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Case Report

The Current State of Fracture-Dislocations of the Knee

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ABSTRACT

Fracture-dislocations of the knee are rare and devastating injuries. They are frequently missed because they are uncommon and often occur in the polytrauma patient with distracting and life-threatening injuries. Because of their ability to cause significant morbidity if not identified and addressed acutely, they are an important topic to explore and understand in more detail. These injuries were initially classified by Moore in 1981 using a sample of 132 patients. Through both retrospective and prospective analysis, Moore divided the injuries into 5 types based on fracture pattern. We conducted an extensive literature review on knee dislocations with concomitant fractures following Moore's seminal paper. Due to their rarity, we found that the studies in the literature tend to be single-center studies or case reports with small sample sizes focusing more generally on knee dislocations. There is often no statical analysis conducted specifically on fracture-dislocations due to low power. We combined data from our literature review with our own experience treating knee fracture-dislocations at our Level 1 trauma center to establish our current protocol and recommendations for the treatment of these injuries. However, because there are no studies to date specifically detailing the treatment of knee fracture-dislocations, there is still a lot of work to be done in understanding these injuries and their management.

INTRODUCTION

Fracture-dislocations of the knee are rare and devastating injuries. They are often missed due to their rarity and because they often occur in the polytrauma patient with distracting and often life threatening injuries [1,2]. Because of their ability to cause significant morbidity if not identified and addressed acutely, they are an important topic to explore and understand in more detail [3-7]. These injuries were initially classified by Moore in 1981 using a sample of 132 patients [8]. Through both retrospective and prospective analysis, Moore divided the injuries into 5 types based on fracture pattern. Type 1 was classified as split, Type 2 as entire condyle, Type 3 as rim avulsion, Type 4 as rim compression and Type 5 as four-part (Figure 1). Type 1 injuries were the most common with the lowest risk of ligament injury while Type 5 was the least common and had the highest risk of neurovascular injury [8].

While type 3 and type 4 injuries may have a benign appearance and only marginal involvement of the tibial plateau, they may be harbingers for underlying severe soft tissue injury. For type 3 injuries, avulsions around the tibial plateau or fibular head would be typically related to Iliotibial Band (ITB) avulsions of Gerdy's tubercle, and anterolateral ligament avulsion of the mid 1/3 lateral tibial cortex. Fibular styloid

avulsion fracture is caused by popliteofibular ligament (PFL) avulsion and fibular head fractures are caused by lateral collateral ligament (LCL) and/or biceps femoris avulsion injuries. In Moore's patient cohort, 86 of the 132 patients required operative management. Patients with Type 1 injuries had the best ultimate knee function while patients with Type 5 injuries rarely obtained a normally functioning knee [8]. Moore also noted that this type of injury actual conceptually between plateau fractures and classic knee dislocations, and also in terms of prognosis. These patients generally did better than patients with classic dislocations [9], but not as well as those with isolated tibial plateau fractures [10] (Figure 2&3).

