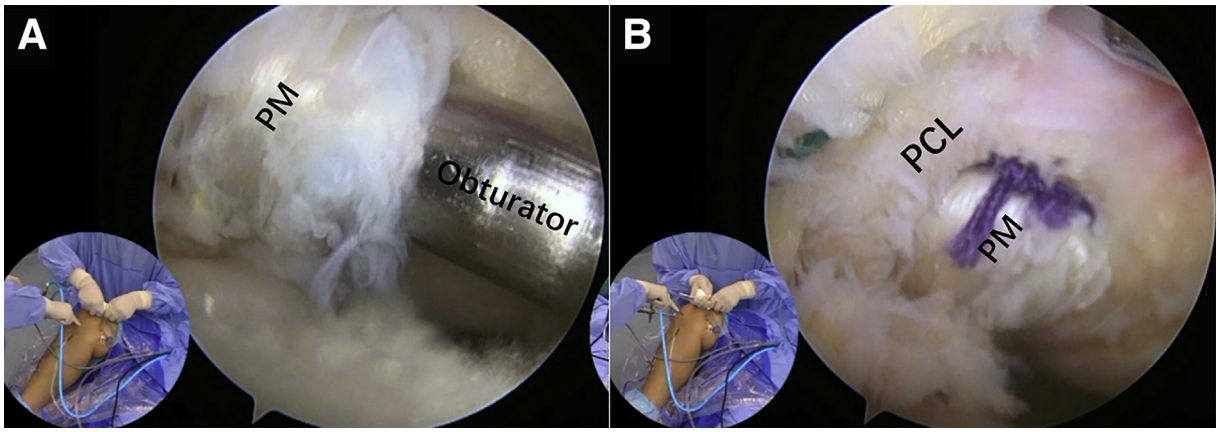

Fig 16. Placement of the graft of the posteromedial bundle into the femoral tunnel (arthroscopic view of the medial wall of the femoral notch of the right knee through the anterolateral portal). (A) an obturator is placed at the inferior posterior side of the fixing sutures at the inner orifice of the femoral tunnel and used as a pulley. (B) The posteromedial-bundle graft is pulled into the femoral tunnel. PCL, the remnant of the posterior cruciate ligament; PM, the posteromedial-bundle graft.

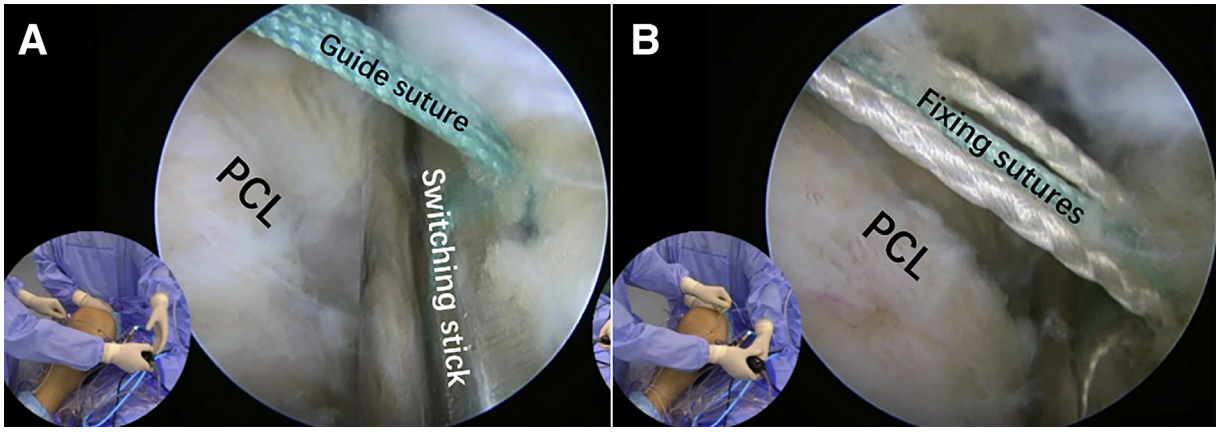

Fig 17. Placing the fixing sutures from the anterolateral bundle into the joint (Arthroscopic view of the posterior compartments of the right knee through the posteromedial portal). (A) Switching stick is placed through the posterolateral portal to the anterior inferior side of the guide suture loop for the anterolateral bundle. (B) The fixing sutures from the anterolateral bundle is pulled into the joint and through the corresponding femoral tunnel. PCL, the remnant of the posterior cruciate ligament.

