Lateral Femoral Epicondylar Osteotomy

An Extensile Posterolateral Knee Approach

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Abstract Open exposure of the posterolateral corner of the knee is challenged by limitations of posterolateral ligamentous tissues and posterior neurovascular structures. We have used a modification of a lateral femoral epicondyle osteotomy, described historically for surgical management of posterolateral rotatory instability, as an approach to the posterolateral intraarticular structures. The historic technique for ligamentous reconstruction has been abandoned because its nonanatomic fixation does not restore ligamentous isometry. In this report, osteotomy of a bone block from the lateral femoral epicondyle is used to access the joint space. The lateral collateral ligament is reflected distally and posteriorly through traction on the block. Once the intraarticular disorder has been addressed, the lateral femoral epicondyle is secured in its native, anatomic position, thereby restoring isometry and normal joint mechanics after surgery. This technique has been used successfully to address posterolateral articular disorders on femoral and tibial sides. Postoperative magnetic resonance imaging verified restoration of lateral collateral ligament anatomy. Physical examination at 0° and 30° knee flexion showed clinical stability at all postoperative evaluations through 6

and 10 months followup. Using this technique, intraarticular disorders at the posterolateral corner may be addressed in an open manner with anatomic reduction and preserved postoperative function of the lateral collateral ligament.

Level of Evidence: Level V, expert opinion. See the Guidelines for Authors for a complete description of levels of evidence.

Introduction

Surgical exposure of the articular surfaces of the posterolateral knee is a challenge. Approaches to the lateral hemijoint are limited by ligamentous tissues of the posterolateral corner and by the neurovascular bundle posteriorly. Posterolateral approaches to the knee traditionally have been described for surgical management of acute and chronic posterolateral rotatory instability. Therefore, such descriptions were aimed at addressing periarticular disorders and instability rather than intraarticular disorders and failed to address arthrotomy and exposure of the deeper articular surfaces [1, 3, 6, 7, 10]. In 1985, Hughston and Jacobson detailed a technique for posterolateral corner reconstruction that involves advancement of the posterolateral corner through an epicondylar osteotomy [3]. This nonanatomic technique offers a window to the lateral femoral condyle and posterolateral hemijoint with potential application for management of intraarticular disorders. More recently, a technique was described in which the iliotibial band (ITB) attachment to Gerdy's tubercle is osteotomized to allow observation of the ligamentous structures of the posterolateral corner [2, 5].

We present a technique building on the osteotomy described by Hughston and Jacobson that affords the surgeon wide exposure of the articular aspects of the lateral

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Each author certifies that his or her institution has approved the human protocol for this investigation, that all investigations were conducted in conformity with ethical principles of research, and that informed consent for participation in the study was obtained.

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and posterolateral hemijoint. Disorders of the articular surfaces of the posterolateral knee can be difficult to address through traditional anterior arthrotomy or arthroscopically because the femoral and tibial surfaces remain opposed throughout the range of flexion. The purpose of the current case series is to identify a safe and effective open exposure to intraarticular disorders of the posterolateral knee not amenable to arthroscopic management. Described here is an extensile posterolateral approach to the lateral hemijoint that uses an osteotomy of the lateral femoral epicondyle and, if needed, Gerdy's tubercle. This approach affords direct observation and exposure of the posterior lateral femoral condyle and lateral tibial plateau for open management of intraarticular disorders.

Materials and Methods

We describe the surgical technique used for this approach. Our institution does not require approval to report these cases and all investigations were conducted in conformity with ethical principles of research. Both patients were informed that data concerning their cases would be submitted for publication, and informed consent was obtained from the patients for this purpose.