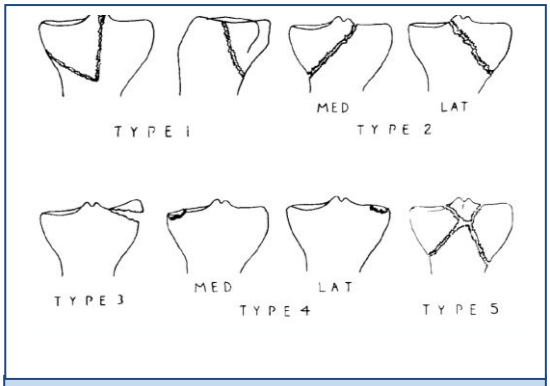
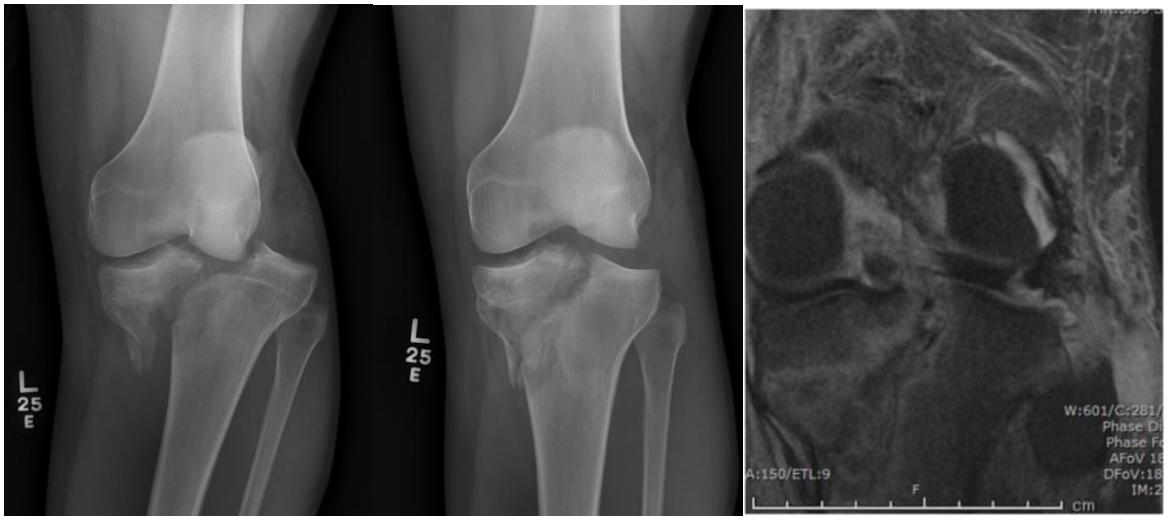


Figure 1: Moore's Classification of knee fracture dislocations.



a. b. c.

Figure 2: a. AP radiograph of the initial presentation of a sheer fracture-dislocation (Moore type 2). b. Post-reduction AP radiographs of the Moore type 2 fracture-dislocations. c. Corresponding MRI coronal image demonstrating the fibular head avulsion of the biceps and LCL off the fibular head.

Since Moore's seminal article, fracture-dislocations of the knee have not been extensively studied. Currently, the literature suggests that knee dislocations account for less than 0.02% of all orthopedic injuries and fracture-dislocations are even less common [3-7]. Due to their rarity, the studies in the literature tend to be single-center studies with small sample sizes focusing more generally on knee dislocations [11-23]. Within these studies, only 1 to 12 patients are usually reported as having a fracture dislocation injury. Because of the low power, there is often no statical analysis conducted specifically on fracture dislocations [12-23]. Other published studies include case reports containing as few as 2 to 4 patients [24,25]. A recent 2018 systematic review of 21 studies

on multiligament knee injuries by Everhart et al. found fewer than 52 total fracture dislocations in a cohort of 239 patients (21.7%) with knee dislocations.

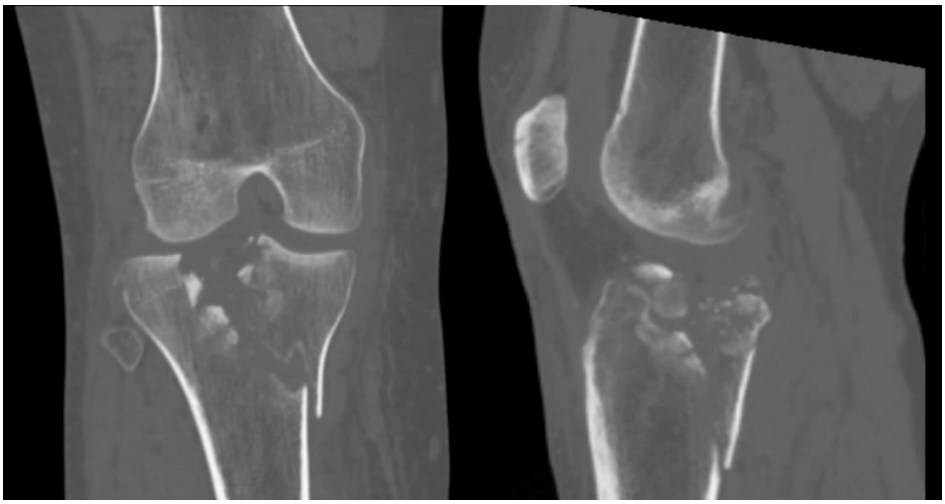


Figure 3: Coronal and sagittal CT reconstructed images of a Moore type 2 sheer fracture-dislocation.

