Joint Preservation

ACL Reconstruction
Cross-Pin Technique

Surgical Technique

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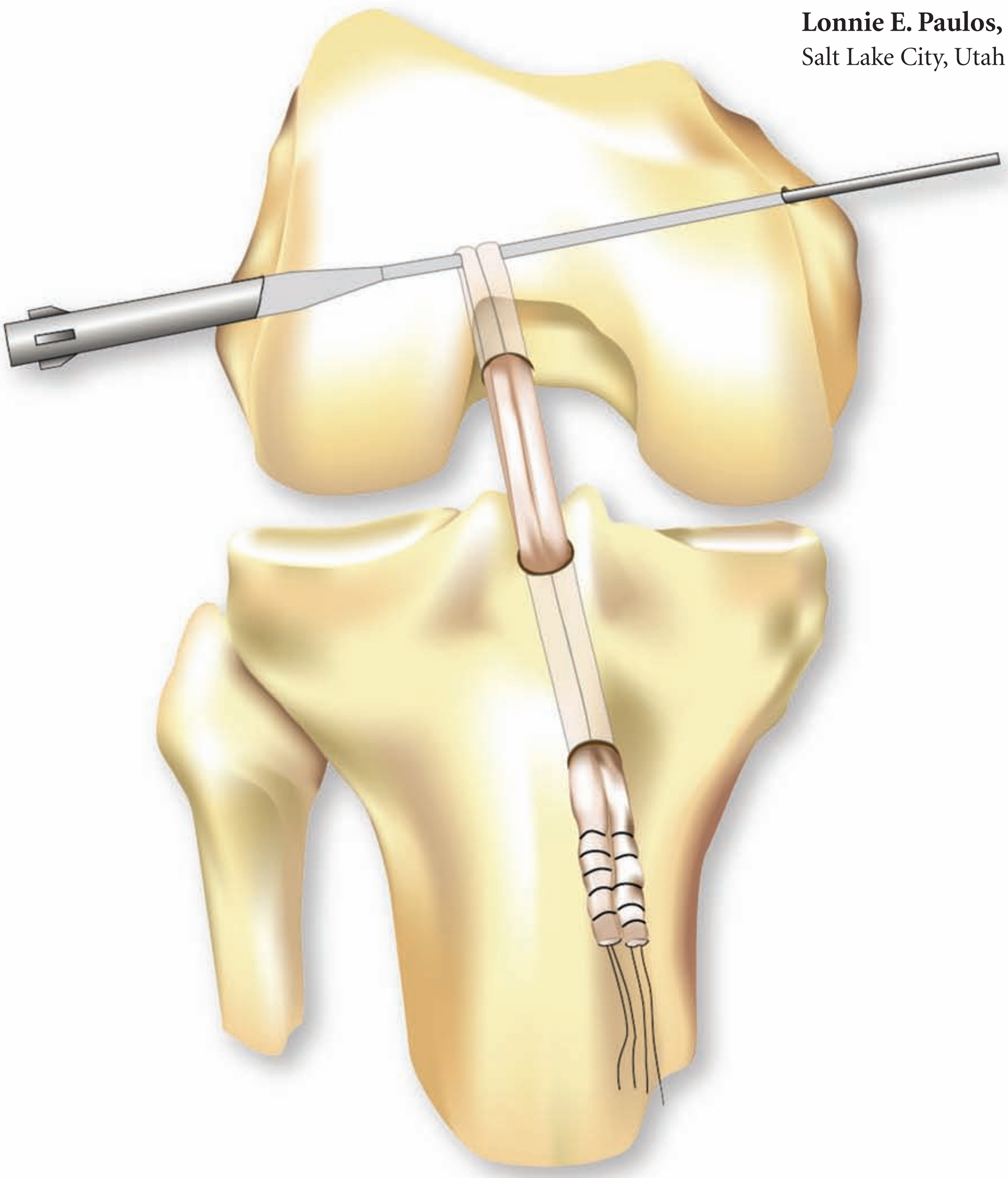

ACL Reconstruction Technique Using Hamstring Tendons and the Stryker Biosteon Cross-Pin System

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Harvest Tendons

After examination, under anesthesia and diagnostic arthroscopy, the surgeon harvests the semitendinosus tendon and, if desired, the gracilis tendon using the Stryker Tendon Stripper. Care must be taken not to prematurely amputate the tendons, all fascial attachments must be pre-dissected free from the tendon prior to stripping. Also, it is important to align the Stryker Tendon Stripper with the longitudinal axis of the hamstring tendon while pulling the tendon into the stripper rather than pushing the stripper into the tendon.