After induction of general anesthesia, the patient may be placed in either a lateral decubitus or supine position with a bump placed under the ipsilateral buttock. Lateral decubitus is useful for a larger patient or one requiring access to the most posterior aspect of the lateral joint, whereas thinner patients or those with more central disorders can be placed supine with a bump under the ipsilateral hip. The leg is prepared and draped in a sterile fashion. The knee is flexed to approximately 90°, and if the patient is supine, the knee is placed over a bump with the lower leg and foot hung over the table edge. The bony landmarks of the lateral knee, including the fibular head, Gerdy's tubercle, lateral femoral epicondyle, and lateral collateral ligament, are marked (Fig. 1). The subcutaneous tissues are injected with local anesthetic containing epinephrine. A tourniquet is not routinely used.

A curvilinear incision is made at the midportion of the ITB and sharp dissection is carried through the skin and subcutaneous tissues. Electrocautery is used to maintain hemostasis at each layer superficially. When working posteriorly near the peroneal nerve or in the joint, bipolar cautery is used. Blunt dissection with a moist sponge is used to elevate and dissect full-thickness tissue flaps anteriorly over the ITB and lateral femoral epicondyle and posteriorly over the biceps femoris tendon and myotendinous junction. In the absence of acute trauma, these tissue planes are easily separated. The common peroneal nerve then is identified and a small vessel loop is placed around it to ensure no excessive traction is placed on the nerve in the

Fig. 1 The bony landmarks of the lateral knee are marked, including the lateral epicondyle (LE), fibular head (FH), Gerdy's tubercle (GT), and lateral collateral ligament (LCL). An extendable curvilinear incision is centered over the epicondyle and Gerdy's tubercle.

event the knee must be placed in varus for management of a tibial articular disorder. The nerve is most easily found coursing in the perineural fat strip posterior to the short head of biceps femoris as it approaches the fibular neck (Fig. 2A). To minimize postoperative adhesions, care is taken to preserve the biceps fascia, and the nerve is dissected over a 3- to 5-cm length with atraumatic forceps and small dissecting scissors.

The ITB may be split longitudinally in line with its fibers directly over the lateral femoral epicondyle. Alternatively, if more anterior or central access to the lateral tibial plateau is needed, the distal ITB may be released with a portion of Gerdy's tubercle using a curved half-inch osteotome (Fig. 2B). If the latter technique is used, an adequate amount of bone should be elevated to securely fix it with a small-fragment screw and washer at the conclusion of the procedure. A curved scissor is used to release the soft tissue sleeve, and then the ITB is split in line with its fibers and peeled back proximally (Fig. 2C). The underlying bursa is sharply excised.

The lateral collateral ligament, popliteofibular ligament, lateral capsule, and popliteus tendon then are exposed. The femoral origin of these structures is outlined with electrocautery and the center of the epicondyle, which anatomically is positioned between the femoral insertions of the lateral collateral ligament and popliteus tendon, is marked for subsequent drilling of a cannulated guidewire (Fig. 2D). The bone is predrilled with a guidewire, and the appropriate screw depth is measured. The near cortex is drilled, measured, and tapped in preparation for later placement of either a 6.5-mm or 7.3-mm cannulated screw and washer.

A square window of the lateral femoral epicondyle then is osteotomized using a microsagittal saw and a curved

Fig. 2A–D (A) The common peroneal nerve (CPN) is identified and tagged behind the short head of the biceps femoris (SHB); (B) a bony wafer (W) of the distal posterior iliotibial band (ITB) insertion on Gerdy's tubercle is raised with a curved osteotome; (C) reflection of the wafer reveals the lateral collateral ligament (LCL) and its attachment to the lateral femoral epicondyle (LE); (D) the LCL is isolated and the femoral insertion is predrilled in preparation for the osteotomy.

¼-inch osteotome (Fig. 3). An approximately 1.5-cm² bony window, encompassing the lateral collateral ligament (LCL), popliteofibular and popliteus insertions, is first scored with electrocautery. A 10-mm microsagittal saw is used to cut the epicondyle directly perpendicular to its surface to a 1.5-cm depth on three sides: first anteriorly, then proximally, and then posteriorly. A combination of narrow straight and curved osteotomes are used to complete the distal, fourth limb of the bone block beneath the LCL. Care must be taken to avoid the articular surface of the femoral condyle. This is facilitated with dissection deep to the LCL and orientation of osteotomes away from the articular surface. An approximately 1.5-cm³ bony block then is raised with the aid of straight and curved osteotomes very gently so as not to damage the condyle. Scissors are passed beneath the LCL and spread parallel to it to define the plane. The posterior capsule is tagged for later reattachment and a portion is released.

