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Chapter 74

c00074 Hamstring Tendon Autograft for Anterior Cruciate Ligament Reconstruction

Keith Lawhorn and Stephen M. Howell

p0010

s0010 Chapter Synopsis

p0015
- This chapter presents a proven transtibial tunnel anterior cruciate ligament (ACL) technique that uses a three-dimensional tibial guide to place the tunnels without posterior cruciate ligament (PCL) and roof impingement. The featured graft construct is a double-looped hamstring graft with slippage-resistant, high-stiffness, strong fixation. The rationale and clinical outcome of brace-free aggressive rehabilitation with this tunnel placement technique and graft construct are supported by peer-reviewed studies that are discussed.

s0015 Important Points

p0025
- Customized coronal and sagittal placement of the tibial tunnel is critical for positioning the femoral tunnel via a transtibial tunnel technique.

u0020
- In the coronal plane, widen the notch, center the tibial tunnel between the tibial spines, and angle the tunnel at 60 to 65 degrees off the medial joint line to minimize loss of flexion and instability from PCL impingement.

u0025
- In the sagittal plane, center the tibial tunnel 4 to 5 mm posterior and parallel to the intercondylar roof with the knee in full extension to minimize loss of extension and instability from roof impingement.

u0030
- Consider the use of slippage-resistant, high-stiffness, strong fixation; a double-looped hamstring graft; aggressive brace-free rehabilitation; and a return to sport at 4 months based on in vivo analysis of graft lengthening.

Clinical and Surgical Pearls s0020

p0050
- Perform a lateral wallplasty until the space between the lateral femoral condyle and PCL is wide enough for the ACL graft.

u0040
- Drill the tibial guide pin with the knee in terminal extension.

u0045
- Rotate the femoral aimer down the sidewall of the lateral condyle.

u0050
- Angle the WasherLoc tibial fixation screw toward the fibular head.

u0055
- Tension the graft bundles equally with the knee in full extension.

Clinical and Surgical Pitfalls s0025

p0080
- Position the anteromedial portal adjacent to the medial border of the patellar tendon so the tibial guide centers in the notch.

u0065
- Almost always perform a lateral wallplasty to make room for the graft.

u0070
- Perform a roofplasty only when the roof overhangs the notch.

Video s0030

p0100
- Video not available

The use of autogenous hamstring tendons for anterior cruciate ligament (ACL) reconstruction continues to grow in popularity. The superb biomechanical properties of these looped -tendons coupled with the low morbidity of graft harvest make this tissue an ideal graft for ACL reconstruction. Furthermore, autogenous hamstring grafts are an excellent graft source for skeletally immature patients. Improved tunnel placement techniques along with improved graft fixation devices also add to the appeal of hamstring grafts for ACL surgery. The use of two smaller-diameter tendon grafts affords the surgeon the ability to use hamstring grafts when performing either single-or double-bundle ACL reconstruction techniques. This chapter focuses on the use of

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a single-tunnel ACL reconstruction technique that uses a scientifically proven transtibial tunnel technique and double-looped hamstring grafts fixed with high-strength slippage-resistant tibial and femoral devices.

s0035 # PREOPERATIVE CONSIDERATIONS

p0110 ACL injury most commonly occurs during a noncontact deceleration change of direction maneuver. Patients typically feel and possibly hear a “pop” at the time of injury. Patients experience acute pain and are unable to continue their sport or activity. Comprehensive provocative examination testing and physical examination findings in the acute and chronic settings are outlined in Box 74-1 and Table 74-1. Anteroposterior (AP), lateral, and oblique radiographs are obtained to assess for fractures in the acute setting. A fracture along the lateral rim of the tibial plateau is a Segond fracture or lateral capsular sign and is pathognomonic for ACL tear. In most cases, no fracture is seen. Magnetic resonance imaging (MRI) may be useful in the acute setting to confirm a suspected ACL tear and to detect any additional ligamentous, meniscal or chondral injuries at the time of injury. In the chronic setting, MRI is seldom needed to identify ACL injury because provocative Lachman and pivot-shift testing results are positive.

p0175 Patients who experience an ACL tear and subsequent instability will benefit from surgical reconstruction. Young patients, particularly skeletally immature patients, should undergo early ACL reconstruction to restore rotational knee stability and minimize the risk of meniscal tears.[1,2] Potential growth disturbances in skeletally immature patients is a concern; however, the incidence of growth disturbance with a hamstring graft is very low, and the deformity can be better salvaged than with the meniscal-deficient knee. A table of indications and relative contraindications for surgery is presented in Box 74-2.

