Technical Note

Eccentric Reaming to Correct Nonanatomic Anterior Cruciate Ligament Tibial Tunnel Placement

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Abstract: Anatomic tibial tunnel placement remains an essential aspect of anterior cruciate ligament reconstruction success. Incorrect placement is a common cause of failure and revision reconstruction. Our technique allows repositioning a suboptimal tibial tunnel without the need to remove the initial guide pin for proper tunnel placement. The use of the eccentric reaming technique allows for this to take place, ensuring the more likely success of anterior cruciate ligament reconstruction procedures.

Traumatic rupture of the anterior cruciate ligament (ACL) occurs at an incidence of 68.6 per 100,000 individuals and remains a common orthopaedic injury.[1] The biomechanical importance of the ACL lies in its stabilization of the knee joint to prevent anterior and rotational displacement of the tibia on the femur.[2] Different factors play a role in proper ACL reconstruction, including graft selection, proper tunnel placement, graft tension, and fixation, as well as graft motion and healing postoperatively.[3-5]

Tunnel placement plays a major role in the success of ACL reconstruction.[6] Studies have shown that the ideal placement of a tibial tunnel is in the same location as the native tibial ACL footprint, approximately 10 mm anterior to the PCL insertion, 6 mm anterior to the medial eminence, and 9 mm posterior to the intermeniscal ligament.[7] Commonly, the tibial tunnel is placed anterior to the posterior margin of the anterior horn of the lateral meniscus (AHLM) because the posterior border of the AHLM is an anatomic marker for the midpoint of the ACL footprint.[8] In addition, studies have shown that the AHLM and ACL share a common footprint on the tibia.[9,10]

Improper tunnel placement remains a major cause of ACL reconstruction revision owing to failure or retear. Studies have shown that 37% to 40% of revisions were due to nonanatomic tibial tunnel placement.[11,12] Several other studies have emphasized that the major cause of revision surgery is tunnel malposition: either anterior or posterior placement. Anterior placement of the tunnel may result in loss of terminal extension, and posterior placement outside the native footprint can lead to loss of flexion.[13]

Nevertheless, malpositioned tunnels still give rise to a significant number of revisions, which allows the opportunity for improvement and creative strategies to mitigate this issue to prevent the need for revision surgery. This article aims to discuss the technique of eccentric reaming to potentially maximize the likelihood of proper tibial placement during ACL reconstruction.

Surgical Technique

Patient Setup

The patient is induced under general anesthesia and positioned supine on the operating table. A tourniquet is then placed high on the patient's injured leg. The thigh is positioned in a leg holder to allow 90° of knee flexion. The leg is then prepared and draped in the normal sterile fashion.

Arthroscopic Access and Diagnostic Arthroscopy

The initial anterolateral arthroscopic portal is made; then, the anteromedial portal is made under direct visualization using the first portal. A diagnostic

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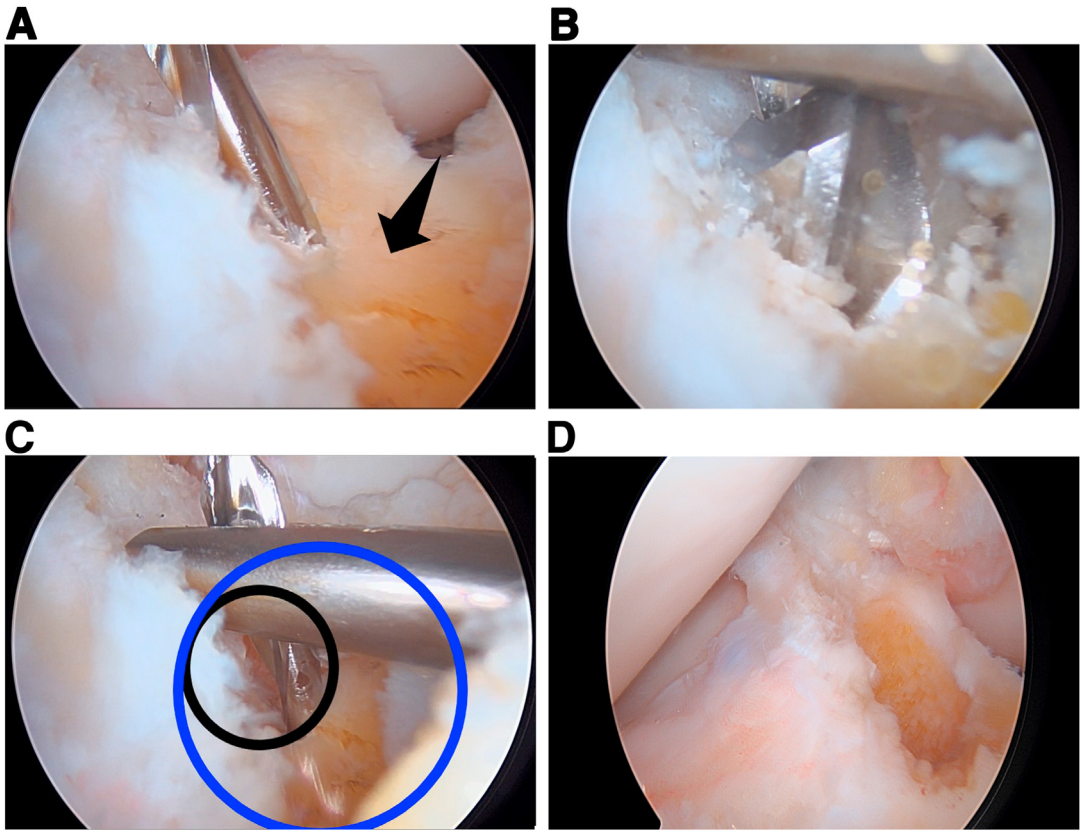

