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Case Report

Management of a Distal Medial Femoral Condylar Nonunion

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Abstract

Isolated condylar femur fractures are extremely rare, particularly those of the medial condyle. While operative stabilization is usually advocated, some fractures are managed conservatively. Irrespective of treatment, nonunion following these injuries remains rare. Current literature on the treatment of femoral condyle nonunion is sparse, with no consensus on those occurring after conservative management. In this report, we present a rare case of a patient with a painful, chronic nonunion of a medial distal femoral condyle fracture following conservative management 27-years prior that was successfully treated with autogenous bone graft and rigid fixation.

Keywords: *Distal Femur Fracture; Unicondylar Distal Femur Fracture; Femoral Condyle Nonunion; Blade Plate*

Introduction

Isolated unicondylar femur fractures are extremely rare, accounting for less than 1% of all femoral fractures [1]. Lateral condylar fractures are three times more common than those of the medial condyle, likely due to the natural valgus alignment of the knee and subsequent contact between the lateral condyle and tibial plateau during traumatic episodes of axial loading [2,3]. Particular attention is often given to the coronal plane to evaluate for the well-described "Hoffa" fracture, though various fracture patterns have been described following simultaneous shear and twisting forces [4]. Though significantly less prevalent, fractures of the medial condyle are often associated with articular comminution and may necessitate an approach that employs a great degree of soft tissue stripping to obtain acceptable articular reduction [5].

Due to the importance of achieving articular congruity and the tendency for fracture displacement over time, the current literature supports surgical intervention for nearly all unicondylar fractures [1,6]. When managed operatively, these fractures rarely go on to nonunion, presumably due to the large cancellous surfaces of the fracture segments [3,6]. In fact, the rate of nonunion of distal femur fractures managed surgically has been described to range from 0 - 4% [1,7,8]. Younger age and open fractures with severe comminution and segmental bone loss have been cited as risk factors for the development of nonunion [1,7,8]. While most unicondylar femur fractures are managed operatively in developed countries, some patients in less developed nations are often treated conservatively. The nonunion rate following such conservative management remains poorly described in the literature. With so few distal femur nonunions described following conservative management, optimal treatment has yet to be established. Here, we describe a medial condyle distal femur nonunion after failed conservative casting that was eventually treated successfully with a fixed angle blade plate device. Patient consent prior was obtained for publication purposed of this manuscript.

Case Presentation

We present an interesting and unique case of a 46 year-old man who presented with chronic medial-sided right knee pain. His initial injury was sustained playing soccer in Africa 27 years ago and was treated in a long-leg cast. He recovered well from this injury and was only mildly symptomatic about the knee until approximately 3 years prior to presentation. Over the previous several years he reported increasing levels of swelling, pain, and subjective instability of his right knee.

Upon examination, his right knee was in slight varus alignment compared to the contralateral leg. Flexion-Extension of the knee was full from 0-155 degrees. There was no laxity during varus/valgus stress testing with no instability during Lachman or drawer stresses. Tenderness was present at the medial joint line and over the medial femoral condyle. Radiographs (Figure 1) demonstrated a sagittally oriented nonunion at the site of his prior medial femoral condyle fracture.

Figure 1: *Anteroposterior radiograph of the knee showing a distal femoral condyle nonunion.*

Due to continued pain and subjective instability, the decision was made to treat this nonunion using rigid internal fixation to achieve primary bony healing. A medial subvastus approach to the knee was utilized with careful attention paid to hemostasis. Gross motion was evident between the medial femoral condyle fracture fragment and the remainder of the femur. Fibrous tissue was removed from the nonunion site and a burr was utilized to prepare a fresh cancellous surface on both sides of the fracture. A small drill bit was also used to make multiple holes in the bone in order to encourage vascular ingrowth. Ipsilateral iliac crest bone marrow aspirate was obtained and mixed with crushed cancellous bone allograft and the cortico-cancellous graft was placed into the nonunion site. Next, two screws were placed perpendicular to the fracture site in lag fashion. A 90-degree short blade plate was then contoured to the medial femoral condyle and used for fixation, allowing bicortical screw purchase across the nonunion site. Intraoperative (Figure 2) and post-operative (Figure 3) radiographs revealed an anatomic reduction at the fracture site and the articular surface. The patient was non-weight-bearing on this

leg for 8 weeks with range of motion as tolerated at 2 weeks. The patient recovered uneventfully. Clinical and radiographic union were apparent by 10 weeks. At the latest follow up, now over 10 years postoperatively, the patient continues to be pain free and is ambulating independently without assistive devices. No new limitations to knee range of motion were noted, and the knee remains stable to stress examination. The most recent radiographs from 10 year follow up are shown in figure 4.