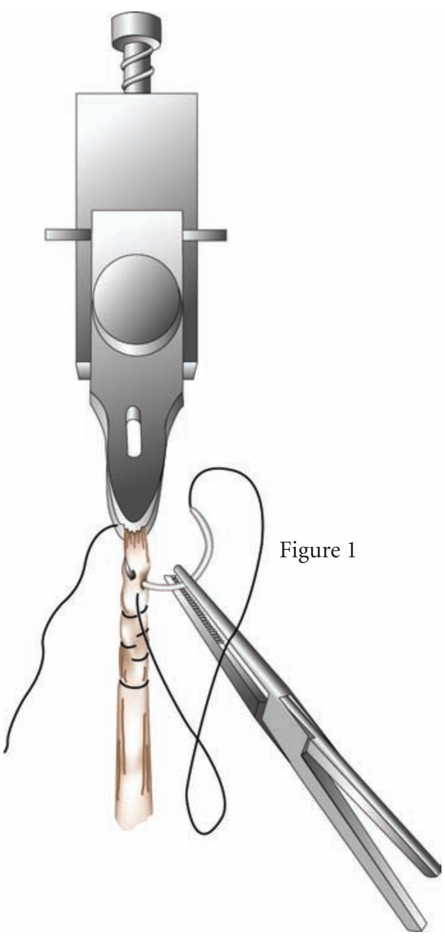


Figure 1

The tendons are then passed to a surgical assistant who prepares the tendons for use as the ACL graft. Graft preparation is accomplished using the Stryker ACL Workstation. The Workstation allows for pre-tension and control of the tendons while placing sutures. The semitendinosus can be used by itself in a quadrupled fashion or the surgeon may select two hamstring tendons in order to extend tissue out the tibial tunnel to allow for fixation directly to bone. After suturing the ends of the hamstring tendons it is best to place the tendons under tension using the Stryker ACL Workstation (Figure 1). This removes excess laxity and allows more predictable tensioning at the time of fixation. Usually 30lbs of tension for 20-30 minutes is adequate.

Tibial Tunnel Location and Preparation

The key landmarks for the tibial tunnel include the continuation of a line from the inner rim of the anterior horn of the lateral meniscus, the mid-point of the inter-condylar eminence, and a distance of 1–2mm plus the radius of the desired tibial tunnel anterior to the fibers of the posterior cruciate ligament. The Stryker ACL Tibial Guide is passed through the anterior medial portal and placed in a position that is slightly medial and posterior in the normal ACL tibial footprint (Figure 2).

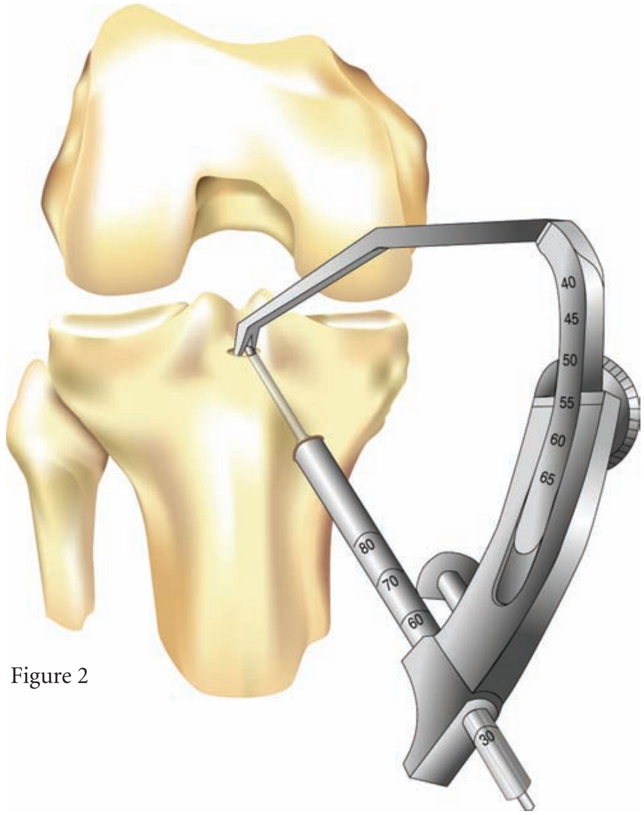
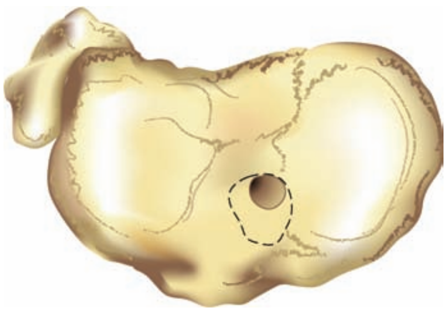
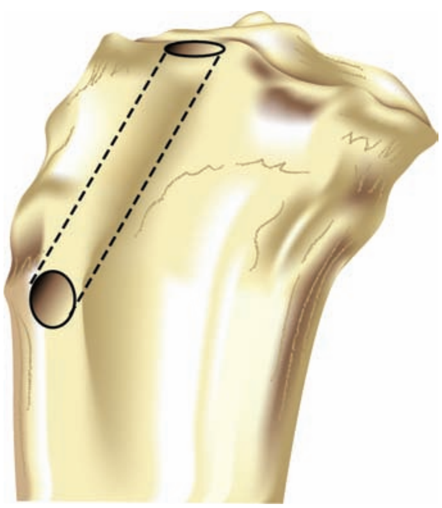


Figure 2



This allows the tibial tunnel to be drilled with the least amount of impingement possible from the lateral femoral condyle and/or the superior condylar notch. Generally, the angle of the tunnel is approximately 55º to the tibial plateau (Figure 2).