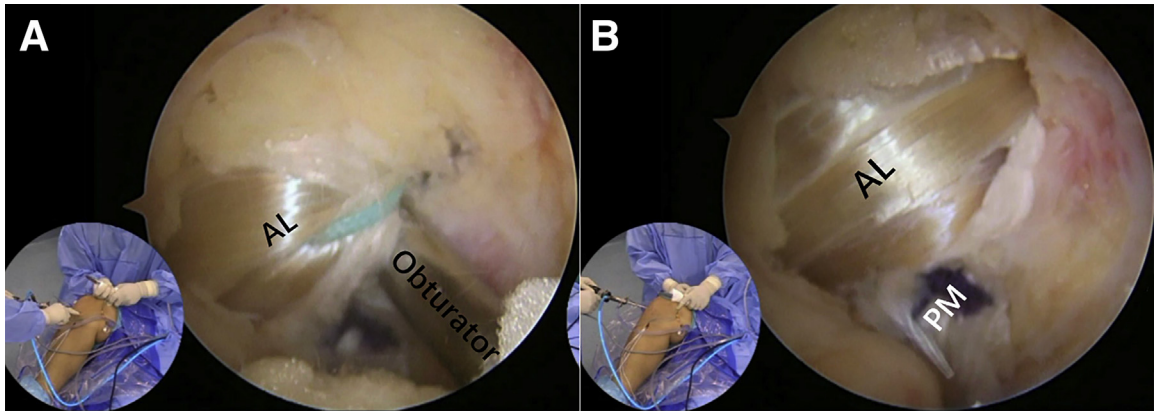

Fig 18. Placement of the graft of the anterolateral bundle into the femoral tunnel (arthroscopic view of the medial wall of the femoral notch of the right knee through the anterolateral portal). (A) An obturator is placed at the inferior posterior side of the fixing sutures at the inner orifice of the femoral tunnel and used as a pulley. (B) The anterolateral-bundle graft is pulled into the femoral tunnel. AL, the anterolateral-bundle graft; PM, the posteromedial-bundle graft.

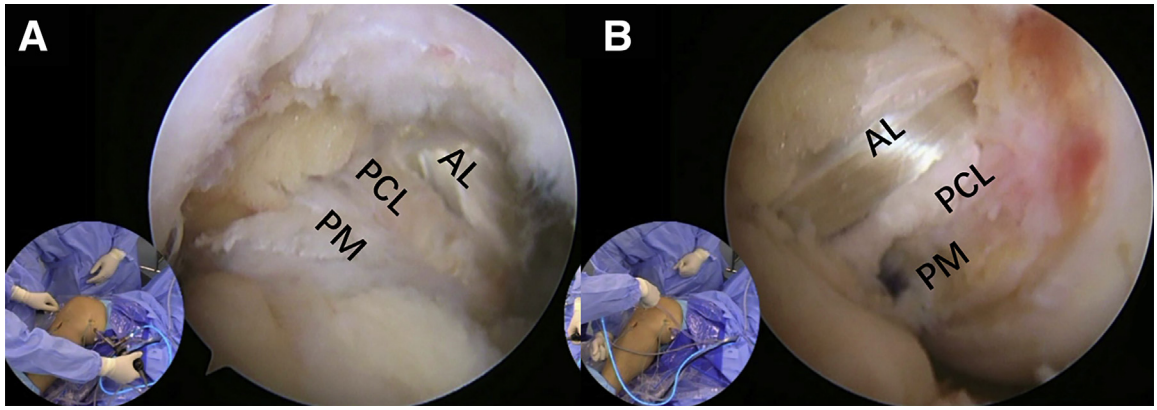

Fig 19. The grafts after proximal fixation and distal tensioning (A) Arthroscopic view of the posterior compartments of the right knee through the posteromedial portal. (B,) arthroscopic view of the medial wall of the femoral notch of the right knee through the anterolateral portal). AL, the anterolateral-bundle graft; PM, the posteromedial-bundle graft; PCL, the remnant of the posterior cruciate ligament.