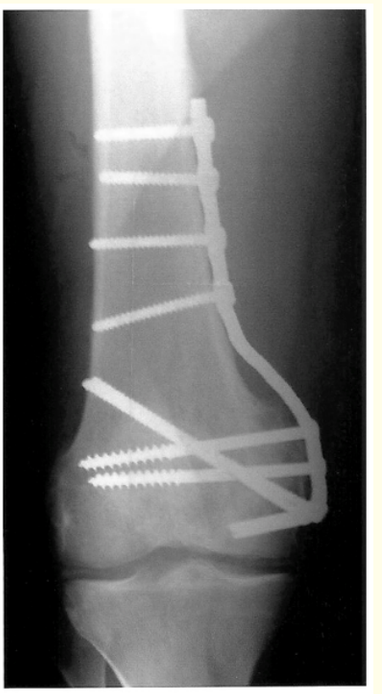

Figure 2a

Figure 2b

Figure 2: *Intraoperative image of medial knee showing a blade plate construct holding reduction of the medial femoral condyle.*

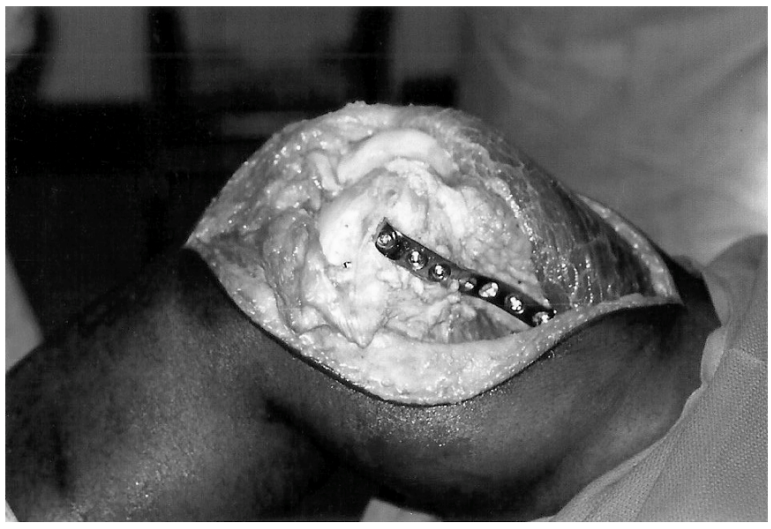

Figure 3: *Immediate postoperative anteroposterior and lateral radiographs of the knee showing a reduced, compressed femoral condyle.*

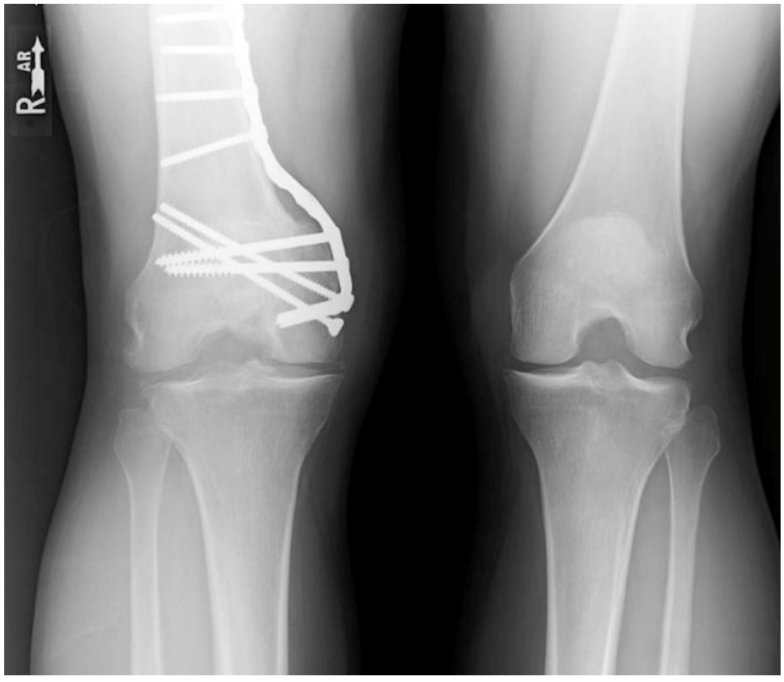

Figure 4: *Most recent radiograph at over ten years' follow-up, showing the well-aligned and healed distal femoral fracture. Hardware has been maintained as it remains asymptomatic.*

