Technique of Reduction and Fixation of Unicondylar Medial Hoffa Fracture

Darius G. Viskontas, MD, FRCS(C), Sean E. Nork, MD, David P. Barei, MD, FRCS(C), and Robert Dunbar, MD

Abstract

Coronal fractures of the medial femoral condyle (Hoffa fractures) are rare. Articular surface comminution is common, and reduction can be difficult. For this injury, an extensile medial subvastus approach can be used to obtain adequate visualization, accurate reduction, and fixation. A case series of these injuries and this treatment method supports this management strategy.

A coronal plane fracture of the distal femoral condyle is commonly referred to as a *Hoffa fracture*. This injury can occur in isolation or, more commonly, in combination with other distal femur fractures, including supracondylar and intercondylar fractures.[1] The approach and fixation methods for lateral Hoffa injuries have been well described.[2-7] Isolated Hoffa fractures of the medial condyle, however, are uncommon[1] and more difficult to treat, likely because of the often associated articular comminution, the relative inaccessibility of the medial femoral condyle articular surface, the difficulty associated with hardware placement, and the magnitude of shear forces that must be resisted with the fixation to avoid loss of fracture reduction.

There are several surgical approaches for identifying, reducing, and stabilizing medial condylar fractures, including posterior approaches, direct medial approaches, anterior approaches, and combinations thereof. However, important medial soft-tissue structures, articular visualization, and fixation may be compromised with nonextensile exposures. For adequate visualization of the primary sites of comminution at the weight-bearing portion of the medial femoral condyle, a combination of wide exposure and knee flexion is necessary; it allows for intraoperative presentation of the medial femoral condyle anterior to the medial collateral ligament (MCL). By using an extensile medial subvastus exposure plus strategic knee positioning (depending on location of major fractures), the surgeon can optimize articular reduction and fixation in these complex injuries. We present a surgical technique used in a small series of cases of displaced medial coronal plane fractures of the distal femur. This technique allows for direct visualization of the entire articular surface, accurate reduction, and stable fixation even in highly comminuted patterns and segmental coronal plane fracture patterns. The patients presented in this paper have provided written informed consent for print and electronic publication of their case reports.

"By using an extensile medial subvastus exposure plus strategic knee positioning...the surgeon can optimize articular reduction and fixation in these complex injuries."

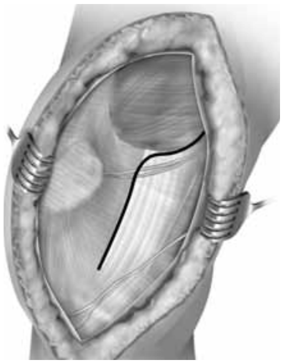

Figure 1. Skin incision and superficial dissection of subvastus approach to right medial femoral condyle. Dark line outlines fascial incision along medial border of vastus medialis and patellar tendon. Infrapatellar branch of saphenous nerve and medial genicular vascular bundle are also visualized.
Figure 1 provided by Kate Sweeney.

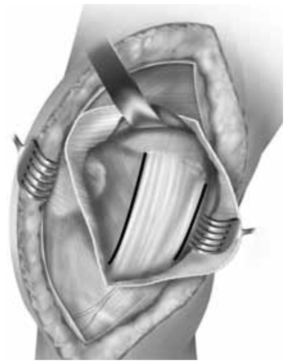

Figure 2. Vastus medialis is retracted proximally and laterally, and superficial fibers of medial collateral ligament are exposed. Two dark lines outline arthrotomy incisions anterior and posterior to medial collateral ligament.
Figure 2 provided by Kate Sweeney.

Dr. Viskontas is Clinical Instructor, Department of Orthopaedic Surgery, Royal Columbian Hospital, University of British Columbia, New Westminster, British Columbia, Canada.
Dr. Nork and Dr. Barei are Associate Professors, and Dr. Dunbar is Assistant Professor, Department of Orthopaedic Surgery, Harborview Medical Center, Seattle, Washington.

Address correspondence to: Darius G. Viskontas, MD, FRCS(C), Department of Orthopaedic Surgery, Royal Columbian Hospital, University of British Columbia, 207-301 Columbia St E, New Westminster, British Columbia, V3L 3W5, Canada (tel, 604-777-5577; fax, 604-777-5644; e-mail, dariusviskontas@yahoo.ca).

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Figure 3. Arthrotomy posterior to medial collateral ligament allows visualization of posterior medial femoral condyle.
Figure 3 provided by Kate Sweeney.

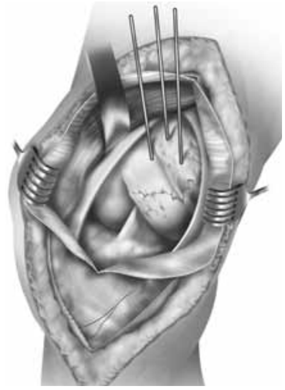

Figure 4. Arthrotomy anterior to medial collateral ligament provides adequate visualization for fracture fragment reduction and fixation.
Figure 4 provided by Kate Sweeney.