b0015 **BOX 74-1** Examination Findings in the Acute versus the Chronic Anterior Cruciate Ligament (ACL)–Deficient Knee

s0040 **Acute ACL Injury**

p0115 • Swelling, hemarthrosis
u0085 • Pain
u0090 • Decreased range of motion
u0095 • Lachman test result—positive
u0100 • Pivot shift limited by pain

s0045 **Chronic ACL Injury**

p0145 • Minimal or no swelling
u0110 • Lack of pain (if pain is present, suspect meniscal tear, bone bruise, chondral injury)
u0115 • Normal motion
u0120 • Lachman test result—positive
u0125 • Pivot shift—positive

SURGICAL TECHNIQUE s0060

Patient Positioning s0065

Position the patient supine on the operating table and place a tourniquet around the proximal thigh of the operative leg. Position the operative leg in a standard p0240

TABLE 74-1. Provocative Examination Tests t0010

Examination	Significance
Lachman and pivot-shift test	ACL injury
Straight-leg raise	Extensor mechanism injury
Patella apprehension	Patella instability
MPFL tenderness	Patella instability
Varus or valgus laxity at 30 degrees	Collateral ligament injury
Varus or valgus laxity at 0 degrees	Capsular injury
Tibial external rotation at 30 degrees	PLC injury
Tibial external rotation at 90 degrees	PCL injury
Posterior drawer at 90 degrees	PCL injury
Quadriceps active test	PCL injury
Joint line tenderness	Meniscal tear, chondral injury, capsular avulsion
Lateral tibial plateau tenderness	Bone bruise, fracture

ACL, Anterior cruciate ligament; *MPFL*, medial patellofemoral ligament; *PCL*, posterior cruciate ligament; *PLC*, posterolateral corner.

BOX 74-2 Indication and Contraindications for Anterior Cruciate Ligament Reconstruction b0020

Indications s0050

• High-demand athlete p0180
• Skeletally immature patient u0135
• Repairable meniscal tear u0140
• Symptomatic instability u0145
• Instability with activities of daily living (ADLs) u0150
• Refusal of older patient to change lifestyle u0155

Relative Contraindications s0055

• Older sedentary patient p0215
• No symptomatic instability u0165
• Willingness to alter lifestyle u0170
• Advanced arthritis u0175

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f0010


Figure 74-1. Our preferred patient setup.

b0025 **BOX 74-3 Surgical Steps**

p0250 • Tendon harvest
u0185 • Portal placement
u0190 • Tibial tunnel placement
u0195 • Femoral tunnel placement
200 • Prepare WasherLoc
u0205 • EZLoc sizing and insertion
u0210 • WasherLoc tibial fixation
u0215 • Bone graft tibial tunnel

knee arthroscopy leg holder with the foot of the operating table flexed completely. The leg holder can be adjusted and rotated proximally to allow for greater knee flexion. Position the contralateral leg in an Allen stirrup with the hip flexed and abducted with mild external rotation. Ensure that there is no pressure on the peroneal nerve and calf (Fig. 74-1). Alternatively, the surgeon can position the operative leg flexed over the side of the table using a lateral post and maintain the contralateral leg extended on the operating table. Prepare, drape, and exsanguinate the leg and inflate the tourniquet.

s0070 Preferred Surgical Technique

p0245 Box 74-3 provides the steps of this procedure.

s0075 *Tendon Harvest*

p0295 Make a 2- to 3-cm vertical incision along the posteromedial crest of the tibia, centered three fingerbreadths below the medial joint line. A vertical incision allows the surgeon a more extensile incision should it be necessary to lengthen the incision for ease of hamstring harvest. Making the incision obliquely or transversely might decrease the risk of sensory nerve injury, but these incisions are not extensile and need to be optimally placed. Incise the skin and subcutaneous fat down to the sartorius fascia. Palpate the hamstring tendons and

 f0015

Figure 74-2. The dotted line at the inferior border of the gracilis tendon represents the transverse incision in the sartorius fascia used to expose the gracilis and semitendinosus tendons.

 f0020

Figure 74-3. The tendon stripper has been placed on the gracilis tendon. Penrose drains isolate each tendon and allow for counterforce during tendon stripping.