The posterolateral complex, including the osteotomized lateral femoral epicondyle, then is retracted distally and held with the weight of a towel clamp placed through the drill hole. The lateral hemijoint then is exposed. A deep malleable or Z-retractor is placed across the posterior aspect of the condyle. The joint then can be opened with mild varus force to expose the lateral femoral condyle (Fig. 4A). For direct exposure to the posterior aspect of the lateral femoral condyle, little varus force is required. For tibial exposure, manual varus force or the use of a femoral distractor may be necessary.

The retracted common peroneal nerve is reassessed to ensure it is not at risk for excessive stretching and

neurapraxia. A gently curved, blunt retractor is placed deep to the ITB anteriorly, and a blunt retractor is positioned deep to the lateral head of the gastrocnemius posteriorly. Because the isometric point of the knee is located on the femoral side, manipulating the extent of knee flexion will not sufficiently expose the mid- or posterior tibial plateau. Therefore, to address tibial-sided lesions, varus force is applied, and the meniscus either is elevated proximally by releasing the coronary ligament for lateral lesions or retracted laterally for more central lesions. We prefer to use polypropylene tag sutures in the lateral meniscus to retract the meniscus proximally after release of the coronary ligament (Fig. 4B). If additional distracting and varus force are needed, a joint-spanning femoral distractor can be applied. The common peroneal nerve should be inspected repeatedly to ensure it is not under excessive traction. Keeping the knee partially flexed allows for varus distraction without excessive strain on the cruciate ligaments and also prevents undue traction on the common peroneal nerve.

Closure of the wound occurs in layers. If the coronary ligament has been released, then this is the first structure to repair. Small absorbable anchors or transosseous sutures may be used. The posterolateral corner and lateral femoral epicondyle then are reattached using either a 6.5-mm or 7.3-mm partially threaded cannulated screw and washer (Fig. 4C). This is facilitated most easily by replacing the osteotomized epicondyle in its anatomic position and reinsertion of the guidewire before screw insertion. Pre-operative templating is useful in determining adequate screw length. Our preference is to use a calibrated tap to

Fig. 3 This illustration shows the deeper dissection and planned osteotomies. The viewed structures are found deep to the iliotibial band (not shown) insertion on Gerdy's tubercle (GT). The lateral collateral ligament (LCL), popliteus (P), and popliteofibular (PF) ligaments are identified. Location of the osteotomies on the femoral side (lateral epicondyle [LE]) and tibial side (GT) are marked with hashed boxes.

determine adequate osseous purchase before determining final screw length. The posterior capsule then is repaired to the posterolateral corner with braided absorbable suture. Finally, the iliotibial band is closed primarily with absorbable braided suture if split or, if osteotomized at Gerdy's tubercle, and is rigidly fixed with a partially threaded 4.0-mm cancellous screw and washer. In the latter case, the split ITB also is secured with suture in a side-to-side manner (Fig. 4D). Stability of the fixation is verified through full range of motion and with varus stress applied at 0° and 30° flexion.

Because the repaired structures are restored to their anatomic and isometric positions, immediate use of full continuous passive motion is started in all patients in a hinged brace. Patients undergo postoperative assessment to determine normal function of the common peroneal nerve. Our patients are given a femoral nerve block in the post-anesthesia care unit; however, a preoperative block should

not interfere with postoperative assessment of the common peroneal nerve. Patients are restricted to nonweightbearing for 4 to 6 weeks depending on their articular disorder and radiographic evidence of osteosynthesis of the epicondylar osteotomy site.

