

BioRCI™
Screw System



Surgical Technique for Hamstring and Patellar Tendon Grafts

Using the BioRCI™ Screw System

The Smith & Nephew BioRCI cruciate ligament reconstruction system incorporates a patented fixation device and reproducible surgical technique for endoscopic fixation of either hamstring or patellar tendon cruciate grafts. The innovative hamstring surgical technique provides reduced soft-tissue morbidity and pain on kneeling, while improving cosmetic appearance for the patient. Cost is also reduced since the procedure can be performed on an outpatient basis.

Fixation of either the hamstring or patellar tendon graft is achieved at the anatomic insertion site of the native ACL using the BioRCI Screw, providing aperture fixation at the femoral tunnel. The BioRCI Screw is also used to fix the graft inside the tibial tunnel, thus providing a short graft construct.

The patented BioRCI Screw has rounded threads along its entire length to protect the graft during endoscopic insertion. Its hemispherical head reduces interfiber stress as the graft exits the femoral tunnel. The head also compresses the graft against the aperture of the femoral tunnel, preventing graft movement and synovial fluid ingress, allowing for easier biologic fixation and providing a secure anatomic reconstruction.

The following technique describes endoscopic ACL reconstruction fixing the hamstring or patellar tendon graft utilizing the BioRCI Screw System.

The RCI Screw and instrumentation was developed by Leo Pinczewski, M.D., and Gregory Roger, M.D., Sydney, Australia. Medial Portal Technique described by Leo Pinczewski, M.D. Sydney, Australia.

Physician Biography

Dr. Leo Pinczewski is one of the principal partners of the North Sydney Orthopaedic and Sports Medicine Centre – Sydney, Australia. His specialty is knee and hip surgery. He has performed over 5,200 anterior cruciate ligament reconstructions.

He is a member of the Australian Orthopaedic Association, Australian Knee Society, Australian Society of Orthopaedic Surgeons, Australian Institute of Musculoskeletal Research and the International Cartilage Repair Society.

Along with his many publications, Leo Pinczewski's commitment to the Australian Institute of Musculoskeletal Research has awarded him the Evelyn Hamilton Trust Memorial Prize for Best Scientific Presentation (1981), American, British, Canadian Travelling Fellowship (1992), Sports Medicine Australia - Best Conference Paper in Clinical Science (1994) and the Sports Medicine Australia - Research Excellence Award (1995).

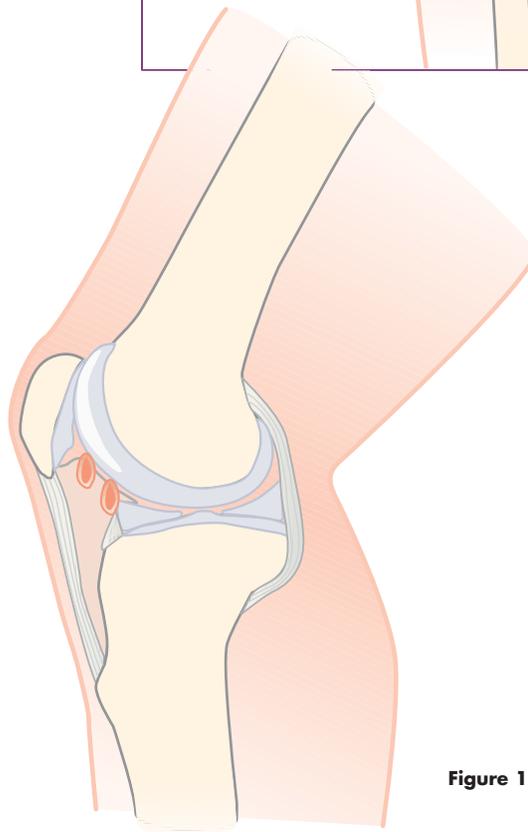
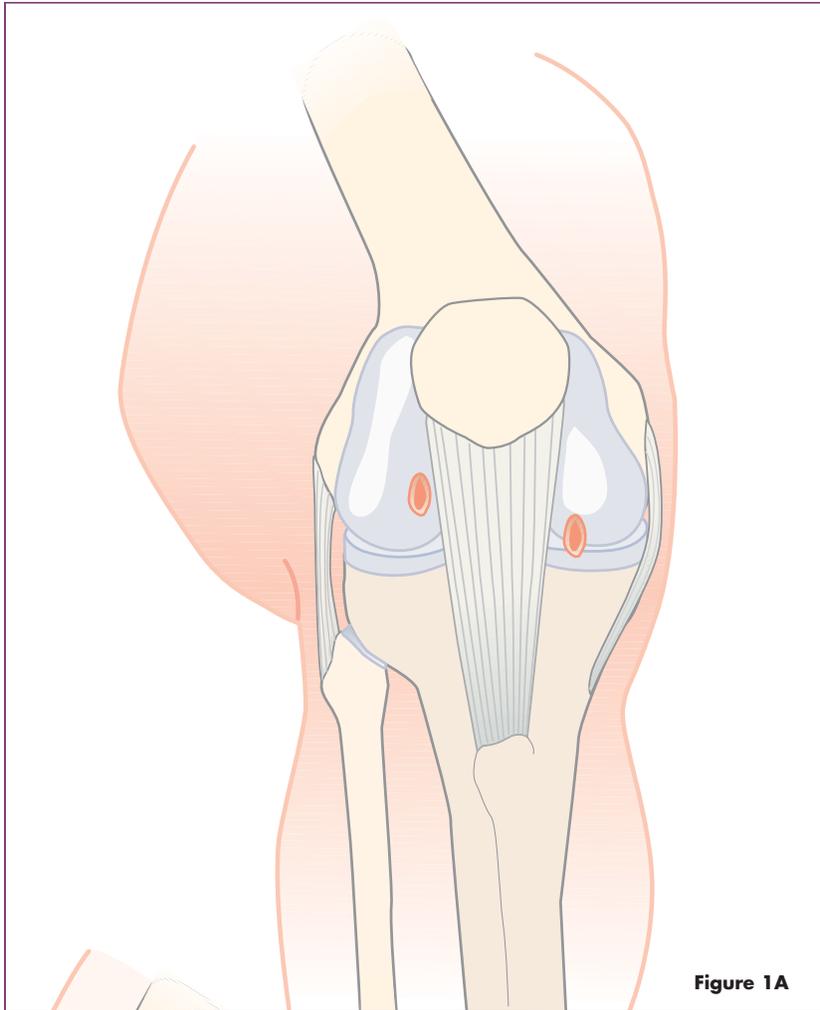
Portal Placement

Routine arthroscopy is performed prior to anterior cruciate ligament reconstruction.

Proper portal placement is critical.

The anterolateral portal must be towards the top of the lateral triangle soft spot - adjacent to, but not crossing the patellar tendon's lateral border (Figures 1A and 1B).