Surgical Technique

The patient is placed supine on a radiolucent table. Preoperative antibiotics and a general or spinal anesthetic are administered. A tourniquet is placed around the ipsilateral thigh and inflated at surgeon discretion. The knee is initially placed in 20° of flexion over a cushioned ramp or stack of blankets or towels. A medial subvastus approach is used through an extensile longitudinal anterior skin incision approximately 25 cm in length. A full-thickness medial skin flap is created, allowing exposure of the vastus medialis muscle belly (Figure 1). The infrapatellar branch of the saphenous nerve is protected. A fascial incision is made along the medial border of the vastus medialis and patellar tendon. The medial superior genicular artery and vein are ligated if necessary. The vastus medialis is dissected bluntly from the knee joint capsule and medial intermuscular septum. A longitudinal capsulotomy is made starting just anterior to the femoral origin of the MCL on the medial epicondyle and extending distally just proximal to the medial meniscus so as not to injure it (Figure 2). The medial meniscus is inspected for injury. Lateral patellar retraction allows visualization of the medial femoral articular surface. For fractures that exit more posteriorly, increasing knee flexion (up to 120°) allows increasing visualization. In the rare circumstance in which there is a posterior condylar fracture (a posterior capsular avulsion fracture), another arthrotomy can be performed, posterior to the MCL (Figure 3).

Figure 5. Anteroposterior radiograph of right knee with medial Hoffa fracture.

Figure 6. Lateral radiograph of right knee with medial Hoffa fracture.

Reduction is optimized with knee valgus, which can be obtained manually or with a medial femoral distractor. The accuracy of the primary reduction is usually judged by the quality of fragment interdigitation at the articular surface, as the medial soft tissues tend to hide the remaining nonarticular visual reductions at the metaphyseal portion of the medial condyle. Reduction and compression of the major fracture components are obtained primarily with a pointed reduction clamp placed anterior to posterior. Temporary fixation of any intercalary osteochondral fragments, as well as the major condylar fragment(s), can be obtained with Kirschner wires (Figure 4). The reduction is confirmed with biplanar fluoroscopic imaging. Fixation is obtained primarily with multiple lag screws placed anterior to posterior and/or posterior to anterior. Screw directions are ideally perpendicular to the major coronal plane fracture and along the longest axis of the medial femoral condyle. Screws vary from minifragment implants (2.0 and 2.4 mm) to 3.5-mm cortical screws, depending on fracture fragment size. Use of several smaller screws is often more advantageous because multiple fixation points can be obtained. Countersinking deep to the cartilage is necessary for implants placed through the articular surface. If necessary, additional fixation can be obtained with a combination of lag screws and small plates. If further exposure is necessary to insert screws posterior to anterior, a second capsulotomy can be made posterior to the MCL (Figure 3). After fixation, accuracy of reduction and implant placement is confirmed by direct visualization and radiographically.

Table I. Patient Demographic Data

Patient	Age (y)	Sex	Mechanism of Injury	Injury Severity Score
1	22	M	Motor vehicle collision	14
2	15	M	Motor vehicle collision	34
3	35	M	Soccer	9
4	36	M	Motor vehicle collision	15
5	38	F	Motor vehicle collision	25

Figure 7. Axial computed tomography image of right knee with medial Hoffa fracture.

Figure 9. Anteroposterior radiograph of right knee with fixation of medial Hoffa fracture.

Figure 8. Sagittal reconstruction computed tomography image of right knee with medial Hoffa fracture.

Figure 10. Lateral radiograph of right knee with fixation of medial Hoffa fracture.

The capsule and retinaculum are closed with absorbable sutures. The sartorial fascia is allowed to resume its normal position. For 12 weeks after surgery, weight-bearing is restricted, and range of motion is unrestricted.

Case Series

In a retrospective review of the orthopedic trauma database at a tertiary-care trauma center—conducted between January 2000 and December 2006—we identified 13 patients with an isolated coronal plane fracture of either the medial or the lateral femoral condyle (Orthopaedic Trauma Association, type 33B3.2 injuries). There were 8 lateral and 5 medial

Figure 11. Anteroposterior radiograph of right knee with healed medial Hoffa fracture after planned hardware removal at 6 months.