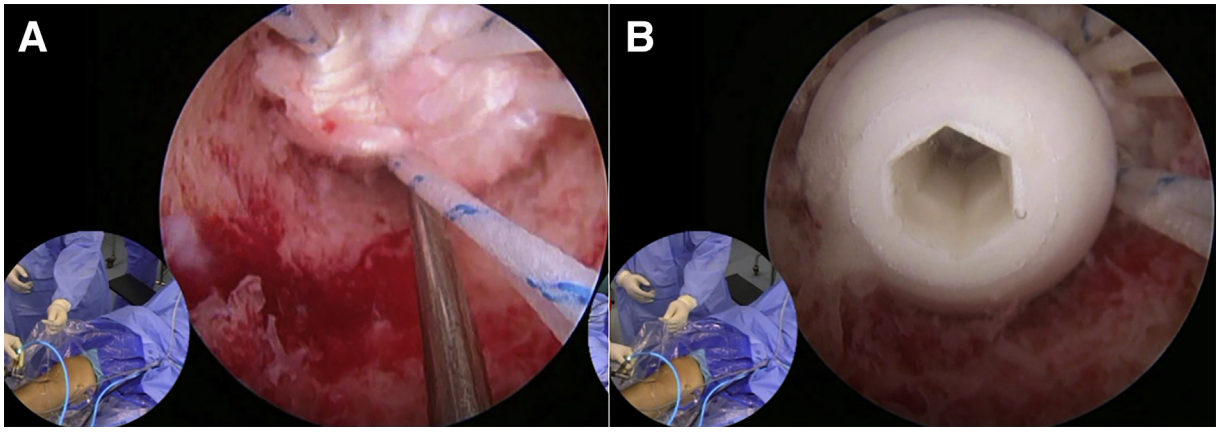

Fig 20. Tibial fixation of the graft at the inner orifice of the tunnel (Arthroscopic view of the tibial tunnel for the anterolateral bundle). (A) A guidewire is placed at the posterior side of the graft. (B) The graft is placed in.

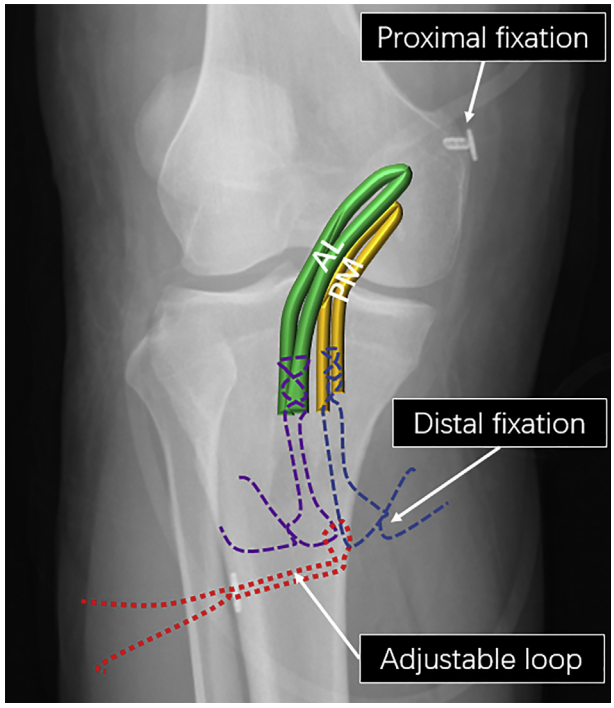

Fig 21. Illustration of the proximal fixation to cortical buttons and distal fixation at a suture loop in a cortical suspensory fixation device.