The anteromedial portal is slightly lower, approximately 1 cm above the joint line. The anteromedial portal can be checked with a small gauge needle to ensure that the medial meniscus is avoided.



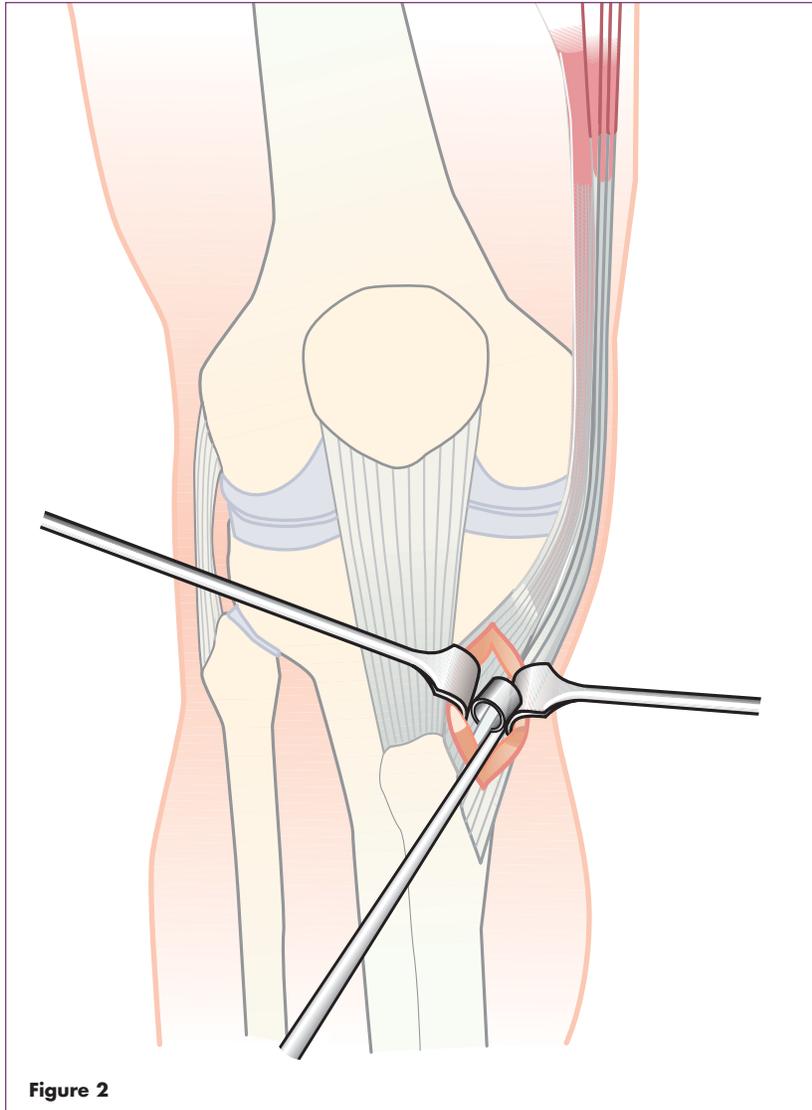


Figure 2

Semitendinosus and Gracilis Tendon Harvest

The graft is constructed by doubling the semitendinosus and gracilis tendons, yielding a four-limbed graft. The tendons are harvested through a 3 cm long incision, one centimeter medial to the tibial tubercle, overlying the pes anserinus insertion. The stripper is carefully advanced, separating the tendon proximally from the muscle, while pulling distally on each tendon. When harvesting each tendon, ensure the accessory distal insertions of the semitendinosus are divided, and do not divert the harvesting tool into the body of the tendon.

Using a Smith & Nephew Acufex® tendon stripper will generally result in two tendons at least 22 cm in length (Figure 2).

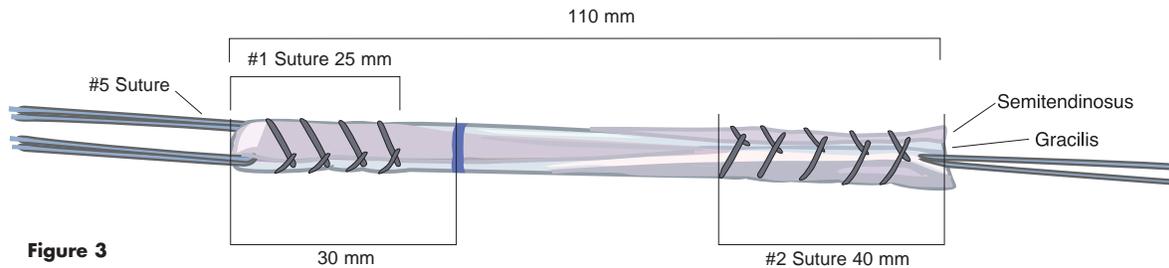


Figure 3

Hamstring Graft Construction

After the tendons are cleared of adherent muscle fibers, their length should be measured and the midpoint determined. Ideally, this is approximately 11 cm from the distal insertion of the tendons. The broad, proximal surface of the semitendinosus can be wrapped around the gracilis tendon to give the graft a smooth exterior surface.

The graft is constructed by doubling the two tendons over two #5 sutures, which will subsequently act as lead sutures.

The resultant four-strand hamstring tendon complex is sutured, using a #1 suture with a modified baseball stitch on each end. The looped end of the graft (for femoral insertion) should have a least 3 stitches securing the whole of the tendon mass for a length of 25 mm.

At the free end, the four tendon strands are sutured for 40 mm with a #2 suture using the running baseball stitch. Any free tissue which may bunch up and obstruct passing of the graft should be excised. An 11 cm long, four-strand graft should be constructed (Figure 3).

A mark is made on the graft 30 mm distal to the looped end with a sterile marking pen. This mark is used to ensure the graft is pulled up sufficiently into the femoral bone tunnel. The diameter of the graft construct is measured at both the proximal and distal ends, using the sizing tubes to determine the appropriate RCI™ winged compaction router.