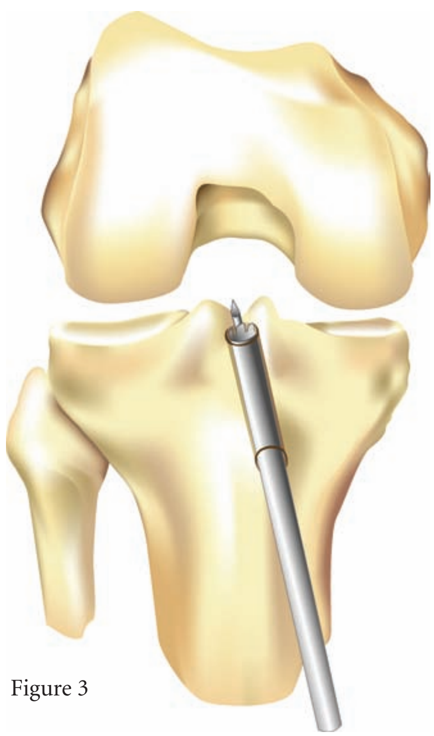


Figure 3

The diameter of the tibial tunnel is determined by sizing the hamstring graft that had been previously harvested. The Stryker ACL System allows for one-half millimeter sizing and this is preferable to allow a tighter tunnel fit and thus discourage tunnel widening. If the surgeon prefers, the Stryker Trephine System can be used in order to obtain a bone plug to enhance later fixation through bone grafting of the ACL graft tunnels.

Femoral Tunnel Location and Preparation

The best location on the femur for the ACL graft placement is approximately the one or two o'clock position in a left knee or the 10 or 11 o'clock position in a right knee. The position selected should correspond to the normal anatomic ACL footprint on the femur at its most medial and posterior position. If the surgeon chooses he can use the Stryker Femoral Aimer to locate the exact position on the femur. The knee should be flexed beyond 90º to allow the guide to sit flush against the bone. In this position the end of the Femoral Aimer slips into the "over-the-top" position and the position can be marked with a drill awl to aid in placing the femoral guide pin (Figure 4).

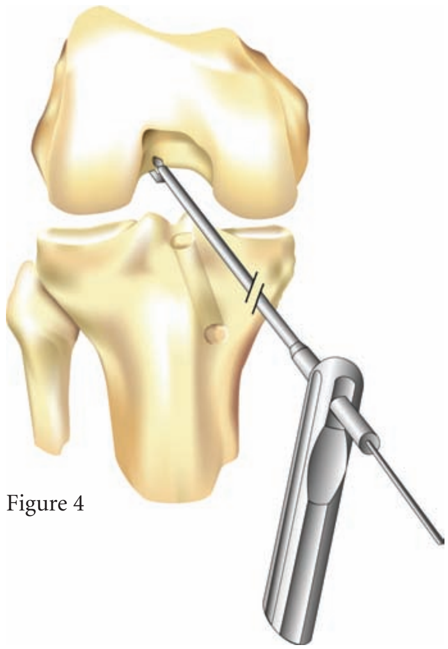


Figure 4

Once the surgeon has selected the appropriate position, the Stryker Forked Femoral Guide Pin is inserted through the tibial tunnel and drilled through the femur out the superior lateral musculature of the thigh (Figure 5).

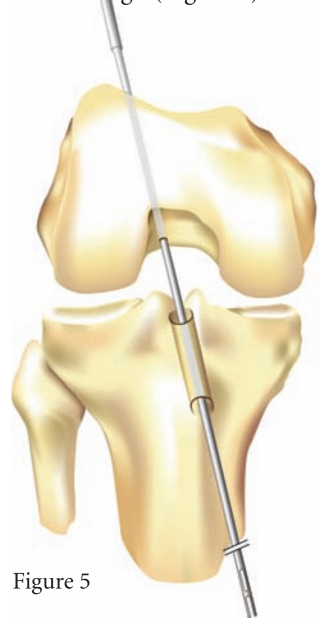


Figure 5

With the Stryker Forked Femoral Guide Pin in place, an appropriately sized cannulated reamer is passed through the tibial tunnel and over the guide pin. The femoral tunnel is then drilled to approximately 25-30mm in depth (Figure 6). If the surgeon chooses, he can drill a shorter tunnel thus pulling less hamstring into the femur and creating an overall shorter graft configuration. This allows more tissue to protrude from the tibial tunnel for later tibial fixation. Unlike using an interference screw, the posterior femoral cortex can be perforated and/or fractionated without compromising femoral fixation. If this should occur or if the surgeon chooses to use this technique it is important that the Stryker Biosteon Cross-Pin be placed parallel to the transcondylar axis or slanted slightly anterior in order to ensure enough posterior bone support for the Cross-Pin.

An optional step the surgeon can use is to drill over the Forked Femoral Guide Pin through the femur until the lateral cortex is broached with a standard 4.5 mm cannulated drill. This will allow easier suture-tape passing in future steps. It also facilitates pulling the Forked Femoral Guide Pin through the femur so the pin is not visible in the femoral tunnel. It is important that the surgeon leaves the pin in the femur for future steps. It must be pulled proximal so as to not interfere with the transverse drill guide position.