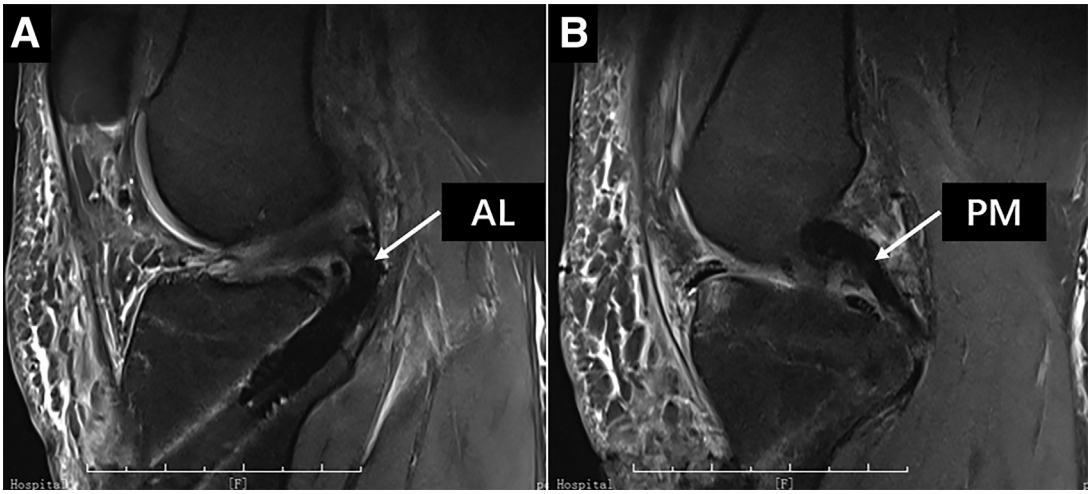

Fig 22. Postoperative sagittal view magnetic resonance images indicating the curving anterolateral-bundle graft (A) and the straight posteromedial-bundle graft (B) (right knee).

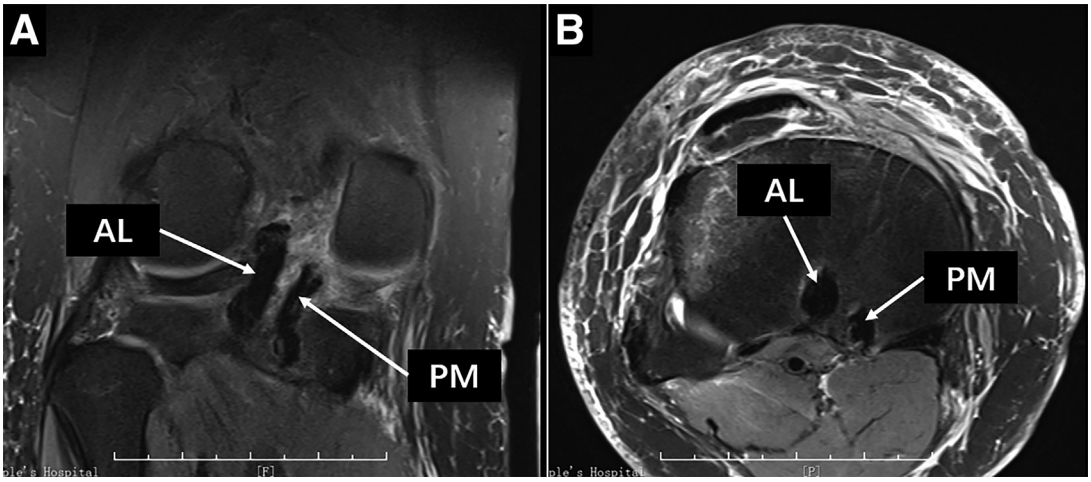

Fig 23. Postoperative coronary (A) and transverse (B) view magnetic resonance images (right knee). AL, the anterolateral-bundle graft; PM, the posteromedial-bundle graft.

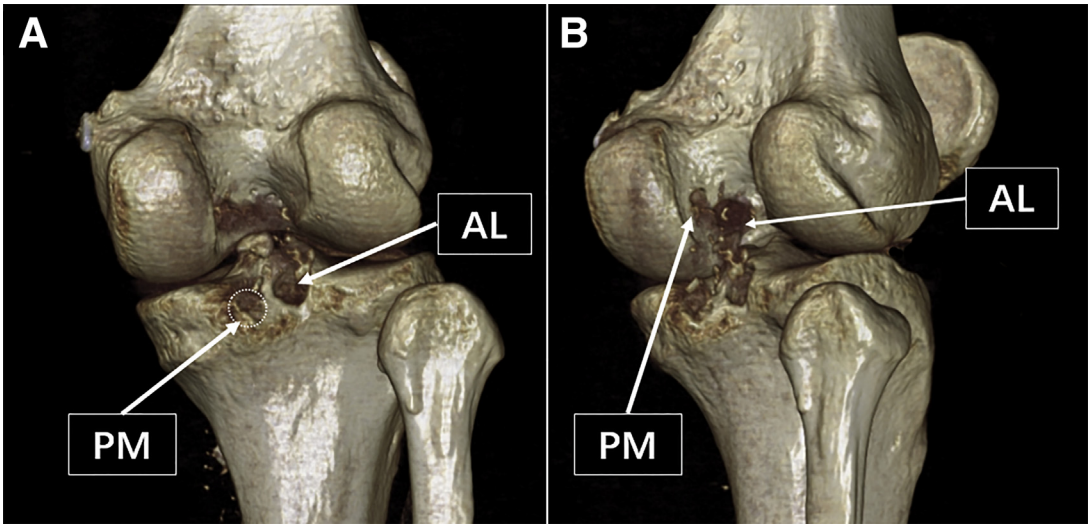

Fig 24. Postoperative computerized topographies indicating the location of the tibial tunnels (A) and the femoral tunnels (B) (right knee). AL, tunnels for the anterolateral-bundle graft; PM, tunnels for the posteromedial-bundle graft.