incise the sartorius fascia horizontal and parallel inferior to the gracilis tendon and proximal to the semitendinosus tendon (Fig. 74-2). Flex the knee to 90 degrees and develop a plane by sweeping a finger in the proximal and posterior direction deep to the sartorius fascia along the gracilis tendon. Flex the finger to capture the gracilis tendon. Loop a Penrose drain around the tendon. Release any fascial slips from the inferior border of the gracilis. Strip the gracilis tendon from its musculotendinous junction with a blunt tendon stripper. Pull back on the gracilis tendon insertion site and identify the semitendinosus tendon along the inferior border of the gracilis. Loop a Penrose drain around the semitendinosus tendon (Fig. 74-3). Identify and cut any fascial slips to the medial gastrocnemius originating from the inferior border of the semitendinosus tendon. Strip the tendon with a blunt tendon stripper (see Fig. 74-3). Prepare the tendons by stripping the muscle from the tendon with scissors or a broad periosteal elevator (Fig. 74-4). Place an absorbable No. 1 stitch in the end of each tendon for tensioning. Double-loop and size the tendons with sizing sleeves. Select the diameter of the tendons by

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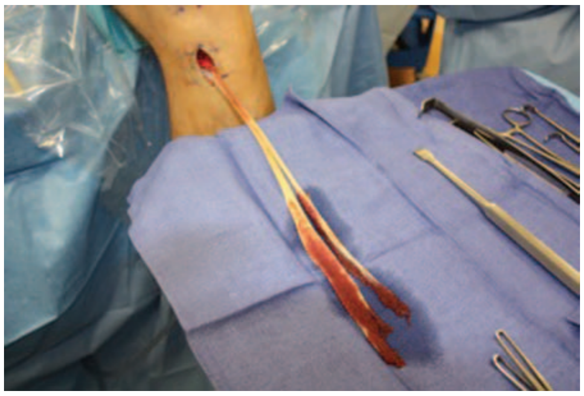

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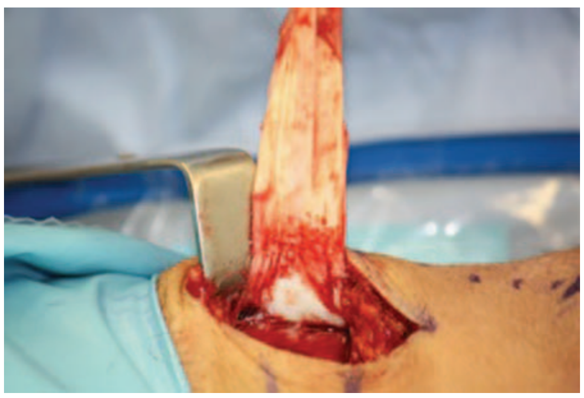
Figure 74-4. Proximal tendon ends are first cleaned of muscle with a broad periosteal elevator and stitched before removal from the tibial insertion site.



f0030

Figure 74-5. Subperiosteal dissection at the hamstring insertion site allows for additional 5 to 10 mm of length.

choosing the smallest-diameter sleeve that freely slides over the looped tendons. Subperiosteally remove the tendons from the anterior tibial crest at their common tendinous insertion, including 5 to 10 mm of periosteum (Fig. 74-5). Suture the common tendinous insertion with a single suture. Store the tendons in the sizing sleeve and a damp sponge in a kidney basin on the back table. Cover the kidney basin with an occlusive Ioban sheet to ensure the safety of the graft on the back table.

s0080
Portal Placement

p0300 Establish inferolateral and inferomedial portals adjacent to the edges of the patella tendon starting 5 to 10 mm distal to the inferior pole of the patella. The medial portal must touch the edge of the patella tendon because if it is placed more medial the tibial guide may not stay seated in the intercondylar notch with the knee in full extension. An optional outflow portal can be established superiorly.

p0305 Perform diagnostic arthroscopy. Treat any meniscal or articular cartilage injuries. Identify and remove the torn remnant ACL stump. It is not necessary to completely denude the tibial insertion of the native ACL tissue. In fact, retaining a portion of the insertion of the native ACL helps seal the edges of the ACL graft at the joint line and does not result in a cyclops lesion and roof impingement if the tibial tunnel has been positioned properly in the sagittal plane. Remove the synovium and soft tissue in the notch to expose the lateral edge of the PCL. Remove any of the ACL origin from the over-the-top position with an angled curette and shaver.