Results

This approach has been used successfully in two patients, once for an injury to the articular surface of the lateral femoral condyle and the other for a lateral tibial plateau lesion. The first was a 25-year-old man who, while dancing, sustained a traumatic patellofemoral dislocation with a lateral femoral condyle osteoarticular lesion. Plain radiographs and MRI showed a posterior femoral condylar lesion consistent with sheering of the osteoarticular surface (Fig. 5). On opening his lateral hemijoint, extensive fracture comminution (Fig. 6) was observed. Provisional reduction of the articular fragments was achieved with guide wires and secured in compression with headless screws (Synthes Inc, West Chester, PA). Postoperatively, the patient remained nonweightbearing on the affected extremity for 6 weeks before advancing to full weightbearing. Sequential radiographs showed healing of the osteochondral fragment and the epicondylar osteotomy in anatomic alignment. Magnetic resonance imaging at 6 months followup was limited by artifact from screw fixation but showed the fracture had healed anatomically and the LCL was intact. At 10 months followup, examination revealed a stable knee at 0° and 30°, a negative dial test, and full, painless range of motion.

The second patient was a 15-year-old boy who presented with persistent lateral knee pain and effusion 6 months after an acute axial loading injury. Magnetic resonance imaging showed a traumatic osteochondral defect of the posterocentral aspect of the lateral tibial plateau (Fig. 7A–B). This was observed arthroscopically, and autologous chondrocytes were harvested from the intercondylar notch. Two months later, the defect was exposed through the described posterolateral approach with an epicondylar osteotomy, and Carticel (Genzyme Biosurgery, Cambridge, MA) implantation was performed. The lesion was débrided to its bony base and then packed with autogenous bone graft taken from the epicondyle osteotomy site. A periosteal patch was placed over the bone graft. Autologous chondrocytes were injected beneath a second periosteal patch sewn onto the grafted lateral tibial plateau site. Postoperatively, he remained nonweightbearing for 6 weeks. Continuous passive motion and a hinged knee brace were used during this time. Osteotomy fixation and healing were verified radiographically at 2 months postoperatively (Fig. 7C). Thereafter, he was advanced to full

Fig. 4A–D (A) The osteotomized epicondyle (LE) and the attached lateral collateral ligament are reflected posteriorly and distally and a capsulotomy exposes the lateral femoral condyle (LFC); (B) to observe the lateral tibial plateau (LTP), the coronary ligament is released and the lateral meniscus (LM) is elevated with traction sutures; (C) after the intraarticular disorder has been addressed, the osteotomized epicondyle is affixed anatomically with a screw and washer; (D) the bony wafer is secured to Gerdy's tubercle with a screw and washer, and the longitudinal split in the iliotibial band (ITB) is closed with interrupted sutures.

Fig. 5A–B (A) An axial CT scan and (B) oblique plain radiograph (right) show an osteoarticular fragment sheered off the posterior lateral femoral condyle in a 25-year-old man who sustained a traumatic patellofemoral dislocation while dancing. Trauma to the medial facet of the patella also is evident on the CT scan.

weightbearing. At the most recent followup, 12 months after surgery, he has no pain with weightbearing activities. His active knee range of motion is from 0° to 130°, and his knee is stable at 0° and 30° with a negative dial test. Magnetic resonance imaging 5 months after surgery verified healing of the lesion and an intact LCL.

Discussion

Arthroscopic techniques are typically sufficient to address the majority of intraarticular disorders of the knee; however, access to lesions of the posterior tibial plateau and

the posterior aspect of the femoral condyle may be limited. In these cases, extensile approaches facilitate exposure and management of the intraarticular disorder. Three layers of the lateral knee must be navigated: (1) the biceps femoris, iliotibial band, and fascia; (2) the patellar retinaculum and patellofibular ligament; and (3) the LCL, arcuate ligament complex, and capsule [8]. The first layer may be dissected through three potential intervals: through the ITB, between the ITB and biceps, and between the biceps and common peroneal nerve [9]. Consistent with the literature [6, 7], we have found the first two options are insufficient for obtaining access to intraarticular structures. Furthermore, as described previously [2, 5], in

Fig. 6 On opening the lateral hemijoint, an extensively comminuted fracture (F) of the posterior lateral femoral condyle (LFC) was identified. An arthroscopic camera was used to image the opened, fully flexed hemijoint in this 25-year-old man. N = notch; LM = lateral meniscus.

our experience, access to the lateral tibial plateau may be improved by osteotomy of Gerdy's tubercle for reflection of the posterior distal ITB. This assists in gaining a direct view of the lateral meniscus and peripheral regions of the tibial plateau.