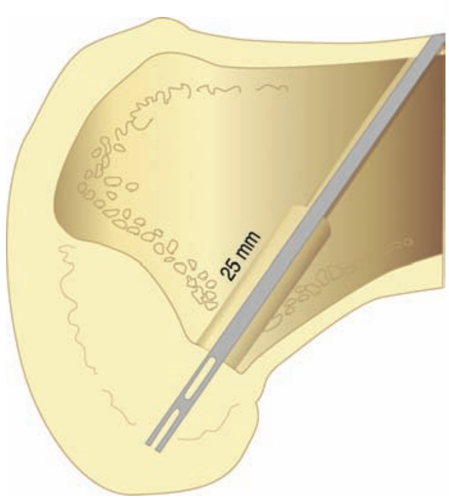


Figure 6

Transverse Tunnel Preparation

Choose a Transverse Femoral Index Guide equal to the femoral tunnel and assemble the Transverse Drill Guide. The Transverse Drill Guide is inserted through the tibial tunnel into the femoral tunnel to the desired depth (Figure 7). (NOTE: The center line of the Stryker Biosteon Cross-Pin is positioned 8mm from the top of the Transverse Femoral Index Guide, perpendicular to the axis. Example: a 25mm femoral tunnel will place the center line of the Stryker Biosteon Cross-Pin 17mm from the aperture of the femoral tunnel).

With the Transverse Drill Guide in a position that is parallel to the transcondylar axis or slightly angled anteriorly, the Transverse Guide Bullet is passed laterally until it contacts the lateral femoral condyle near the lateral epicondyle of the femur through a small incision in the skin and fascia lata. It is not necessary to advance the bullet to the bone. It is more important that it slides freely without torquing the guide.

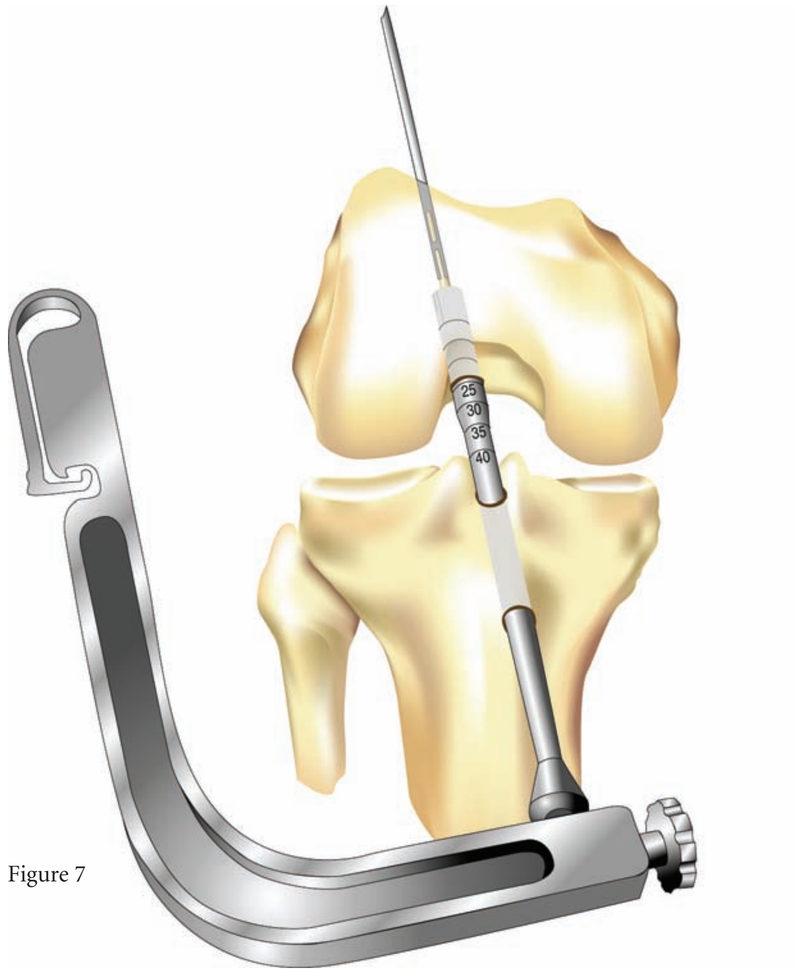


Figure 7

It is important that the surgeon directs the Transverse Drill Guide appropriately so as not to allow the Transverse Guide Bullet to direct the guide pin posteriorly. This not only keeps the neurovascular structures safe but also ensures that there is sufficient bone posterior to the femoral tunnel to support the Cross-Pin. The incision in the skin is made through the soft tissues down to the periosteum taking care to avoid the lateral femoral tibial joint line. (Caution: Do not flex the knee while the Transverse Drill Guide is in place. Damage to bone tunnels and/or the Drill Guide may occur). Once the placement of the Guide Bullet is confirmed on or near the lateral femoral cortex, the 2.7mm Transverse Threaded Guide Pin is drilled from the lateral direction through the femur and out the medial femoral cortex. By assuring that the Transverse Threaded Guide Pin passes parallel to the transcondylar axis or slightly anterior, no damage will occur to neurovascular structures on the medial side of the knee. The Guide Pin should emerge from an area near the medial epicondyle or slightly posterior. Care is taken not to force the Drill Guide and/or torque it to avoid misdirection while drilling (Figure 8).