Tibial Tunnel Placement
s0085

When a transtibial tunnel technique is used, the key step is correct placement of the tibial tunnel because the femoral tunnel position is dependent on placement, especially in the coronal plane. Most failures regarding tunnel placement are the result of aberrant tibial tunnel placement. Consider the use of a three-dimensional guide (Howell 65° Tibial Guide, Biomet Sports Medicine, Warsaw, IN) that is designed specifically to correctly position the tibial tunnel in the coronal and sagittal planes to avoid graft impingement on the PCL and roof and to properly restore the tension pattern in the graft similar to the intact ACL. This tibial guide customizes the sagittal and coronal placement of the tunnel for individual differences in knee anatomy including the width of the notch, the slope of the intercondylar roof, and the hyperextension of the knee. p0310

Insert the 65° Tibial Guide through the medial portal. Advance the guide into the intercondylar notch. The tip of the guide is 9.5 mm wide, which mimics the width of an 8- or 9-mm wide ACL graft. Typically the guide contacts the lateral femoral condyle and deforms the PCL because the space is narrower than the width of the graft. Perform a lateral wallplasty to the apex of the notch by removing bone from the lateral wall until the tip of the guide passes into the notch without deforming the PCL. Performing a wallplasty moves the tibial tunnel laterally away from the PCL and minimizes PCL impingement. Do not remove bone from the intercondylar roof unless overhanging osteophytes are present because the 65° Tibial Guide references the intercondylar roof when setting the sagittal position of the tibial tunnel. p0315

Insert the 65° Tibial Guide through the anteromedial portal into the intercondylar notch, and fully extend the knee (Fig. 74-6). While extending the knee visualize that the tip of the guide is inside the notch and the arm of the guide contacts the trochlea groove. Place the heel of the patient on a Mayo stand to maintain the knee in maximum hyperextension. Stand on the lateral side of the leg and insert the coronal alignment rod through the proximal hole in the guide. Rotate the 65° Tibial Guide in the coronal plane until the coronal alignment rod is parallel to the joint and perpendicular to the long axis of the tibia (see Fig. 74-6). Insert the combination bullet guide–hole changer into the 65° Tibial Guide, and advance the bullet until it is seated against the p0320

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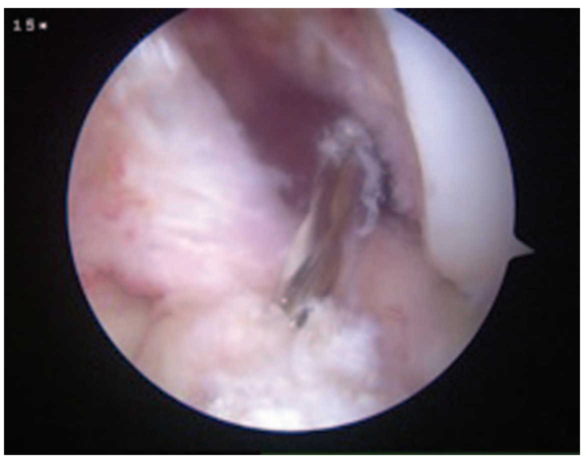
Figure 74-6. The tibial guide is positioned through the medial portal with the coronal alignment rod parallel to the joint line or perpendicular to the long axis of tibia. The knee is in full extension and remains in this position during guide pin placement.



f0040

Figure 74-7. Customized tibial guide pin placement viewed from lateral portal.

anteromedial cortex of the tibia. Drill the tibial guide pin through the lateral hole in the bullet until it strikes the guide intra-articularly with the knee in terminal extension. If you want to check the position of the guide pin, use a C-arm to confirm the position with the tibial guide and guide pin in the knee. Remove the bullet from the tibial guide and remove the guide from the notch. Tap the guide pin into the notch and assess its position.

p0325 The tibial guide pin is properly positioned medially and laterally in the coronal plane when it enters the notch midway between the lateral edge of the PCL and the lateral femoral condyle. The guide pin should not touch the PCL and should be directed toward the native ACL femoral footprint (Fig. 74-7). The tibial guide pin is properly positioned rotationally in the coronal plane when the projection of the tibia of the guide pin touches the lateral femoral condyle halfway between the apex and the bottom of the notch. The tibial guide pin is properly positioned anteriorly and posteriorly in the

f0045

Figure 74-8. Cancellous bone plug harvested from tibia during tunnel preparation will be reinserted into the tibial tunnel once reconstruction has been completed.

sagittal plane when there is a 2- to 3-mm space between the guide pin and intercondylar roof with the knee in full extension (see Fig. 74-7). The space can be assessed by manipulating a 2-mm-wide nerve hook probe between the between the guide pin and intercondylar roof in the fully extended knee.