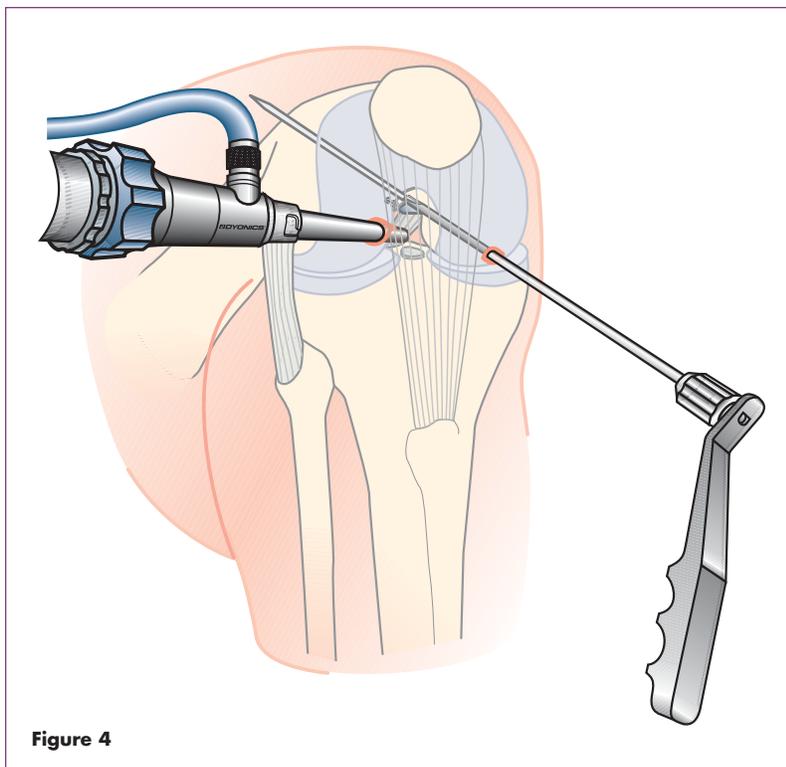


Figure 4

Femoral Drilling

Insert the 5 mm offset EndoFemoral Aimer Guide into the medial portal. Positioning the knee in full flexion (normally 120 degrees) will enable the tip of the guide to be located at the “over-the-top” position. Position the guide with the 2.7 mm Drill Tipped Passing Pin* placed 30° from the roof of the notch (11 o’clock in the right knee, 1 o’clock in the left knee) at the point 5 mm anterior to the posterior cortex of the notch (Figure 4).

Once the offset guide is properly positioned, the passing pin is placed in the guide and the tip engaged into bone. The pin is drilled through the femur and pushed through the skin of the anterolateral thigh. The EndoFemoral Aimer Guide is then removed and the position of the pin in the notch is verified. The pin should be directed approximately 30° anteriorly and 30° laterally, with respect to the femoral long axis.

With the knee held fully flexed, the RCI™ winged compaction router is advanced along the passing pin and the femoral tunnel drilled under direct vision. The femoral compaction router has a diameter equal to that of the measured proximal tendon graft (Figure 5A).

It is imperative that the router continue up to the laser mark just distal to the router’s wings. These wings countersink the tunnel entrance to accommodate the graft and screw head, increasing the cancellous area for biologic fixation of tendon to bone (Figure 5B).

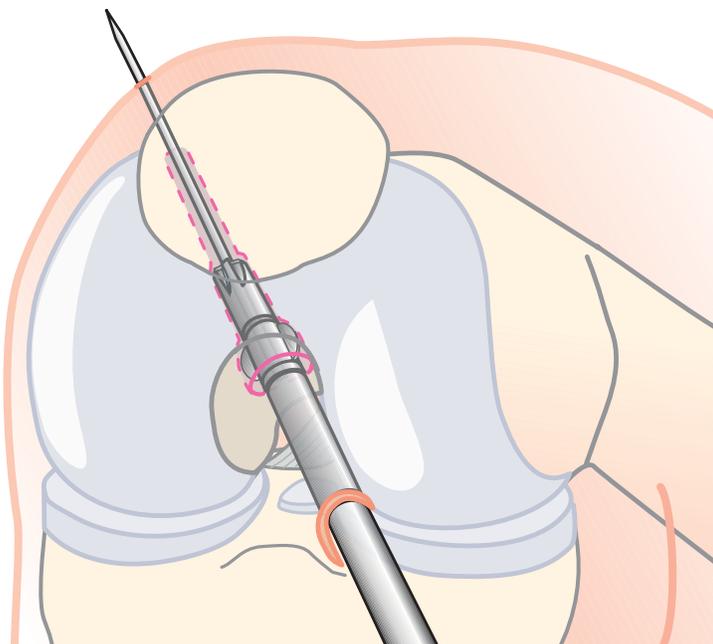


Figure 5A

The router is removed and a #1 suture is threaded into the slot of the passing pin. With the looped end of the suture held externally, the passing pin is drawn into the joint and out through the femur, drawing the free ends of the suture out through the lateral thigh (Figure 6A).

To prevent losing the suture inside the joint, the free ends of the suture may be clipped onto the loop on the outside of the knee. The edge of the femoral tunnel may be smoothed and debrided of any loose tissue (Figure 6B).

*A 2.4 mm passing pin is compatible with this step.