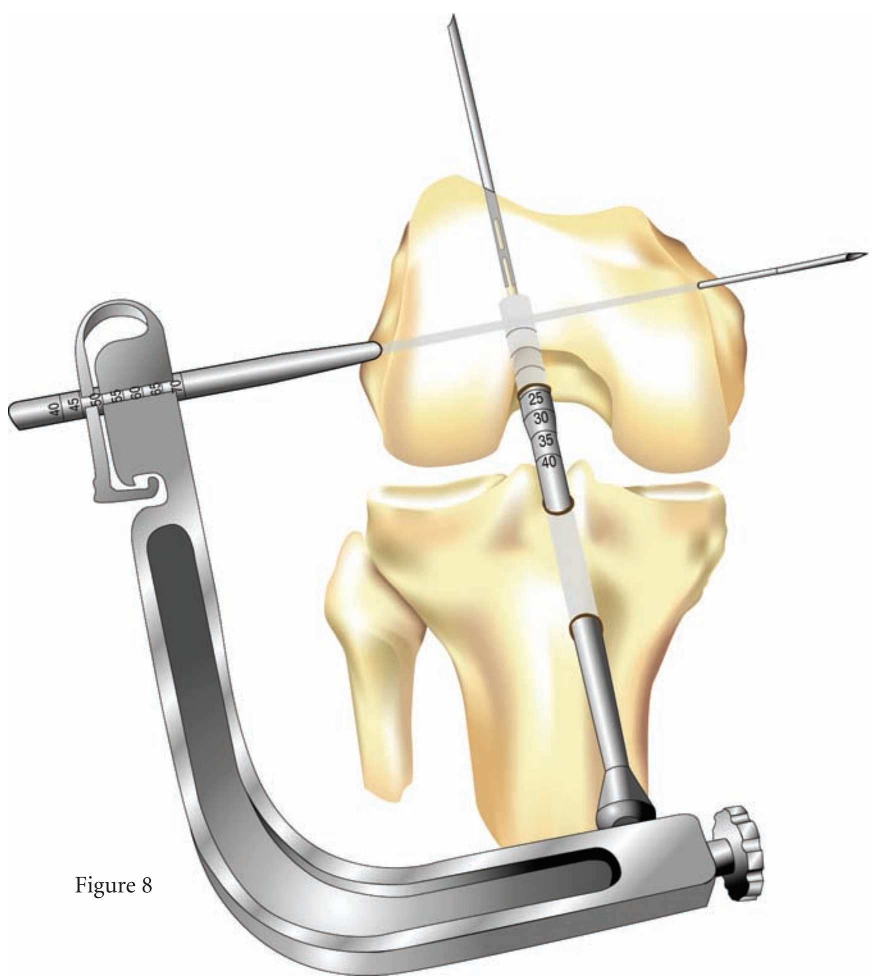


Figure 8

Calibrations on the Transverse Guide Bullet denote the length of the Stryker Biosteon Cross-Pin (40 or 50mm Cross-Pin) to use (Figure 8). The measurements are read from the outside of the Transverse Drill Guide. Each measurement represents the distance from the lateral femoral cortex to 10mm beyond the medial wall of the femoral tunnel (this assumes a femoral tunnel diameter of 10mm).

Once the Transverse Threaded Guide Pin is in place the Transverse Drill Guide is removed. Viewing with an arthroscope through the tibial tunnel will allow the surgeon to directly confirm that the 2.7mm Transverse Guide is in place through the center of the femoral tunnel.

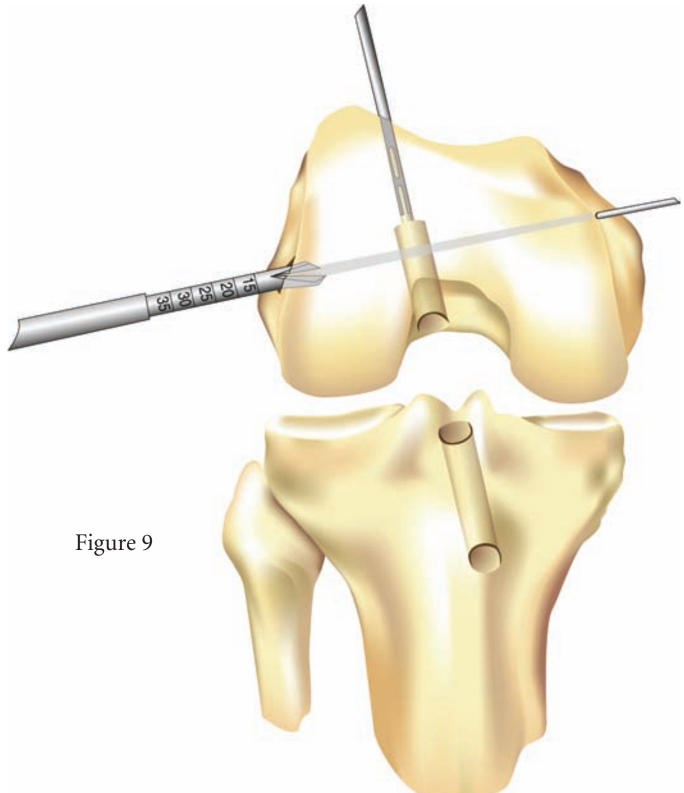


Figure 9

A 5mm Fluted Reamer is used to drill over the Transverse Guide Pin from lateral to medial to a depth of approximately 10mm less than the Stryker Biosteon Cross-Pin being used. This allows easier insertion of the Stryker Biosteon Cross-Pin at the time of fixation (Figure 9).