Prepare the tibial tunnel by breaking through the tibial cortex with a drill with the same diameter as the prepared ACL graft. Harvest a bone dowel from the tibial tunnel by inserting a centering rod over the guide pin and then impacting an 8-mm-diameter bone dowel harvester over the tibial guide pin to the subchondral bone. Remove the dowel harvester with cancellous bone dowel (Fig. 74-8). If the tibial guide pin is removed with the bone dowel, replace it by inserting it through a 7- or 8-mm-diameter reamer that has been reinserted into the tunnel. Drill the remainder of the tibial tunnel. p0330

Check for PCL impingement by placing the knee in 90 degrees of flexion and inserting the impingement rod into the notch. A triangular space at the apex of the notch and no contact at the base of the notch between the PCL and impingement rod confirm the absence of PCL impingement (Fig. 74-9). Check for roof impingement by placing the knee in full extension and inserting an impingement rod of the same diameter as the tibial tunnel into the intercondylar notch. The impingement rod should disappear into the intercondylar notch (Fig. 74-10). Free movement of the impingement rod in and out of the notch with the knee in full extension also confirms the absence of roof impingement. p0335

Femoral Tunnel Placement s0090

Place the femoral tunnel via the transtibial technique. Insert the size-specific femoral aimer through the tibial tunnel with the knee in flexion. The size of the offset of the femoral aimer is based on the diameter of the ACL graft and is designed to create a femoral tunnel with a 1-mm back wall. Extend the knee, and hook the tip of the femoral aimer in the over-the-top position. Allow p0340

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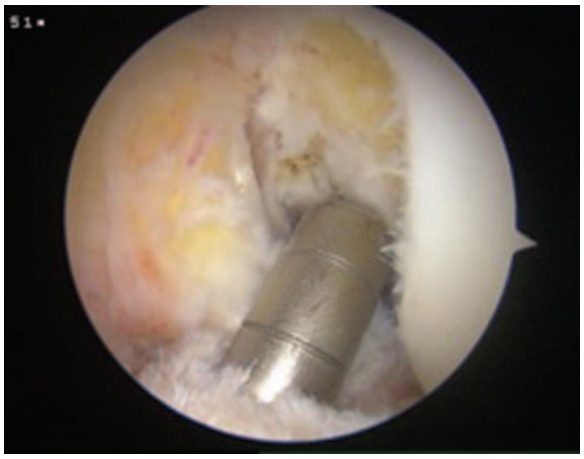
gravity to flex the knee until the femoral guide seats on the femur. Rotate the femoral aimer a quarter turn lateral away from the PCL, which positions the femoral guide pin farther down the lateral wall of the notch, minimizing PCL impingement. Drill a pilot hole in the femur through the aimer and remove both the guide pin and femoral aimer.

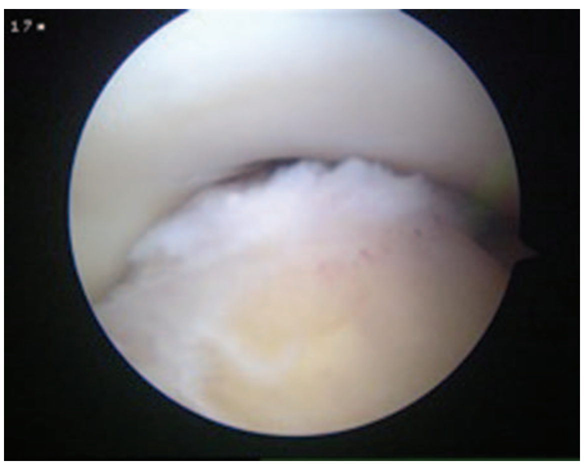
p0345 Redirect the femoral guide pin to shorten the femoral tunnel from 35 through 50 mm in length with use of the following technique. Reinsert the femoral guide pin into the pilot hole, and flex the knee to 90 to 100 degrees. Drill the guide pin through the lateral femoral cortex. The guide pin should be located within the native ACL femoral footprint (Fig. 74-11). Pass a cannulated 1-inch reamer the same diameter as the ACL graft over the guide pin. Ream the femoral tunnel. Confirm that the back wall of the femoral aimer is only 1 mm thick. Confirm that the center of the femoral tunnel is midway between the apex and base of the lateral half of the notch (Fig. 74-12). A femoral tunnel placed correctly down the sidewall does not allow room for a second posterolateral tunnel (see Fig. 74-12). Last, measure the length of the femoral tunnel with the transtibial tunnel depth gauge.