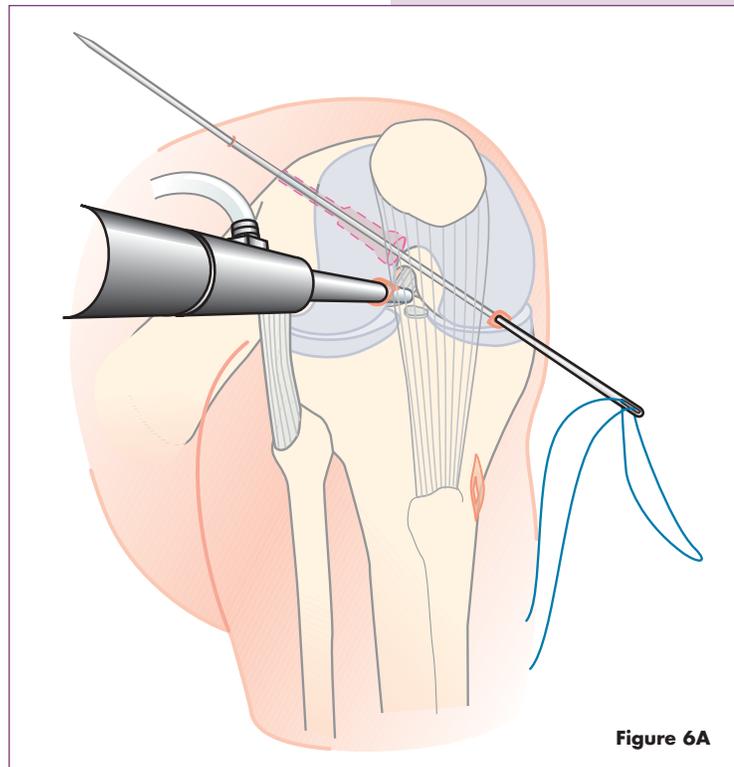


Figure 6A

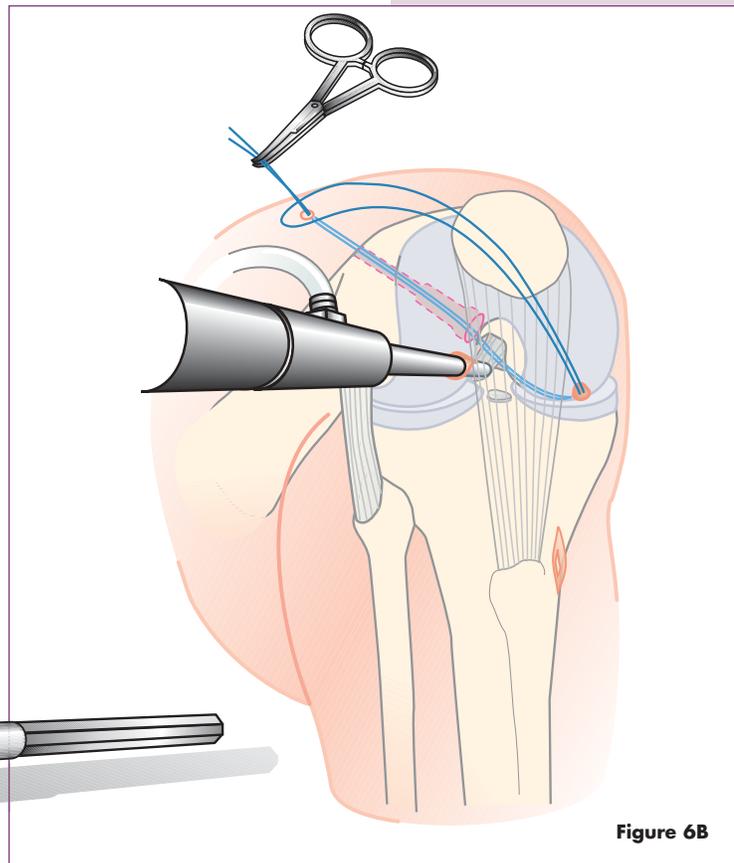


Figure 6B

Figure 5B



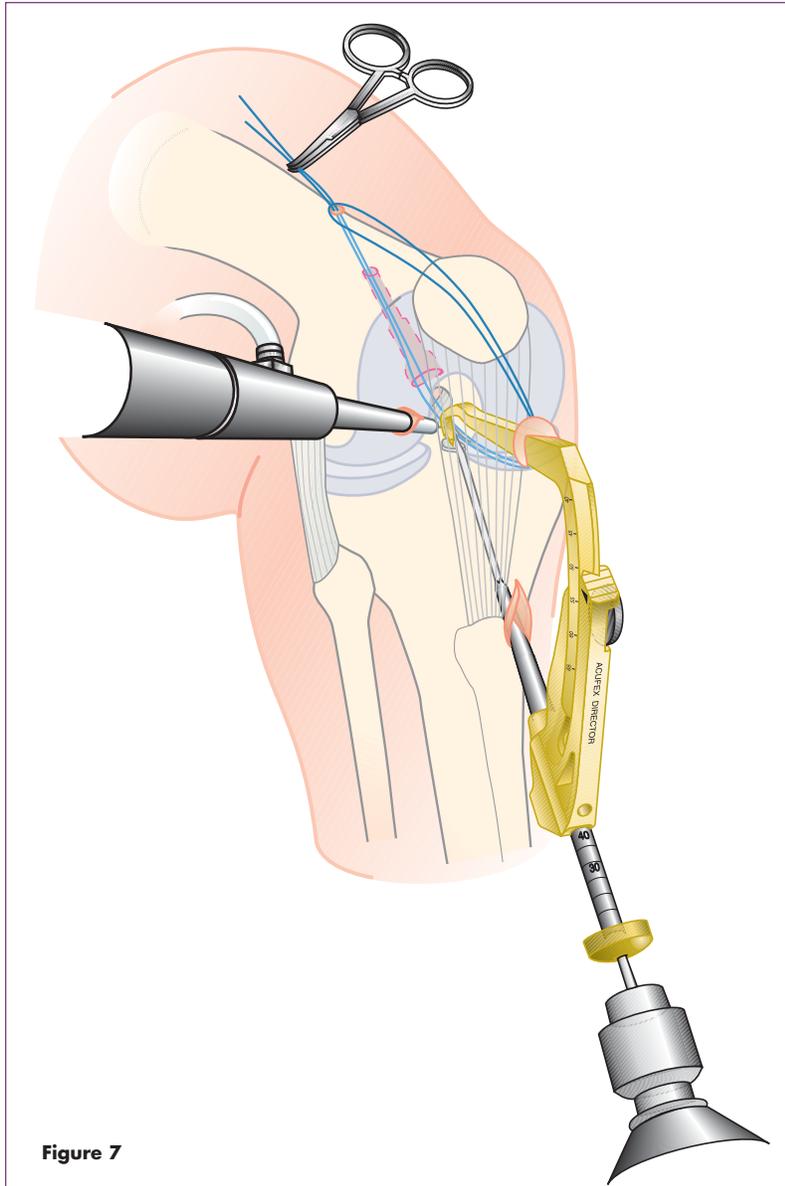


Figure 7

Tibial Drilling

The tibial hole is made with the use of the Acuflex® Director Drill Guide. The tip of the guide is passed through the anteromedial portal and positioned to create a tunnel that enters the joint through the posteromedial portion of the ACL footprint.

The drill guide is set to make a 45 mm long tibial tunnel that corresponds to the 45 mm length of the RCI™ tibial compaction routers (Figure 7).

A 2.4 mm Drill Tipped Guide wire is used to establish the line of the tibial tunnel. After drilling, the position of the guide wire should be checked to ensure it enters the joint through the posteromedial fibers of the ACL footprint.

When utilizing the Tibial Specific BioRCI™ screws, please note the length of the tibial tunnel prior to drilling to ensure adequate tunnel length for fitting of the screw.

If not satisfied with the placement of the guide pin, the Acufex® Offset Guide can be used to reorient the placement of the 2.4 mm pin a distance from 2 mm to 5 mm from the original drill hole. Drill the tibial tunnel using the RCI™ tibial compaction router with a diameter equal to that of the graft's distal end (Figure 8A).

Drilling of the tibial tunnel should continue up to the laser mark indicated on the RCI tibial router (Figure 8B).