Fig 1. Eccentric reaming technique for anterior cruciate ligament reconstruction in right knee. (A) Guide pin deflection can occur with extramedullary tibial drilling for anterior cruciate ligament reconstruction. The arrow indicates the ideal tibial footprint center. (B) A 5-mm reamer is used to create a preliminary tunnel over the deflected guide pin. This will allow flexibility about the pin's axis of rotation before finalizing the tunnel trajectory. (C) A Kocher instrument is introduced in the anteromedial portal to hold the guide pin in the desired position at the center of the tibial footprint. In this case, the position is at the anteromedial aspect of the 5-mm preliminary tunnel (black circle). The blue circle indicates the 10-mm ideal tunnel. (D) Ideal tibial tunnel creation after eccentric reaming with 10-mm reamer. No tunnel widening has occurred because the tunnel radius remains at 5 mm.

arthroscopy is performed to assess the extent of injury and other structures that may be injured. The ACL tear is visualized and debrided extensively using a motorized shaver and cautery. The tibial and femoral footprints are then prepared, and a notchplasty is performed.

ACL Reconstruction With Eccentric Reaming Technique

An extramedullary tibial guide (Acufex ACL tip aimer; Smith & Nephew, Andover, MA) set to 55° is placed within the native ACL tibial footprint, and a 2.4-mm guide pin is placed (Video 1). While the guide pin is being placed, it can be deflected and result in suboptimal positioning (Fig 1A). We have found the parallel drill guide to be suboptimal in obtaining a more ideal position.

Our solution is perform eccentric reaming by initially using a 5-mm reamer over the guide pin to create a preliminary tunnel (Fig 1B). This will allow flexibility about the pin's axis of rotation before finalizing the

Table 1. Pearls and Pitfalls of Eccentric Reaming in Anterior Cruciate Ligament Reconstruction

Pearls	Pitfalls
A 5-mm reamer is used over the guide pin to allow for flexibility of the axis.	When using the final reamer, the surgeon should avoid lingering in the tunnel because this can cause widening as one end of the guide pin is still mobile.
A Kocher instrument or driving the pin into the femoral notch stabilizes the 2.4-mm guide pin at the desired location.	The guide pin must be held steady to prevent tunnel widening.
The surgeon should place a 10-mm reamer over the guide pin and ream to the desired location of the tibial tunnel.	Tibial tunnel placement can still be suboptimal if the surgeon does not have a full understanding of how to correct the initial non-ideal trajectory.

Table 2. Advantages and Disadvantages of Eccentric Reaming

Advantages	Disadvantages
Decreased risk of damage to articular cartilage and meniscus as parallel guide places pin in nonanatomic location	Risk of Kocher instrument movement while reaming, resulting in poor tunnel position
Avoidance of re-drilling guide pin	Potential tunnel widening if there is too much side-to-side movement of final reamer while reaming
Prevention of tibial tunnel widening	

tunnel trajectory. A Kocher instrument is then used via the anteromedial portal to hold the pin in the exact desired position—the center of the tibial footprint (Fig 1C). Alternatively, the guide pin can be driven into the femoral notch to hold its position. A 10-mm reamer is placed over the guide pin, and reaming is performed to create the final desired tibial tunnel. This technique prevents any tunnel widening as the tunnel radius remains at 5 mm (Fig 1D). If a smaller final tunnel is desired, we can also use a smaller initial reamer that is not greater than half the final diameter.

Discussion

Proper anatomic placement of tibial and femoral tunnels remains challenging in an ACL reconstruction procedure. Historically, anatomic placement leads to better outcomes and a lower likelihood of revision surgery. However, non-ideal pin placement can lead to the need to re-drill a pathway or can create a malpositioned tibial tunnel. Our technique of eccentric reaming allows for anatomic tibial tunnel placement without the need to re-drill or modify a malpositioned pin.

Few studies have discussed the use of eccentric reaming during ACL reconstruction surgery. Burnham et al.[14] discussed the use of eccentric reaming in a sequential fashion to achieve anatomic positioning of the femoral and tibial tunnels. This study discussed sequentially increasing the size of the reamer used by 2 to 2.5 mm while eccentrically reaming. However, using sequentially increasing sizes of reamers leads to the possibility of widening the final tunnel diameter. If the second to last reamer usedis more than half the radius of the final reamer, tunnel widening can occur, which may result in a looser construct.

The technique of eccentric reaming during ACL reconstruction allows for anatomic placement of the tibial tunnel without the need to re-drill the pin or use a parallel guide. Our method allows for the use of one 5-mm reamer and then a 10-mm reamer (for a graft 10 mm in size) while maintaining a radius of 5 mm in the tibial tunnel. This prevents the widening of the tibial tunnel that may lead to a loose graft construct and the risk of revision surgery. Starting with the 5-mm reamer also allows for flexibility of the axis; pearls and pitfalls of our technique are further described in Table 1.

The advantages of our technique include avoidance of re-drilling and decreasing the risk of damage to the articular cartilage and are further explained in Table 2. However, this technique has risks of Kocher instrument movement and tunnel widening; thus, proper technique use is essential to allow for proper repositioning of the tunnel (Table 2).

Disclosures

All authors (A.A., D.G., F.J.C.) declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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