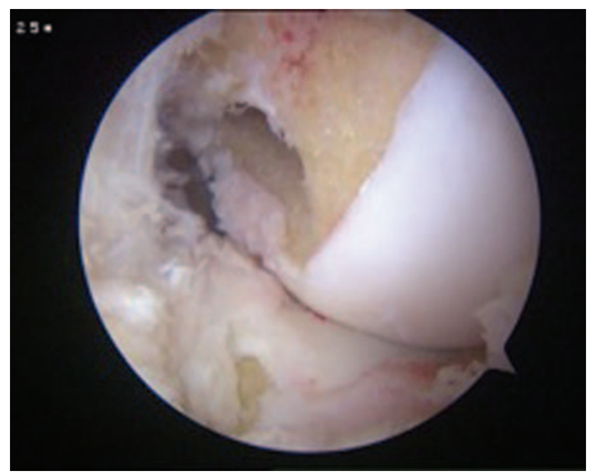
f0050 **Figure 74-9.** Impingement rod angles away from posterior cruciate ligament and toward the native femoral footprint.

Prepare WasherLoc s0095

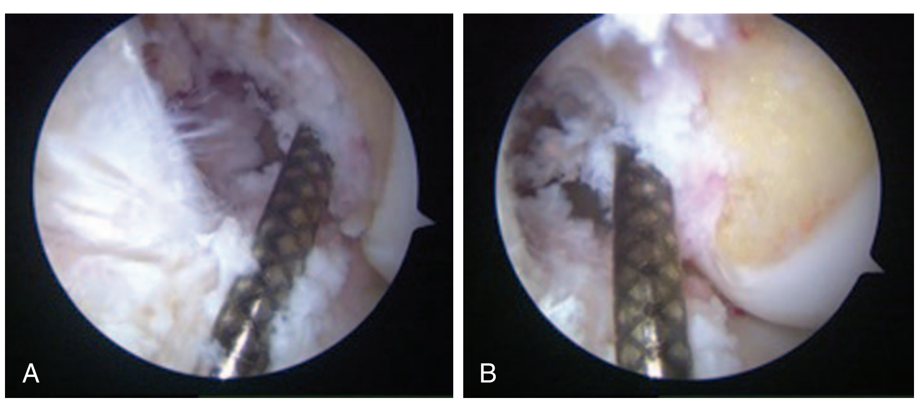
p0350 Expose the distal aspect of the tibial tunnel by removing a thumbnail portion of the surrounding soft tissue and



f0055 **Figure 74-10.** With the knee in full extension, the impingement rod should disappear into the intercondylar notch.



f0065 **Figure 74-12.** Femoral tunnel position in native anterior cruciate ligament footprint with this backwall. Virtually all of the footprint will be filled with graft tissue.



f0060 **Figure 74-11.** Position of the femoral guide pin in the native anterior cruciate ligament footprint.

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f0070 **Figure 74-13.** Counterbore awl guide being positioned to angle counterbore reamer and screw toward the fibular head.

periosteum. Insert the counterbore aimer into the tibial tunnel. Rotate the guide to aim toward the fibular head. Impact the counterbore awl to create a pilot hole in the tibial tunnel (Fig. 74-13). Drill the anterior tibial tunnel with the counterbore reamer seated in the pilot hole and aimed toward the fibular head. Ream the anterior distal tibial tunnel until it is flush with the posterior wall of the tibial tunnel. Do not ream deeper than the posterior wall into the tibia. Save the bone from the flutes of the reamer.

s0100 *EZLoc Sizing and Insertion*

p0355 The EZLoc femoral fixation device is available in two diameters and three lengths to maximize fixation on the cortical bone and optimize bone tunnel surface area and graft length. For femoral tunnel diameters of 7 or 8 mm, choose the 7/8 EZLoc device; and for femoral tunnel diameters of 9 or 10 mm, choose the 9/10 EZLoc device. For femoral tunnel lengths of 35 to 50 mm determined by depth gauge measurement, choose a standard-length implant. For femoral tunnel lengths less than 35 mm, choose a short implant, and for femoral tunnel lengths greater than 50 mm, choose a long implant.