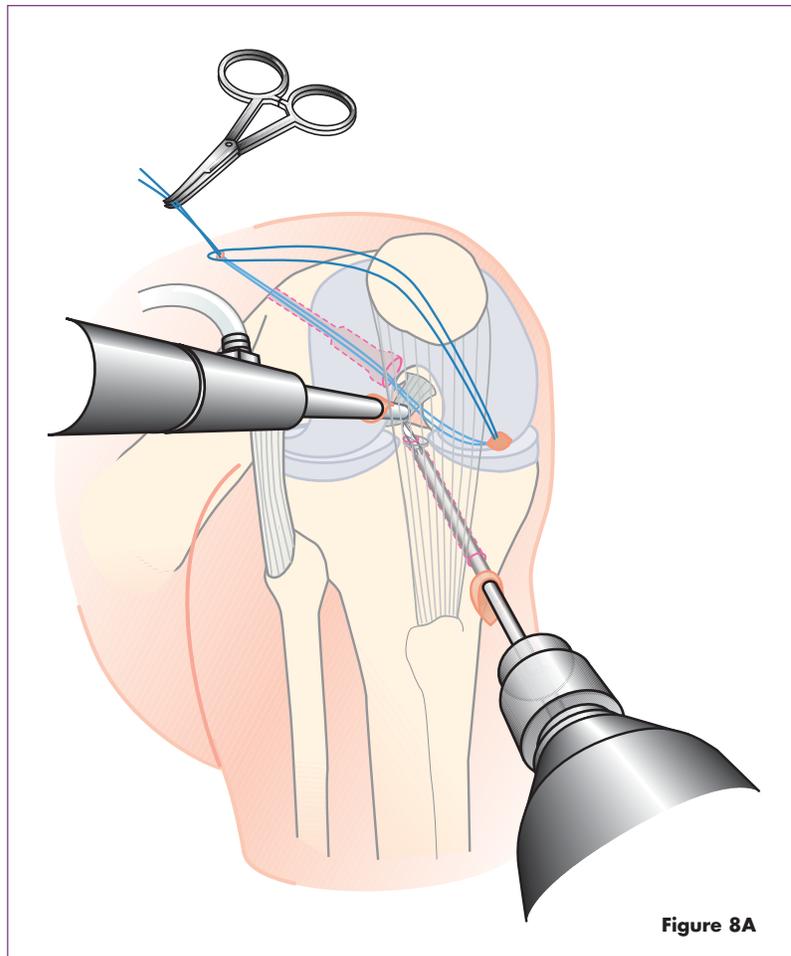


Figure 8B

Graft Passing

Prior to passing the graft, the screw starter may be used. This will create a small pilot hole to ease in starting the BioRCI™ screw. With the knee at 90° flexion, insert a grasping arthroscopic forceps through the tibial drill hole until the jaws of the forceps are around the #1 suture previously passed through the femoral tunnel. The looped end of the suture is then pulled through the tibial tunnel (Figure 9A).

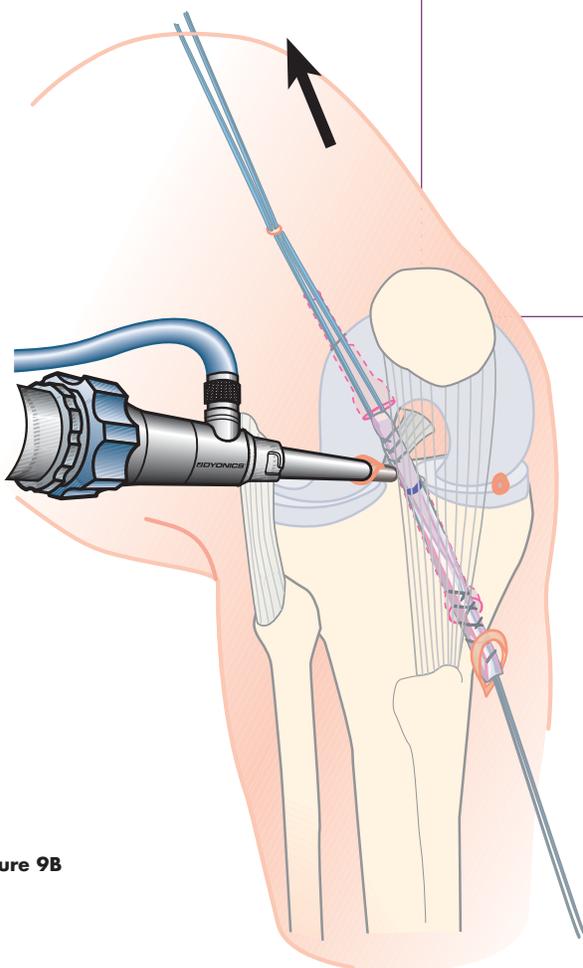


Figure 9B

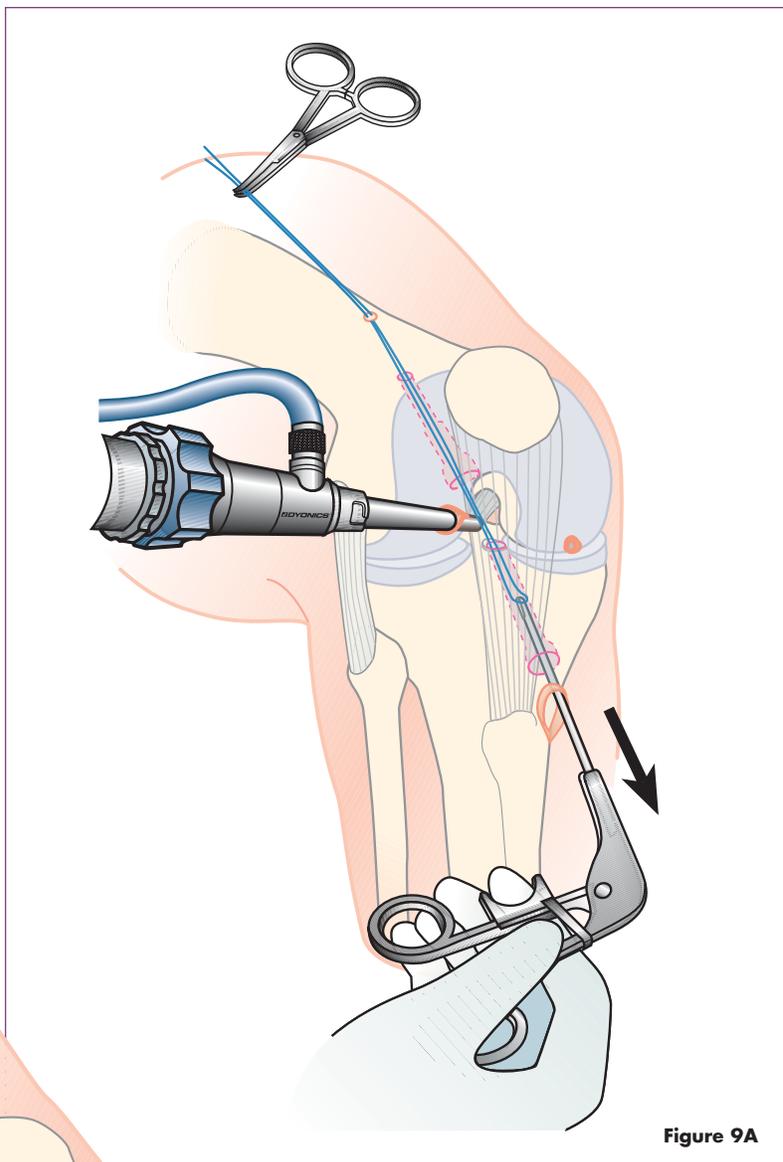


Figure 9A

This suture loop is now passed through the tibial and femoral drill holes and is used to pass the graft. The #5 lead sutures from the graft construct are pulled through the joint by the #1 passing suture, pulling it proximally first through the tibial tunnel and then through the femoral tunnel (Figure 9B).