On the back table the surgeon or the assistant attaches one end of the FLEXWIRE to the 1.5mm x 2.4mm Stepped Insertion Pin. The next step is to attach the opposite end of the FLEXWIRE to the 2.7mm Transverse Threaded Guide Pin already positioned in the femur. The surgeon and/or the assistant then pulls the Threaded Guide Pin medially out of the femur, thus pulling the FLEXWIRE through the femur leaving it visible on both sides of the knee (Figure 10).

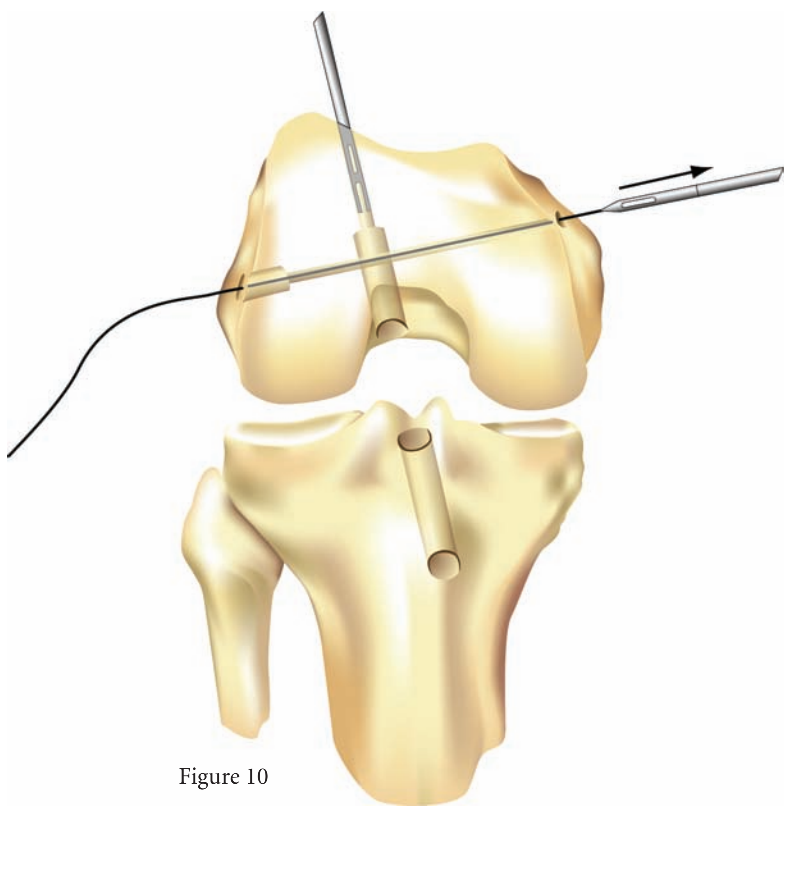


Figure 10

Graft Placement

While visualizing the femoral tunnel arthroscopically through the tibial tunnel the surgeon pushes the 2.4mm Forked Femoral Guide Pin down through the femur to hook the FLEXWIRE with the fork while continuing to push the Forked Femoral Guide Pin out through the tibial tunnel until the FLEXWIRE is visible (Figure 11). It is important to keep the FLEXWIRE from twisting by using a hemostat on the strands of the wire after it has emerged from the tibia. Twisting the FLEXWIRE can cause difficulty in pulling the graft into position in subsequent steps.