Figure 12. Lateral radiograph of right knee with healed medial Hoffa fracture after planned hardware removal at 6 months.

condylar fractures (Figures 5–8). Patient demographics are presented in Table I. One fracture was open and had an associated medial traumatic skin wound. One knee had concomitant lateral and posterolateral ligament injuries. All medial femoral condyle Hoffa fractures were displaced and surgically treated a mean of 1.2 days after injury (range, 0 to 4 days). The deep dissection previously described, involving a medial subvastus approach, was used in all cases. In 4 patients, the skin incision was an extensile anterior longitudinal approach. In the 1 patient with an open medial fracture, the skin incision was altered to incorporate the traumatic medial wound. The fractures were reduced as described earlier, and the most appropriate hardware was used to fix the fractures (Figures 9, 10). Hardware selection was based on the character of the fracture. For 12 weeks after surgery, range-of-motion exercises were unlimited, and weight-bearing was restricted. Clinical results are listed in Table II. All fractures healed, and reductions were maintained. There were no complications. One patient required multiple screws countersunk directly beneath the weight-bearing surface of the distal femoral condyle; this patient underwent planned hardware removal 6 months after original fixation (Figures 11, 12).

Discussion

An isolated coronal plane fracture of the posteromedial distal femoral condylar was originally described

Table II. Follow-Up Duration and Clinical Results

Patient	Follow-Up (mo)	Final Range of Motion (°)	Radiographic Evidence of Degenerative Changes
1	0	Not available	None
2	35	0-135	None
3	6	0-135	None
4	2	0-110	None
5	3	0-95	None

by Hoffa[8] in 1904. It is assumed to occur secondary to a high-energy blunt force trauma[1,6,9-13] that, applied to a flexed knee, causes shearing of the posterior condyle(s).[6] The lateral condyle is more commonly affected than the medial condyle[6,10,13]; bicondylar injuries are rare.[1,9,14-17] Associated injuries, which are common, occur in the ipsilateral knee,[1,9] lower extremity,[18,19] and more distant locations.[1,13,20]

Diagnosis and treatment of Hoffa fractures are challenging. Radiographic diagnosis can be difficult with simple anteroposterior and lateral plain radiographs.[1,6,21,22] Oblique radiographs may assist in identifying minimally displaced fractures that are not visible on other views.[19] Axial computed tomography with sagittal reformations is becoming the gold standard for diagnosis and characterization of intra-articular fractures of the distal femur.[1,6,21,22] Indications for surgical treatment are poorly defined, but reduction and fixation are presumed necessary, given the common injury site: at the weight-bearing articular surface of the knee. Nonoperative management has been shown to lead to further displacement, malunion, and poor overall results.[6,10,11,22,23] Open reduction allows for accurate assessment of any associated articular comminution, restoration of the local anatomy, and stabilization for joint mobilization. In addition, fracture morphology and fracture plane orientation determine type of hardware, optimal screw positioning, and trajectory required for fixation.[22]

Several approaches and fixation methods for distal femoral coronal fractures have been described, but most descriptions involve treatment of lateral Hoffa fragments.

Previous descriptions of medial Hoffa fracture surgical fixation are limited. Attempts at fixation with a limited medial approach or a medial parapatellar approach with the knee in extension can be frustrating. The MCL lies over the typical coronal intra-articular fracture plane and limits exposure and reduction. Femoral distraction with the knee in extension is limited in increasing visualization. In a case report, Holmes and colleagues[4] described using an anterior midline incision with a medial parapatellar approach. Although the parapatellar approach allows access for reduction anteriorly, visualization of posterior comminution and ease of reduction may be limited. A medial subvastus approach allows extensile exposure of the articular surface and, if needed, access to the posterior femoral condyle—for placement of fixation in multiple planes. The subvastus approach has been popularized by Hofmann and colleagues[24] for total knee arthroplasty. It has been compared with the medial parapatellar approach and has been shown to preserve the extensor mechanism of the knee[25-27] and patellar blood supply.[24] Although no similar comparison has been made for applications in trauma, these issues may be important in medial femoral condylar fractures, especially with regard to the local blood supply. The intraosseous blood supply to the posterior femoral condyle is tenuous and is likely disrupted in displaced fractures, making preservation of the extraosseous blood supply important. The extraosseous blood supply is derived mainly from the medial superior geniculate artery with a small contribution from a branch of the popliteal artery.[28] The medial subvastus approach has the potential advantage of preserving these vascular contributions when ligation of the medial genicular artery is avoided with careful dissection. This should minimize the surgical vascular insult and thereby potentially minimize the risk for condylar avascular necrosis and nonunion.

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Stabilization of the articular reduction can be accomplished with a combination of extra-articular screws and countersunk screws placed anterior to posterior and/or posterior to anterior. Posterior-to-anterior screws may have some biomechanical advantage, but placement can be difficult. Although larger (6.5-mm) screws have higher loads to failure, the rigidity achieved with two 3.5-mm screws is the same as that achieved with one 6.5-mm screw.[2,3] Placement of implants from the posterior fragment into the shaft of the femur may further improve rotational stability.[6]

Although conclusions about the long-term outcomes of these injuries cannot be drawn, reduction and fixation of these high-energy intra-articular injuries using this surgical approach have been favorable and may be useful for the medial Hoffa fracture.

Authors’ Disclosure Statement

The authors report no actual or potential conflict of interest in relation to this article.

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