Discussion and Conclusion

Unicondylar distal femur fractures are most often treated operatively to avoid any articular incongruity and to re-establish length, rotation and alignment of the lower extremity [1,6,9]. Conservative management is typically reserved for those patients who cannot tolerate a procedure, as its use has a reported satisfaction rate as low as 46%, with up to 33% requiring lifelong bracing due to axial malalignment and instability [10]. However, in developing countries, use of conservative management is more commonly employed than in the developed nations. Conservative management significantly increases the risk of nonunion following these injuries, as utilization of internal fixation has reported nonunion rates as low as 0 - 4% and superior clinical functional outcomes with improved range of motion [7,11].

Management of unicondylar femur nonunions are fraught with challenges in treatment. The wide medullary canal, thin cortices, and often limited bone stock of the distal femur all contribute to the difficulty in managing condylar nonunions, especially when disuse osteopenia and soft tissue scarring further complicate this injury [13,14]. For these reasons, new techniques have been recently described; use of a retrograde intramedullary nail with a "condyle screw and nut" system allows for osteosynthesis of a medial unicondylar nonunion without extensive dissection [14]. However, in the setting of nonunion, a fixed angle plate and screws may provide a more reliable construct as it affords a rigid articular surface, direct visualization of the fracture, and allows for the introduction of bone grafting.

Understanding the biomechanics of the knee joint is imperative in operative planning of these fractures as this area experiences forces at least 3x the body's weight during the stance phase of a gait cycle [12]. The femoral condyles are stressed not only in axial loading, but are also subjected to rotational and bending forces. Any hardware construct must be able to withstand these forces and minimize micromotion that predisposes to the formation of callus near the joint, subsequently increasing the risk for nonunion. It was felt that a fixed angle blade plate construct would best resist these forces until successful fracture union.

The biology of the fracture site is also critical to consider when treating a nonunion. In this case, evidence of hypertrophic nonunion was noted secondary to inadequate immobilization and increased motion at the fracture site. To achieve fracture union in this setting requires the elimination of gross motion of the fracture site, debridement of the fibrous nonunion tissue and implementation of rigid fixation. After exposure of healthy cancellous bone, osteogenesis of fibrous tissue at a nonunion site can be stimulated by interfragmentary compression and stable plate fixation, or by reaming of the medullary canal before stable intramedullary fixation with a fixed angle device [15]. In this case, a blade plate was used to address the nonunion and achieve absolute stability. Alternatively, a locking plate may be employed as biomechanical studies have demonstrated no significant difference in stability between blade and locking plates [16,17].

In addition to rigidity of the chosen construct, supplemental bony augmentation may also be necessary to add stability and healing potential to the nonunion site. In a retrospective review, Wang., *et al.* noted a 100% union rate in patients with distal femoral nonunions treated with internal fixation and strut allograft [18]. Similarly, Chapman., *et al.* also reported 100% healing of distal femoral nonunions treated with rigid single or double-plate fixation with use of autologous bone-grafting; however, their complication rate was 17%, and many patients required additional surgical procedures [19]. It must be noted, however, that some of these studies were not limited to isolated unicondylar fracture nonunions, as there is a scarcity of literature regarding fixed angle devices used for unicondylar nonunion in the distal femur.

In summary, isolated unicondylar femur fractures are extremely rare, accounting for less than 1% of all femur fractures and have received little attention in the orthopedic literature [1]. Even more rare is an isolated medial femoral condyle fracture. Furthermore, owing to the rarity of the injury and the high union rates achieved with surgical intervention, literature regarding the treatment of unicondylar femoral fracture nonunions is essentially nonexistent. Our case exemplifies the concept that rigid and angular stability as well as biologic integrity are critical in achieving union of femoral condyle fractures. The use of a blade plate provided a fixed angular construct and corti-co-cancellous bone graft was important in restoring an environment advantageous for healing at the nonunion site. In the aforementioned case, union was successfully achieved and pain and functional ability were dramatically improved. While we report a unique case involving medial femoral condylar nonunion, the principles of treatment approach can be applied to most distal femoral nonunion encounters.

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