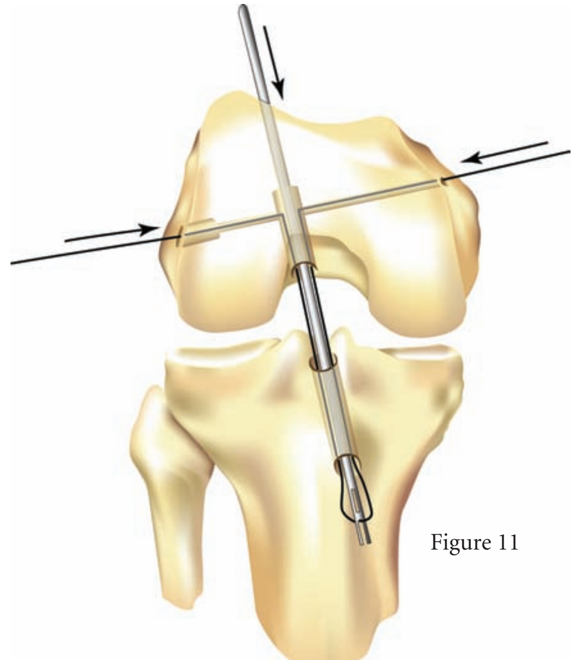


Figure 11

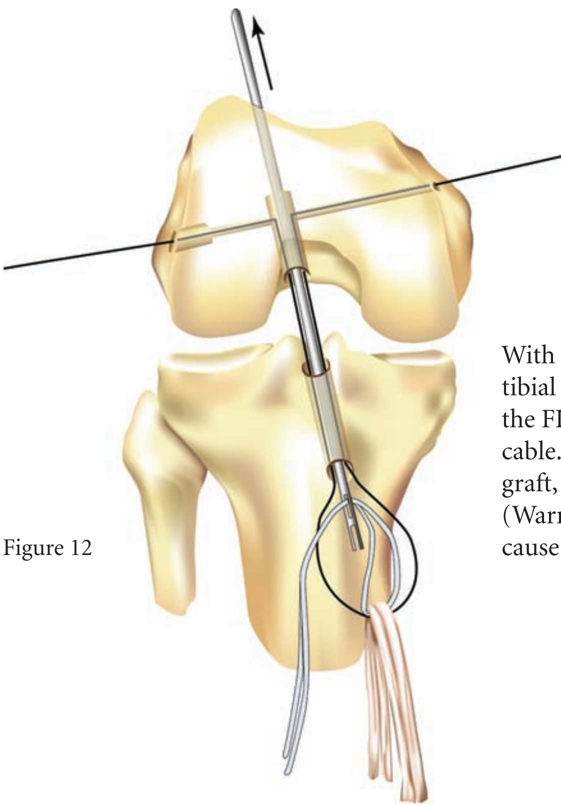


Figure 12

With the FLEXWIRE and the Forked Femoral Guide Pin visible distal to the tibial tunnel the hamstring graft is looped over the cable taking care not to twist the FLEXWIRE or ACL graft. The soft tissue should be looped evenly over the cable. Next, a loop of polyester tape or #5 suture, which is looped around the graft, is threaded through the eyelet of the Forked Femoral Guide Pin. (Figure 12) (Warning: Do not pull the graft into position with the flexible cable as this can cause graft and/or tunnel abrasion).

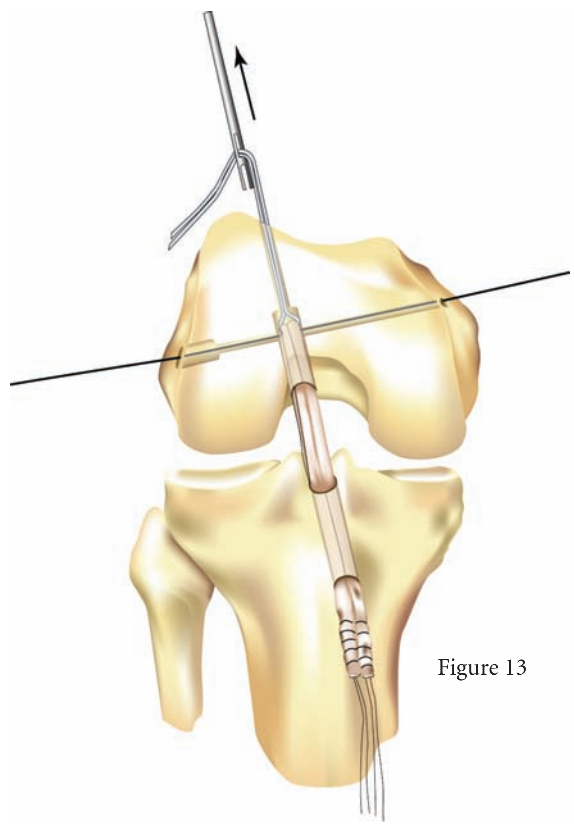


Figure 13

The Forked Femoral Guide Pin is then pulled proximally through the tibial tunnel into the femoral tunnel and out the femoral musculature. This will deliver the tape/suture, which is looped through the ACL graft so that the surgeon can pull the graft into position. The surgeon should firmly grasp the tape/suture and pull the graft into the femoral tunnel through the tibial tunnel. While pulling on the tape/suture apply even tension to both ends of the FLEXWIRE to avoid twisting the wire with the graft (Figure 13). Once the graft is in position it is important to remove the tape/suture from the graft by pulling on one end and extracting it out of the femoral musculature. This will facilitate passage of the Stryker Biosteon® Cross-Pin in the next step.

Graft Fixation

Once the ACL graft is in place, the FLEXWIRE is passed medially and laterally to ensure there is free passage through the transcondylar tunnel and the center of the graft. This should be done minimally to ensure free passage but not to cause abrasion to the graft.

The surgeon then pulls on the FLEXWIRE from the medial side of the knee. The FLEXWIRE, with the previously attached 1.5mm x 2.4mm Stepped Insertion Pin is pulled across the knee, leaving enough length on the lateral side to guide the Stryker Biosteon Cross-Pin into the femur. With the 1.5mm x 2.4mm Stepped Insertion Pin through the graft and across the knee the surgeon can then pull on the sutures of the graft to ensure the graft is looped over the rigid guide wire (Figure 14).

With the 1.5mm x 2.4mm Stepped Insertion Pin in proper position, the Stryker Biosteon Cross-Pin is passed over the lateral end of the guide pin until the Cross-Pin is seated against the shoulder of the Stepped Guide Pin. Next, the tamp is placed on the Stepped Guide Pin behind the Cross-Pin and then impacted until the Stryker Biosteon Cross-Pin is fully seated into the lateral femoral condyle (Figure 15). The implant is fully seated when the shoulder of the tamp is flush with the lateral femoral cortex.

