Posterolateral Knee Reconstruction Using Clancy Biceps Tenodesis

Surgical Technique

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ABSTRACT: Posterolateral instability is an uncommon but debilitating knee injury. This entity may occur with anterior cruciate ligament or posterior cruciate ligament injuries, or it may exist separately. This article discusses the biceps femoris tenodesis surgical technique popularized by Clancy, which we have used to treat patients with symptomatic posterolateral instability in valgus aligned knees.

INTRODUCTION

Our understanding of the posterior cruciate ligament (PCL) and posterolateral rotatory instability lags far behind our understanding of the anterior cruciate ligament (ACL)-deficient knee. However, in the past decade, improvements have been made in the understanding of the pathomechanics, pathoanatomy, and surgical treatment of posterolateral knee rotatory instability.[10,23] Seebacher and Warren described a three-layered schemata for understanding the anatomical structures of the posterolateral corner of the knee.[24] In the mid-1980s, DeLee and Baker reported the observation of acute posterolateral knee laxity, and Hughston reviewed his results with 140 patients with chronic posterolateral instability.[2,3,8,15] Important basic science contributions were made by Gollehon et al[11] and Grood et al[14], who arrived separately at similar conclusions regarding primary and secondary restraints of the posterolateral corner. These authors observed that an increased posterolateral spin can occur either with a PCL injury or injuries to the posterolateral structures. However, to differentiate between the two, it was observed that in a knee with isolated posterolateral pathology, an increased posterolateral tibial rotation will be more pronounced at 30° rather than at 90°. In a knee with an isolated PCL injury, there will be a minimal increase in external tibial rotation in contrast to a combined PCL posterolateral injury where posterolateral tibial rotation will be markedly increased both at 30° and 90°.

These basic science studies using selective cutting criteria in cadavers contributed to our understanding of the pathoanatomy of these entities, as well as provided a foundation for helping differentiate them from a physical examination standpoint. In patients with posterolateral knee laxity (Figure 1), the posterolateral spin (Figure 2), increased asymmetric thigh-foot rotations (Figure 3), a positive reverse pivot shift, a dynamic reverse pivot shift

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test as described by Shelbourne, and varying degrees of varus laxity may be seen on physical examination.[5,7,17,19,25]

There is no true consensus with regard to the surgical indications or the surgical treatment for posterolateral instability. A variety of surgical procedures have been popularized including popliteus tendon recession, popliteus tendon bypass, reconstructions using allograft tissues, posterolateral corner advancements, iliotibial band rerouting procedures, and biceps tendon tenodesis procedures using either a portion of the biceps tendon or the complete biceps tendon.* Clancy is credited with the description and popularization of the biceps tenodesis procedure.[4] The biceps femoris is a powerful flexor and external rotator of the knee. The rationale for tenodesis of the biceps femoris is twofold in that, from an EMG standpoint, the muscle unit serves as a posterolateral tibial subluxor and tenodesis negates this effect.[26] Second, tenodesis anatomically will reinforce and advance the posterolateral structures, reinforce the lateral collateral ligament (LCL), and parallel the PCL in the sagittal plane.[21,28]

This article describes the surgical technique popularized by Clancy for posterolateral knee reconstruction. A short review of pertinent anatomy and selective cutting studies also is discussed.

ANATOMY

The anatomy of the posterolateral knee has been described by Seebacher and Warren.[4] These structures are classified into three discrete layers (Figure 4). Layer I consists of the iliotibial band anteriorly and the superficial biceps tendon posteriorly. Each of these structures also has an expansion. Deep to the layer I structures and posterior to the biceps tendon is the peroneal nerve. It is important to remember that multiple fascial attachments can tether the nerve to surrounding structures as it proceeds distally.

Layer II is comprised of the quadriceps retinaculum anteriorly and two patellofemoral ligaments posteriorly. The more proximal patellofemoral ligament attaches into the lateral intermuscular septum, and the distal patellofemoral ligament either inserts into the fabella (if present) or into the lateral gastrocnemius muscle extension to the posterolateral capsule. The patellomeniscal ligament is also part of layer II.

Layer III consists of the lateral joint capsule, which attaches to both the tibia and femur and the lateral meniscus along a horizontal plane. The capsular attachment to the meniscus is the coronary ligament. There is a hiatus in the coronary ligament for the passage of the popliteus tendon, which runs superolateral (Figure 5). Posterior to the iliotibial tract, the lateral capsule forms two discrete laminae. The more superficial lamina encompasses the LCL, which runs from the lateral epicondyle to the fibular head. The LCL is actually superficial to layer III. The superficial lamina ends posteriorly at the fabellofibular ligament. The deeper lamina forms the previously described coronary ligament and runs back to the arcuate ligament. The arcuate ligament is "Y"-shaped and spans the area between the popliteus muscle and its tendon from the apex of the styloid process to the posterior femur. There are anatomical variations in this region, but the most common presentation has both the arcuate ligament and fabellofibular ligament reinforcing the posterolateral capsule. The arcuate ligament also expands medially over the popliteus tendon and muscle. The popliteus itself arises from the posterior tibia as a muscular belly and becomes tendinous as it sweeps superiorly and laterally into a plane between the coronary ligament and the synovial membrane lining the knee joint.

Marshall[21] noted that the long head of the biceps tendon becomes tendinous 7 cm to 10 cm proximal to the joint line. The short head of the biceps remains muscular and joins the long head of its deep surface, near the fibular head. Prior to insertion, the long head of the biceps splits into three layers with the superficial layer coursing lateral (superficial) to the LCL, the middle layer wrapping around the LCL, and the deep layer coursing medial (deep) to the LCL. The superficial layer has multiple firm expansions both anteriorly and posteriorly. The deep layer of the common biceps tendon bifurcates with both fibular and tibial attachments.

BIOMECHANICS/CUTTING STUDIES

Much of our understanding and clinical ability to differentiate between isolated PCL injuries, posterolateral rotatory instabilities, and combined injuries can be attributed to sequential and combined sectioning studies reported by Jakob[19] in the early 1980s and subsequently expanded on by both Gollehan et al[11] and Grood et al[14] in the mid-1980s. These recent studies arrived separately at similar conclusions regarding the static contributions of the posterior and posterolateral knee region. These studies demonstrated that isolated sectioning of the PCL significantly increases posterior translation of the knee at all angles, with the greatest degree of posterior translation being seen at 90°. Isolated sectioning of the PCL did not increase external rotation of the tibia to any significant degree at any angle, nor did it increase varus or valgus instability. Isolated LCL sectioning produced no increase in posterior translation at any angle of knee flexion. It did produce significant increases in primary external rotation at 30°. Isolated sectioning of the deep ligament complex (arcuate ligament, popliteus, fabel-

*1-3, 8, 9, 12, 13, 15, 16, 22, 27.