The graft is drawn into the femoral hole until the 30 mm mark on the graft is at the entrance of the femoral tunnel.

Femoral Fixation

The 1.5 mm screw guide wire is introduced through the anteromedial portal. Place the tip at the femoral tunnel entrance, between the anterior edge of the tunnel and the graft. The knee is then fully flexed and the guide wire advanced to its 25 mm mark. As the femoral drilling was made through the anteromedial portal, collinearity of the fixation screw and graft is assured (Figure 10A).

A BioRCI™ screw and the BioRCI 1.5 mm cannulated driver are run over the guide wire through the anteromedial portal and into the joint under arthroscopic visualization (Figure 10B).

Note:

See Appendix B for instructions on using a Reverse Thread BioRCI screws on right knees.

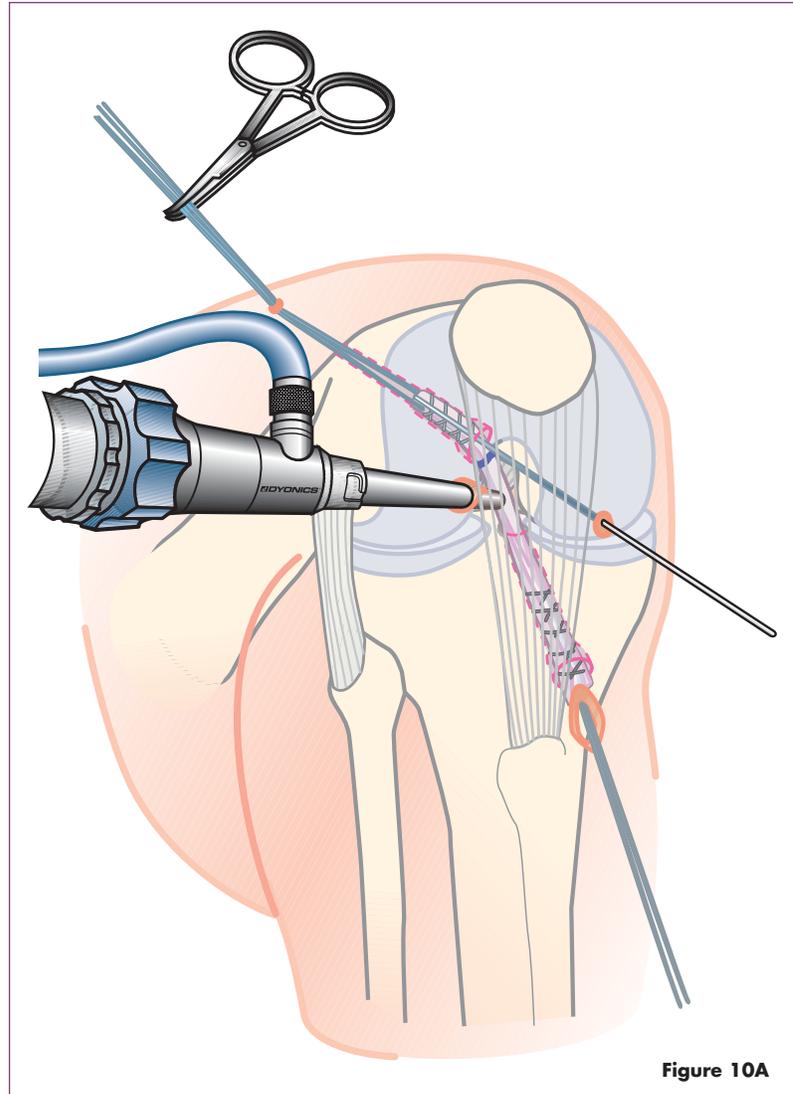


Figure 10A

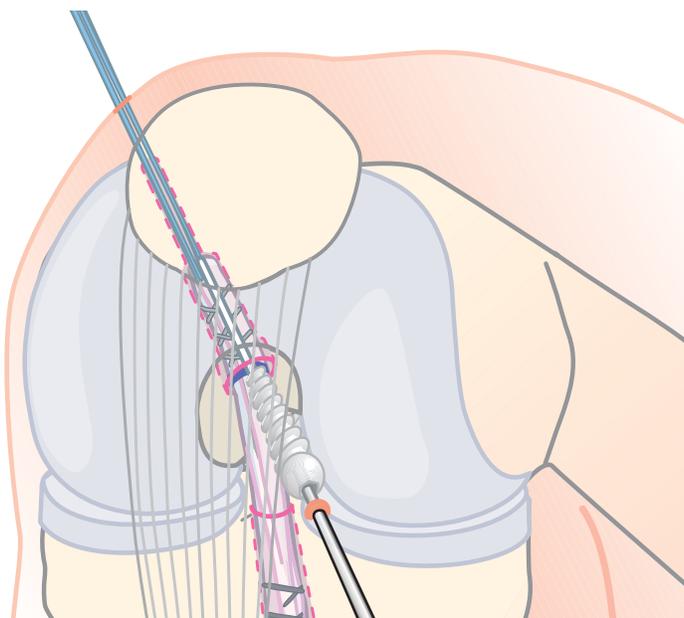


Figure 10B

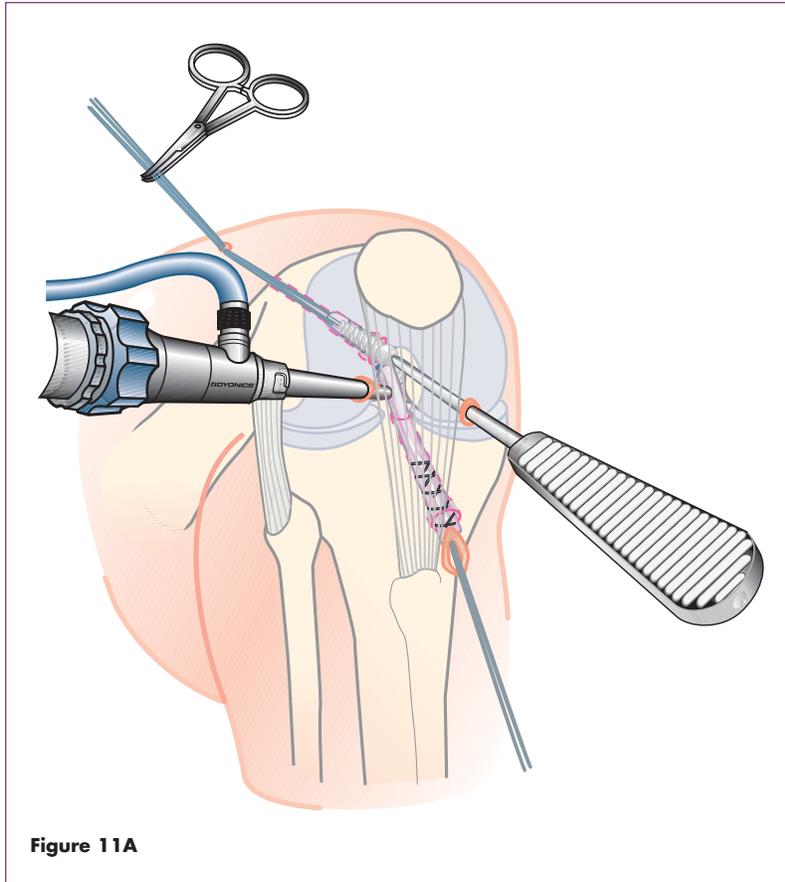


Figure 11A

Maintaining traction on the graft through the distal and proximal sutures, the screw is advanced (Figure 11A). Care must be taken to ensure the driver remains fully seated within the screw body. Failure to do so may result in screw failure. The screw is advanced until the head is completely buried within the femoral tunnel, ideally 5 mm deep to the internal femoral cortex aperture.*