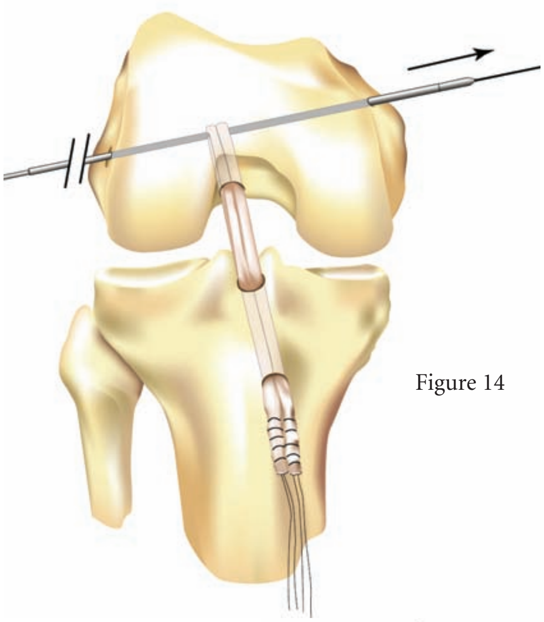


Figure 14

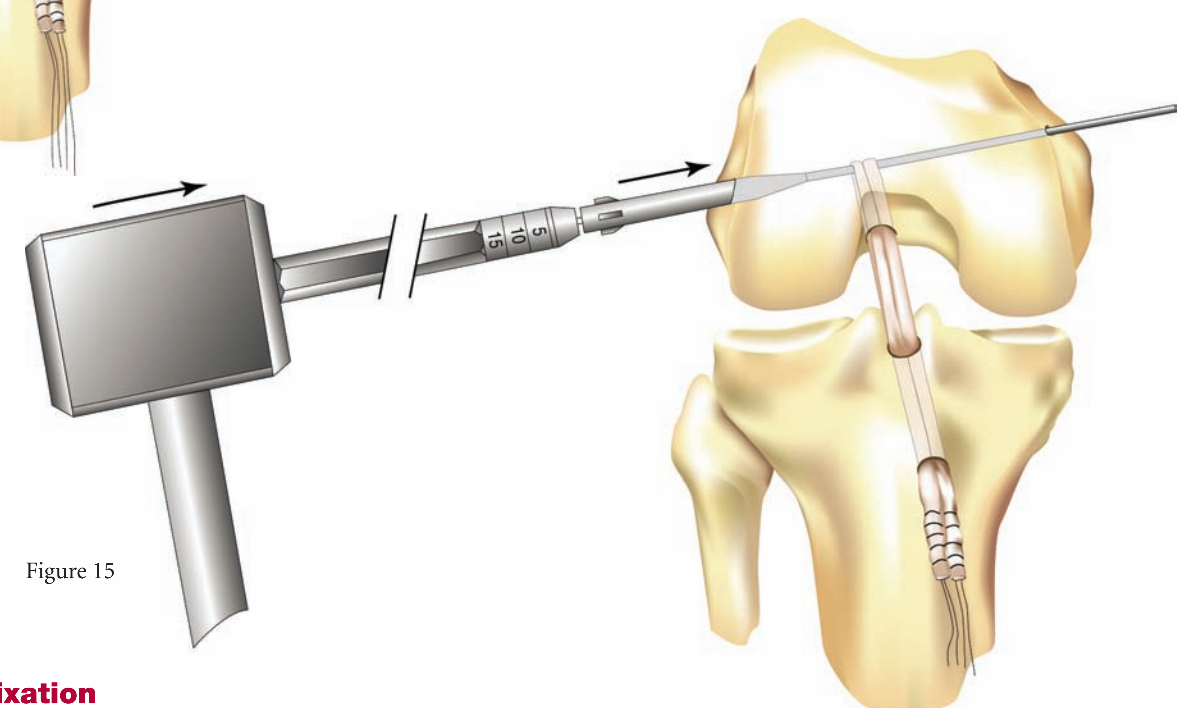


Figure 15

Tibial Graft Fixation

After confirmation of femoral graft fixation, the opposite end of the graft is tensioned manually as the knee is manipulated through a series of cycles from full extension to full flexion. This will properly set the sutures in the graft for more predictable tensioning. With the knee flexed between 10-20º, approximately 15 lbs. of manual force is placed on the ACL graft and it is then fixed with a Stryker Interference Screw. If the coring reamer was used to drill the tibial tunnel, the bone that was harvested can be impacted into the tibial tunnel prior to graft fixation.

Indications:

Intended for use in the surgical reconstruction of anterior cruciate ligament (ACL) deficient knees to provide cross-pin femoral fixation of the various soft tissue ACL autografts and allografts.

Contraindications:

1. Insufficient quantity or quality of bone.
2. Blood supply limitations, and previous infections which may tend to retard healing.
3. Foreign-body sensitivity where material sensitivity is suspected, appropriate tests should be made and sensitivity ruled out prior to implantation.
4. Active infection.
5. Conditions which tend to limit the patients ability or willingness to restrict activities or follow directions during the healing period.

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