Table 2. Pearls and Pitfalls of Four-Tunnel Double-Bundle Posterior Cruciate Ligament Reconstruction With Remnant Preservation

Pearls
Two-tibial tunnel double-bundle PCL reconstruction with remnant preservation should be regarded as the most complex type of PCL reconstruction. The surgeon must be familiar with single-bundle PCL reconstruction with remnant preservation[11] and the double-bundle PCL reconstruction without remnant preservation first before transitioning to the double-bundle PCL reconstruction with remnant preservation.
The PM-bundle graft composites are mounted to the tendon manipulation tables for pre-tensioning with 60 to 80 N force until graft placement.
On the proximal end of each graft, two No. 5 UHMWPE sutures are used as fixing sutures. UHMWPE tape can also be used for proximal fixation.
The PM and posterolateral portals are above the joint line and about 3 cm proximal from the posterior edge of the femoral condyle at more than 90° of knee flexion.
Cannulas are placed in the PM and PL portals to facilitate the placement of arthroscope and instruments.
Because the residual fibers are retained, the graft circumvents the residual fibers in the joint, so the graft's reserved length in the joint needs to be increased. It is recommended that an AL bundle graft should be 40 mm in the joint and a PM bundle graft should be 30 mm in the joint.[12]
Although the posterior capsule can be pushed backwards and the buffer space for the drilling can be increased, it is still suggested slowing down the drilling when the posterior cortex is to be penetrated.
Pitfalls
To prevent injury of the posterior vascular structure passing nearby, the posterior septum tissue is first separated from the remnant PCL fibers bluntly with the shaver. Care should be taken not to face the shaver posterior ward. Otherwise, the posterior vascular structure may be endangered.
The PM-bundle tibial tunnel should not be set too medially. Otherwise, impingement of the PM-bundle graft and the medial femoral condyle will occur.
The meniscofemoral ligament should be separated from the remnant of the PCL remnant. Otherwise, graft passage may be hindered.
There are two killer turns when a PCL graft is placed in. thus pulleys are needed to be built at these sites with switching stick or obturator. Otherwise, the proximal fixing sutures may cut through the cortex at the inner orifices of both the tibial and the femoral tunnel.
When the AL-bundle graft is to be fixed at knee extension, it should not be pretensioned. Otherwise, a pretensioned AL-bundle femoral tunnel may break when the knee is flexed.
The PM-bundle graft should be placed in first and the AL-bundle graft should be placed in later. Otherwise, the AL-bundle graft will hinder the observation and placement of the PM bundle graft.
The tibial tunnel should be 0.5 mm larger than the graft to facilitate graft emplacement. However, it should not be too large to affect tendon-bone healing.

PCL, posterior cruciate ligament; UHMWPE, ultra-high molecular weight polyethylene; PM, posteromedial; AL, anterolateral.

allowed as tolerated. Muscle-strengthening exercises begin immediately after operation. Proprioceptive and agility training begins 6 weeks after the operation.

Discussion

The current technique is a modification of the Sandwich style PCL reconstruction reported by Zhao et al.[10] First, this is an anatomical double-bundle PCL reconstruction (Figs 22 to 24). We do not intend to perform non-anatomical reconstruction for the remnant. Second, both the length and the size of the graft are ensured by using 3 tendons, the ST, the GT and the AHPLT, to make 10 strands of grafts. Third, we try to place the AL bundle through the space between the PCL and the meniscofemoral ligament to avoid too long circumference of the graft. Finally, on the tibial side backup fixation with a suspensory cortical fixation device is taken.

The pearls and pitfalls are listed in Table 2.[11,12] The critical points of the current technique are the skillful manipulation across the femoral notch, with the preservation and the hindrance to operation of the PCL remnant, and avoiding neurovascular injury at the posterior side of the knee.

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