Anteromedial marginal fracture of medial tibial plateau without significant knee ligamentous injury in hypermobility patient: a case report and review of literature

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Abstract

Anteromedial rim fracture of medial tibial plateau is a rare fracture pattern with only a small number of case reports in the literature. However, it is highly likely that is associated with specific significant soft tissue injuries, especially posterior and posterolateral corner structure, and medial meniscus injury. It is thought this fracture is caused by hyperextension and varus rotation mechanism. The previous reports highlight the typical pattern of severe concomitant knee ligament injury associated with this fracture that always require surgical repair to restore knee stability and function. In this report, we present an unusual case with a history of generalized joint laxity and acute anteromedial marginal fracture of medial tibial plateau without associated significant ligament damage, together with a literature review of this condition. We believe this case report introduces new insights into this unique fracture pattern.

Case Report

A 26-year old male presented with right knee pain of three days duration after being directly struck by a motorcycle at the posterolateral part of the right distal thigh that resulted in hyperextended and rotational knee injury. Physical examination revealed that his right knee had anteromedial swelling and tenderness with a small ecchymosis in that area. The dorsalis pedis and posterior tibial pulses were normal, and distal neurological findings were unremarkable. In addition, he had previously reported an underlying generalized joint laxity that had been assessed by Beighton score (7 out of 9). Initial radiographs and computerized tomography (CT) showed a displaced fracture of the anteromedial margin of medial tibial plateau (Figure 1A-C). He was initially immobilized with a compression bandage. Given the uncommon fracture pattern and the high probability of significant meniscal and ligament injury, as described in previous reports, the patient was sent for magnetic resonance imaging (MRI) for pre-operative evaluation. MRI findings revealed a large amount of lipohemarthrosis, the aforementioned fracture with grade III cartilage lesion, and bone contusion at the anteromedial part of medial condyle. The ligament injuries were grade I sprain of medial patellar retinaculum and medial meniscus contusion, grade I ligament sprain of the anterior cruciate ligament (ACL) and posterior cruciate ligament (PCL), popliteus tendon (PT) and lateral collateral ligament (LCL) (Figure 1D-F).

To address the displaced intra-articular fracture and any intra-articular pathologies, the surgical planning combined open reduction and internal fixation (ORIF) with small T-buttress plate and arthroscopic diagnosis. After spinal block and after performing varus stress test, examination under anesthesia showed a 2-mm increase of the lateral opening compared to the uninjured side (12 mm on injured knee vs 10 mm on uninjured knee). The other tests for suspected ligament injury, including anterior and posterior drawer test, external rotation recurvatum and tibial dial stress were all negative. Once examination was complete, surgery was performed. The first step was open reduction, internal fixation using an anteromedial approach with a small T-buttress plate on anteromedial rim fracture. Arthroscopic examination was then performed to evaluate the quality of reduction and intra-articular lesion. This showed nearly anatomical reduction of the fracture (1-mm articular step-off) and grade III cartilage injury, as assessed by International Cartilage Repair Society (ICRS) classification, on the anterior half of the medial tibial plateau. It also demonstrated normal cartilage on both femoral condyles and lateral plateau with intact ACL, PCL, and both medial and lateral meniscuses (Figure 2A and B). On completion of surgery, varus stress test was re-evaluated under fluoroscopy comparing the operative and uninjured sides. The finding showed only equal 1-cm lateral opening under equal varus stress force (Figure 2C and D).

Post surgery, the compressive dressing was applied to the patient for two days and he was then discharged on post surgery Day 3. After this, the hinge knee brace was applied and locked in a 20° knee flexion position for two weeks in order to immobilize the injured soft tissue. Ambulation with partial weight bearing was allowed for four weeks after surgery and then progressed to full weight bearing without any gait support. After two weeks, the brace was unlocked and the range-of-motion exercise was started with a knee brace for another two weeks. The brace was removed at the fourth week post surgery and the patient was followed up periodically until the fracture had healed. After three months, the fracture united uneventfully and the knee stability tests were all equal to those of the uninjured side. Six months post surgery, the patient was able to walk independently without pain and could participate in moderately strenuous sports activities. The follow-up radiographs and clinical pictures are shown in Figure 3.

Discussion

Tibial plateau fractures are complex intra-articular fractures that usually have a variety of fracture patterns and associated ligament injuries. These are caused by many contributing factors, such as mechanisms of injury, the patient’s age, and quality of bone and soft tissue. Concomitant ligament injury is one of the major problems and is easily missed because of the benign nature of the fracture configuration. For example, even a small bony fracture around

Received for publication: 30 October 2012. Accepted for publication: 21 February 2013.

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doi:10.4081/or.2013.e12

Conflict of interests: the authors declare no potential conflict of interest.

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Key words: anteromedial marginal fracture, rim fracture, impingement fracture, anterior part medial plateau fracture, compression fracture.