Osteotomy of the lateral femoral epicondyle was used by Hughston and Jacobson [3] to address periarticular disorders resulting in chronic posterolateral rotatory instability of the knee. We have used a similar osteotomy to gain extensile exposure to the posterolateral articular structures of the knee. This is performed by reflecting the femoral insertion of the LCL, popliteofibular ligament, and popliteus tendon. The fibular or LCL originates proximally as a 5-mm [2] fan-like expansion between the lateral

epicondyle and supracondylar process of the femur [4]. This attachment is positioned laterally, posteriorly, and an average of 19 mm proximal to the femoral insertion of the popliteus tendon [4]. The femoral insertions of the LCL and popliteus tendon should be identified and included in the planned osteotomy. An oscillating saw is used to cut a larger bony block around a screw hole predrilled in the lateral femoral epicondyle. The block extends approximately 15 mm into the cancellous bone. The periosteal edges are released, and the precut block is lifted gently with a curved osteotome. A tenaculum can be placed through the predrilled hole in the bone block and used to reflect and retract the LCL. Subsequent release of the posterior capsule and, in some cases, the coronary ligament allows extensile exposure to the posterior femoral and tibial articular surfaces. By releasing these structures through an epicondylar osteotomy, anatomic fixation is possible allowing for restoration of joint kinematics and biomechanics. This exposure greatly enhances posterolateral exposure compared with previously described approaches, including a split in the iliotibial band or isolated osteotomy of the iliotibial band from Gerdy's tubercle.

There are a few caveats to observe when performing this procedure. Only two patients are described in this report limiting our ability to clearly state outcomes after use of this approach. Although we have not experienced the following with our limited subjects, injury to the peroneal nerve, hardware failure, osteotomy nonunion, or subtle lateral or posterolateral instability are potential pitfalls. Injury to the common peroneal nerve may be avoided by identification and protection of the nerve on reaching the superficial layer of the posterolateral corner. Once the iliotibial band is reached, a wide posterior flap is raised and the nerve may be identified posterior to the short head of the biceps femoris with the knee in flexion to relax the nerve. Intermittent palpation, frequent

Fig. 7A–C (A) Sagittal and (B) coronal MR images of a 15-year-old patient reveal a traumatic osteochondral defect of the mid-portion of the lateral tibial plateau. Autologous chondrocyte implantation of the lateral tibial plateau lesion was performed through the described surgical approach. (C) A postoperative radiograph shows anatomic fixation of the lateral femoral epicondyle and Gerdy's tubercle.

irrigation, and the use of a small vessel loop with no clamp attached or tension applied will ensure safety of the nerve throughout the exposure. Osteotomy union is aided by preoperative planning of screw length, careful predrilling and tapping of the screw before osteotomy, and creating an osteotomy that is at least 15 mm deep to ensure adequate surface area for healing and inherent stability. From a technical standpoint, extra caution must be taken to ensure the osteotomy does not breach the articular surface of the condyle. Our preference is to complete the posterior portion of the osteotomy with a half-inch straight and subsequently a half-inch curved osteotome rather than a sagittal saw. Additionally, the osteotomy is gently directed away from the articular surface. When the osteotomy is used in a skeletally immature patient, the bone cuts and screw fixation must be done without violating the distal femoral physis.

The exposure described in this article affords the surgeon access to the lateral hemijoint by using a lateral femoral epicondylar osteotomy. The advantages of this approach include extensile exposure to the posterolateral articular structures with preservation of knee kinematic and biomechanical function.

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