p0360 With the appropriate-size EZLoc device chosen, insert the passing pin connected to the EZLoc into the tibial tunnel and out of the femoral tunnel under arthroscopic visualization (Fig. 74-14). Pull the passing pin out the lateral thigh until the EZLoc implant is just outside of the tibial incision and tibial tunnel entrance. Pass the graft through the loop of the EZLoc device. Even the ends of the graft and tie the sutures from the ends of the tendons together. With a ruler, measure from the distal aspect of the gold lever arm of the EZLoc, and with a marking pen mark the graft according to the length of the femoral tunnel. This mark will ensure that the EZLoc has passed lateral and proximal to the proximal-most aspect of the femoral tunnel. Once the marked portion of the graft enters the femoral tunnel, the suture on the EZLoc and passing pin is cut. The

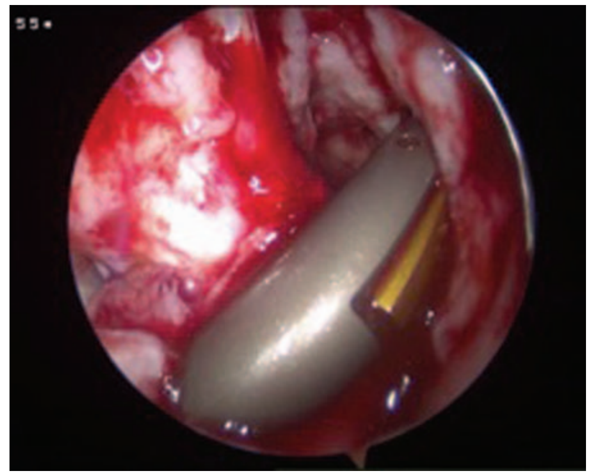

Figure 74-14. Passage of EZLoc device. Position the gold deployment lever laterally. f0075

passing pin is removed, and tension is pulled on the EZLoc suture deploying the lever arm. Pull tension on the graft strands and rock the graft–EZLoc device back and forth to ensure that the EZLOC is seated on the cortical bone of the lateral femur. Cycle the knee 20 to 30 times, maintaining tension on the graft.

WasherLoc Tibial Fixation s0105

After cycling the knee, position it in full extension. Tie all graft sutures together, and pass an impingement rod through the suture loops. Assemble the WasherLoc to the inserter and drill guide. Place the WasherLoc inserter awl thorough the pilot hole and capture the strands of the graft within the long tines of the WasherLoc. Have an assistant pull tension on all graft strands equally by pulling on the impingement rod. With all graft strands isolated between the long tines of the WasherLoc, impact the WasherLoc into the graft and bone with a mallet. Remove the inserter awl and drill the far cortex with a 3.2-mm drill through the drill guide. Remove the drill guide and measure the length of the drill hole. Place the measured length 6.0-mm cancellous screw through the WasherLoc, compressing the WasherLoc and graft against the posterior wall of the tibial tunnel (Fig. 74-15). p0365

Bone Graft Tibial Tunnel s0110

Insert the tibial tunnel dilator into the distal aspect of the tibial tunnel. The dilator often can be advanced up the tunnel by hand. Alternatively, gently impact the dilator up the tibial tunnel by tapping lightly with a mallet. Place the plastic sleeve over the tip of the bone dowel harvest tube. Position the plastic sleeve at the tip of the harvest tube against the dilated opening of the tibial tunnel. Impact the inner plunger rod to deliver the cancellous bone dowel from the harvest tube into the tibial tunnel. Insert the scope into the joint and inspect the graft (Fig. 74-16). Flex and extend the knee p0370

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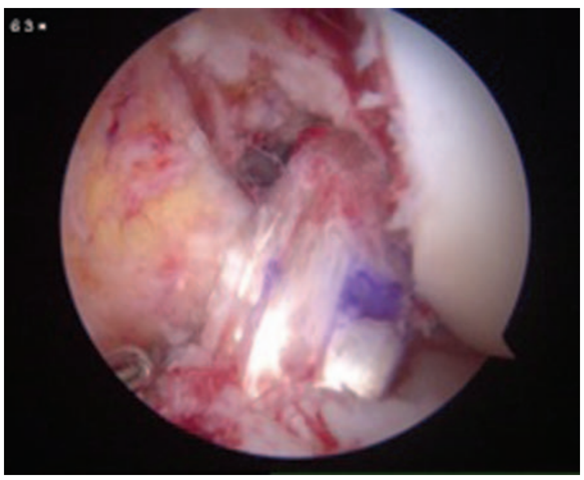
f0080 **Figure 74-15.** WasherLoc fixation of graft with bone graft impacted in tibial tunnel.