Contributions: PrC and PS performed surgery, reviewed the literature, and prepared the manuscript. PoC helped in manuscript preparation. SJ interpreted MRI and prepared MR images. CS and WW provided intellectual input.

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the knee joint, such as a marginal fracture or avulsion fracture, has its own distinctive nature which commonly associates with severe soft tissue damage, including major ligament injury, and requires appropriate treatment to restore function and prevent late knee instability.

As far as the fracture pattern is concerned, anteromedial rim fracture of medial plateau is a rare fracture pattern with only a small number of case reports in the literature. However, it has been found to be highly correlated with specific significant soft tissue injuries, especially posterior and posterolateral corner (PLC) structure injury, and medial meniscus injury. Our case shared the common characteristics of the typical injury described in previous reports with the same fracture pattern with highly probable concomitant bicruciate and PLC injuries. This patient had sustained an injury with the same hyperextension and varus rotation mechanism as that reported by Cohen et al. However, the severity of ligament injuries in this case was only a minor grade sprain. To our knowledge, this is the first study of a patient with anteromedial rim tibial plateau fracture that was not associated with significant knee ligament injury that could not be explained by the patient’s hyperlaxity.

In previous studies, the associated ligament injury of anteromedial rim fracture of the medial plateau has been described in two different patterns. The first is an avulsion fracture for deep capsular ligament of MCL, as referred to a reverse or medial Segond fracture which is thought to be caused by valgus stress and external rotation of the flexed knee; this type of injury had a consistent triad of PCL, medial collateral ligament (MCL), and medial meniscus injury. The second pattern is an impingement fracture of the anteromedial tibial margin which was first described by Cohen et al. in 2001. The postulated mechanism of injury is hyperextension (leading to PCL and PLC injury), and combined varus rotation and posterior tibial translation (resulting in compression anteromedial rim fracture). The authors had mentioned that this fracture could only occur in the presence of grade III PCL and PLC rupture.

In 2001, Chiba et al. reported a case series of 12 patients who had concomitant posterolateral (PL) injury with compression fracture of anterior part of medial tibial plateau. They classified the size of anterior compression fracture into two types: small (less than a quarter of anteroposterior diameter of medial tibial plateau), and large (more than a quarter of that). A correlation between the cruciate ligament injury and the fracture size was also identified. The study concluded that a small compression fracture of medial tibial plateau not only associates with PL injury, but also strongly suggests an accompanying PCL injury.

In 2003, Bennett et al. performed an MRI review study of 16 knee injuries (in 15 patients)
which had evidence of PLC injury. Among the subjects in this study, tibial plateau fractures were presented in 6 knees and 5 of these (83%) were anteromedial rim fractures which showed the same common feature in that the fractures involved less than 10-15% of anteromedial edge of the articular surface of medial tibial plateau. All of the patients with this anteromedial rim fractures in this study had significant intra-operative PLC tear and surgical repair was required. In this series, they also highlighted the unique finding of the correlation between the anteromedial rim fracture and significant PLC injury, and the benefit of MRI to reveal associated ligament injuries with this specific fracture. In 2007, Engelsohn et al. reported 2 cases of anteromedial marginal fracture of medial tibial plateau in that associated with medial meniscal root tears after knee fracture-dislocation injury. The first case was thought to be a reverse Segond fracture due to its typical pattern (cortical avulsion injury by the deep capsular ligament, bicruciate and MCL injuries, and medial meniscus tear). Another case was shown to be associated with PCL and PLC complex injury, which was referred to as an impingement-type fracture. In conclusion, this study demonstrated some important issues concerning the diagnosis of associated meniscal root injury, and also pointed out the shared feature of these 2 different types of anteromedial marginal fracture with possible medial meniscus injury.

In 2009, Yoo et al. reported a case of compression fracture of anteromedial margin of the tibial plateau and medial femoral condyle combined with PCL and posterolateral capsule disruption. The patient had presented with chronic knee discomfort for six months after significant injury and had been treated with conservative methods. Definite diagnosis in this case was given by PCL and PL laxity on physical examination, anterior marginal fracture of medial tibial plateau and a dimpling on the adjacent part of medial femoral condyle on imaging, and positive findings on arthroscopic examination, which strongly correlated with this type of fracture. The authors, therefore, confirmed the mechanism of injury and reported the association between small bony lesion and major ligament injury. This current paper introduces new insights into anteromedial marginal fracture of medial tibial plateau because our patient had not shown any significant ligament injures requiring surgical repair as previously reported. We hypothesized that this could be explained by the hypermobility of the soft tissue that could absorb the distraction force and allow the ligament structure to be stretched more than normal range without disruption, resulting, therefore, in only anteromedial rim fracture without ligament disruption.

Conclusions

In conclusion, we agree that the anteromedial rim fracture of medial tibial plateau was highly likely caused by the mechanism of knee hyperextension and varus rotation, and that this can occur without cruciate ligaments or PLC disruption in patients with hypermobility.

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