With the knee still fully flexed, the guide wire is removed. The head of the screw should not be visible once the screwdriver is removed and the knee extended (Figure 11B).

* If hard bone is encountered, the use of a sized BioRCT™ tap is suggested.

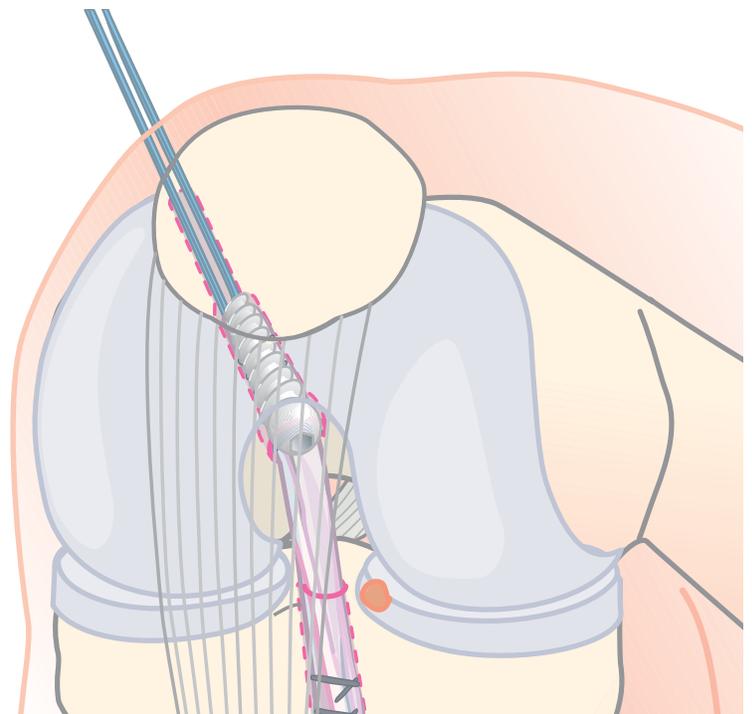


Figure 11B

Tibial Fixation

After fixing the graft in the femoral tunnel, the knee is placed at 90° flexion and the distal end of the graft pulled firmly down the tibial tunnel. As the knee is placed through a range of motion, the surgeon should visually check that the graft does not impinge on the condyles of the notch. If so, a notchplasty may be required or more posterior placement of the tibial tunnel may be made.

The graft is then pulled taut and the 1.5 mm guide wire inserted between the graft and the posterior aspect of the distal tibial tunnel. While maintaining tension on the graft, and holding the knee at 30-40° flexion, the BioRCI™ screw is advanced until it is partially inserted. The knee is gently extended to 0° to ensure that full extension is achievable, and the screw is advanced fully until the head is in the tunnel (Figure 12). The guide wire is then removed.

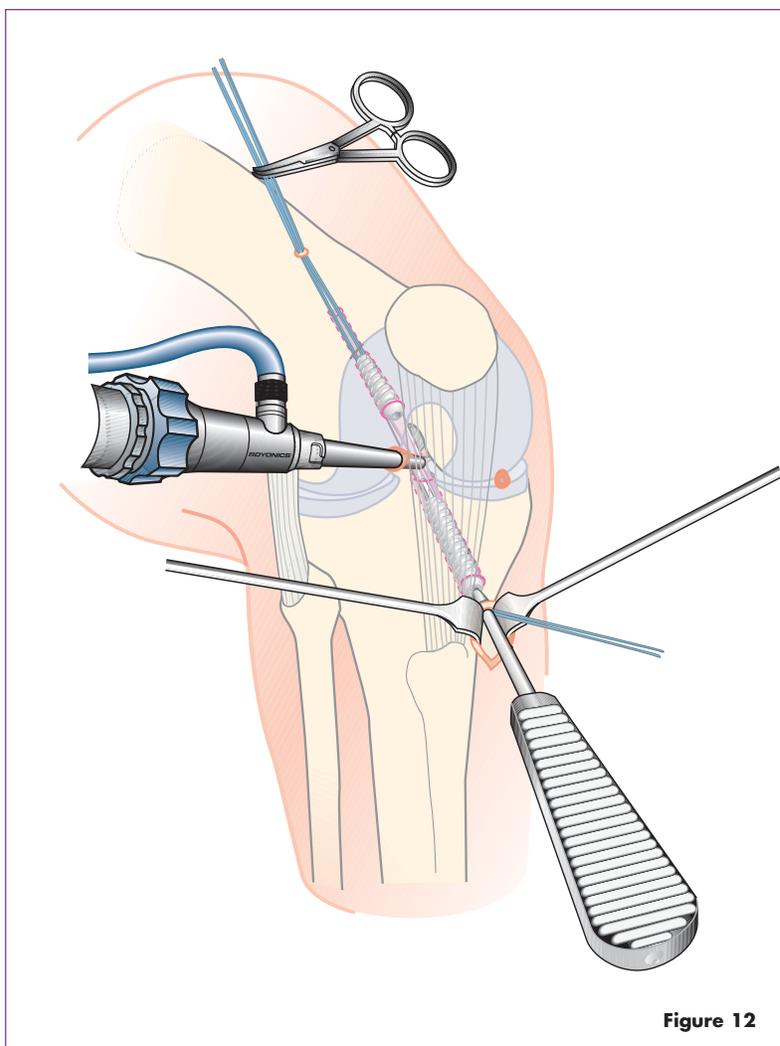


Figure 12

The Tibial Specific 35 mm BioRCI screws may be substituted to maximize graft fixation in the tibia. When determining tibial screw diameter and length for fixation the following points should be considered:

1. Increasing length is more effective in increasing pullout resistance than increasing diameter.
2. In soft bone, screw diameter should equal or exceed hole diameter.
3. In hard bone, screw thread diameter should be less than the hole diameter.