f0085 **Figure 74-16.** Completed anterior cruciate ligament reconstruction.

to ensure that no roof or PCL impingement is present. Connect the outer sheath of the arthroscopy handpiece shaver blade to a syringe filled with bupivacaine (Marcaine), advance the sheath under the sartorius fascia along the hamstring tendon sheaths, and inject to provide local anesthesia to the proximal medial thigh. Close the hamstring harvest site in layers, and close the portal sites. Place a sterile dressing and deflate the tourniquet.

s0115 POSTOPERATIVE REHABILITATION

p0375 The postoperative goals in rehabilitation are given in Table 74-2.

s0120 RESULTS

p0380 Several recently published articles question the effectiveness of the transtibial tunnel technique to properly position the femoral tunnel for ACL reconstruction.[3,4] These articles suggest that proper femoral tunnel placement

TABLE 74-2. Goals in Rehabilitation t0015

Time	Activity
0-2 weeks	Brace-free, weight bearing as tolerated
2-4 weeks	Stationary bike, quadriceps and hamstring strengthening
8-12 weeks	Jogging, leg press, open and closed chain exercises
12-16 weeks	Add weights and agility exercises
After 16 weeks	Return to sport if single-leg hop is greater than 85% of normal side

6

within the native ACL footprint can be inconsistent and difficult to achieve with a transtibial tunnel technique. One criticism of these studies is there is no planar control for tibial tunnel placement. Simply identifying an exit point for the tibial tunnel within the native ACL tibial footprint appears to be inadequate to allow for consistent transtibial placement of the femoral tunnel within the native ACL femoral footprint. Both the sagittal and coronal plane positions of the tibial tunnel are critical, because the tibial tunnel will determine in large part the position of the femoral tunnel and ultimately the ACL graft position when a transtibial tunnel technique is used. The 65° Tibial Guide was specifically developed to position the tibial tunnel in the appropriate sagittal and coronal planes rather than simply choosing a point in the native tibial footprint to prepare the tibia tunnel. Appropriate planar position of the tibial tunnel with use of this guide consistently positions the tibial tunnel in the native ACL tibial footprint for all patients.[5] Coronal plane angulation of 60 to 65 degrees prevents PCL impingement and lateralizes the position of the femoral tunnel more obliquely down the sidewall of the lateral condyle.[6,7] Based on MRI studies, the native ACL position is consistently posterior and parallel to the intercondylar roof when the knee is in full extension.[8,9] Thus the native ACL position is influenced by knee extension and the intercondylar roof angle for any given patient.[10] Use of a coronal alignment rod along with the use of the intercondylar roof anatomy of the knee while the knee is in full extension as described earlier enables the surgeon to consistently and accurately position the tibial tunnel in the correct planes for any given patient.[11] Whereas use of intraoperative fluoroscopy may be helpful in preventing roof impingement, a recent study demonstrated difficulty in solely relying on fluoroscopy to establish proper tibial tunnel placement for all patients because of normal anatomic variability among them.[12] Correct planar position of the tibial tunnel leads to correct femoral tunnel position, resulting in ACL graft tension behavior similar to that of the native ACL.[13,14] Furthermore, complications of roof and PCL impingement are avoided because the 65° Tibial Guide improves the accuracy of ACL graft

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position, taking into account the anatomic differences between our graft sources and the native ACL.

p0385 Second, use of strong, stiff, and slippage-resistant fixation devices further ensures successful outcomes regardless of the use of autogenous hamstring or allograft tissues. In a recently submitted prospective randomized controlled trial comparing autogenous hamstring grafts with anterior tibialis allografts with use of the previously described surgical technique, no differences in subjective or functional outcomes were determined between groups in this appropriately powered study.[15] In addition, a recently published study that used the described surgical technique with fresh-frozen tibialis allograft demonstrated only a 1- to 2-mm overall graft length change in the first 2 months after surgery, with no additional graft length change after 2 months as detected by radio-stereophotogrammetry.[16] This in vivo study clearly demonstrated the importance of the use of strong and stiff fixation devices coupled with proper tunnel placement via a transtibial tunnel technique to achieve graft isometry, knee stability, and an early return to sport and activity.

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