The knee's range of motion, Lachman's test and anterior drawer test may be performed to ensure that stability has been achieved. The knee may be inspected one last time, irrigating and suctioning any remaining debris. Proximal lead sutures are removed from the lateral thigh puncture and the wound is closed in layers over a drain. Routine dressing and postoperative care follows.

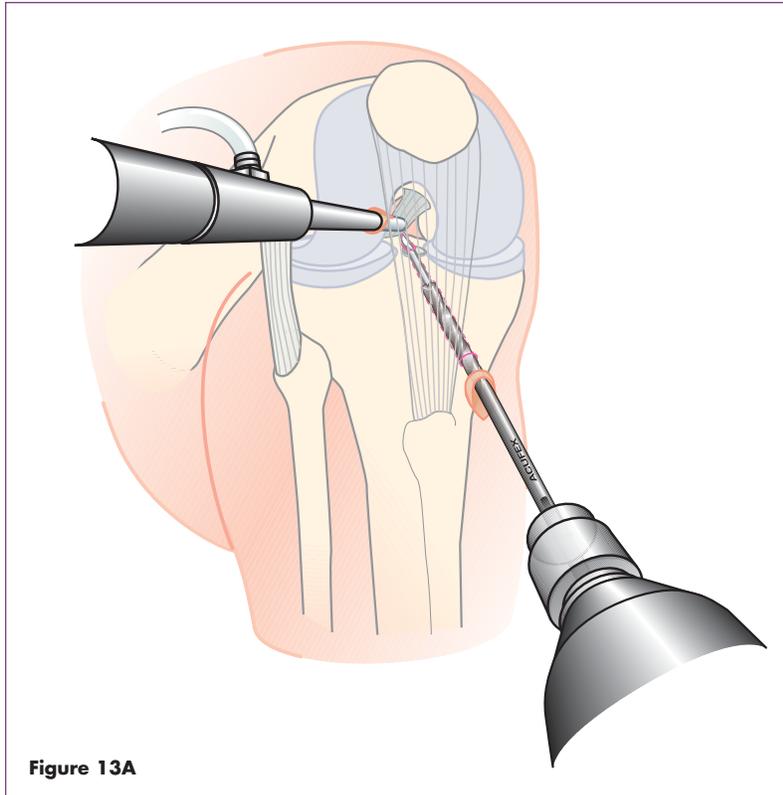


Figure 13A

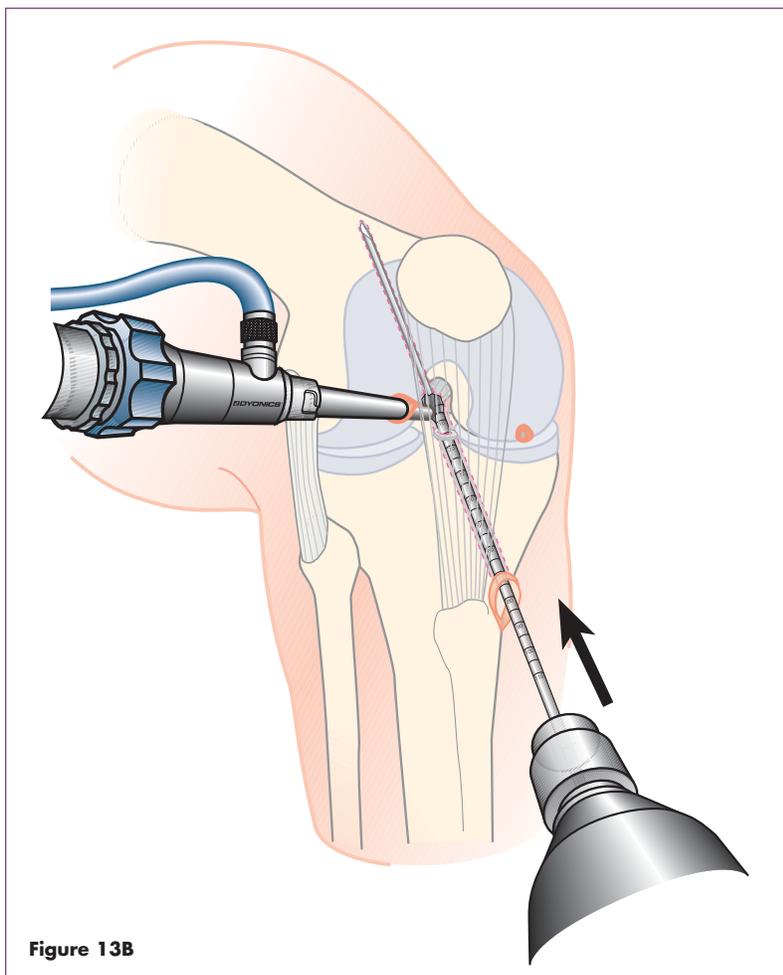


Figure 13B

Transtibial Approach Using BioRCI™ Screws

In addition to the medial portal approach described previously, a transtibial approach may also be utilized for ACL reconstruction using the BioRCI Screw System.

Tibial Preparation

The tibia is prepared using the Acuflex® Director drill guide and a 2.4 mm drill guide wire. A cannulated drill bit, matched to the diameter of the graft, is utilized to prepare the tibial tunnel. It is not recommended to use the “acorn” endoscopic cannulated drill bits as they may be deflected anteriorly by the hard bone of the tibial spine. This could result in less than optimal tunnel placement (Figure 13A).

Femoral Preparation

After the 2.7 mm passing pin has been placed using the Acuflex endoscopic femoral aimer, an endoscopic cannulated drill bit is passed through the tibial tunnel and against the over-the-top position. Care must be taken to avoid the PCL. With the knee in approximately 90 degrees of flexion, power is applied and the drill bit is advanced to its 30 mm mark. The rim of the femoral and tibial tunnels may now be smoothed to avoid any hard cortical edges (Figure 13B).

Reverse Thread Screw – The Right Solution

The Reverse Thread BioRCI™ screws are indicated for use in ACL Hamstring fixation in Right knees.

The Reverse Thread screw is a patented screw that addresses two basic challenges.

- **Visualization**

When using a (Clockwise) right threaded screw in a right knee, there is a tendency for the graft to “wind up” around the screw, reducing the surgeon’s visibility of the screw during insertion. The Reverse Thread BioRCI screw is inserted in a counterclockwise fashion (left direction - reverse threaded to a standard screw). The advantage is that it allows proper visualization of the femoral aperture and ensures that the screw is fully countersunk.

- **Orientation**

A hamstring graft tends to wind anteriorly around the screw as the screw is advanced into the right knee femoral tunnel. This anterior rotation may cause the graft to be placed in a less than optimal position. The counterclockwise rotation of the Reverse Thread BioRCI screw maintains the graft in its proper posterior orientation.

The Reverse Thread BioRCI screw has the same characteristics and advantages as the standard BioRCI screw with the exception that the threads are rotating to the left. It is designed specifically for ACL reconstructions in right knees.

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