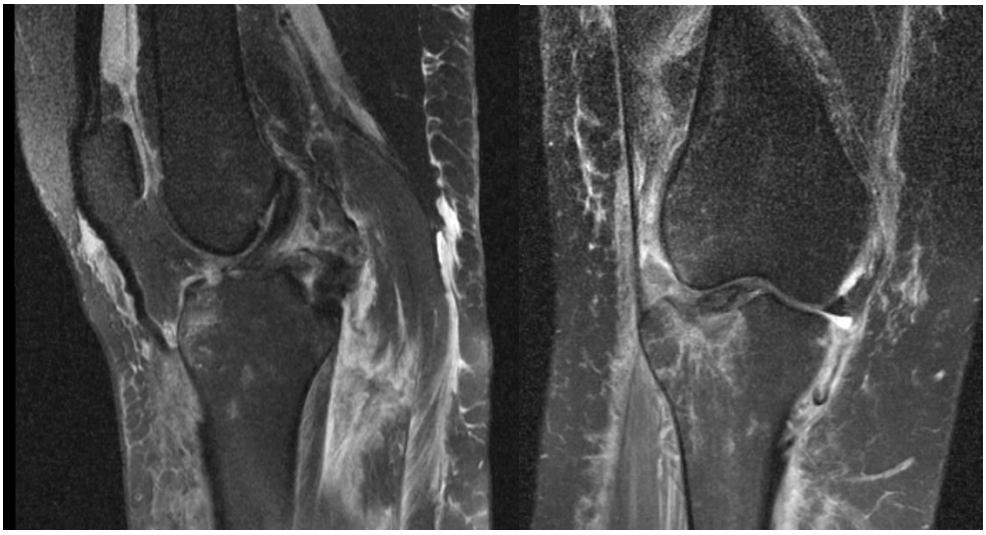


Figure 4: Sagittal and coronal views of a T2 weighted MRI after a knee dislocation that is consistent with a multiligament knee injury

Table 1: Comparison of ligamentous dislocations with fracture dislocations. The differences between the two groups were not significant.

Category	Ligamentous dislocation	Fracture dislocation
Mean age	35 Years	32 years
Sex distribution	18 males, 5 females	10 males, 3 females
Motor vehicle accident	14 23(60%)	11 13(85%)

Table 2: Clinical testing of ligaments injured comparing reconstruction vs. non-operative management in fracture dislocation and ligament dislocation groups (NS not significant). The only significant difference noted in clinical testing was for the anterior cruciate ligament in the ligamentous dislocation group.

	Ligamentous dislocation Reconstruction vs. non-operative	Fracture dislocation Reconstruction vs. non-operative
ACL	*P* 0.001	NS
PCL	NS	NS
MCL	NS	NS
CL	NS	NS

This review focused on return to work following multiligament knee injuries [11]. Return to work with no or minimal modifications (100%, 12 patients) was higher in studies that excluded fracture-dislocation patients than in studies that included Schenck grade IV and V (fracture dislocation) patients (66.0%, 70/106 patients) (P = .017) [11]. Only a few studies had sufficient sample sizes to conduct an analysis on fracture dislocations. Werier et al. reported 4 patients with distal femoral fracture dislocations and 9 patients with a tibial plateau fracture dislocation out of 38 knees in their 1998 study [26]. They found no significant differences between demographics (Table 1) or in clinical testing following different treatments (reconstruction vs. non-operative) in the fracture dislocation group (Table 2) [26]. No significant difference in the Lysholm score was detected between different treatment methods in the fracture-dislocation group. There was a tendency towards more favorable ligament stability and overall knee function in patients with a fracture-dislocation compared to classic dislocations, but those differences were not statistically significant [26] (Figure 4).

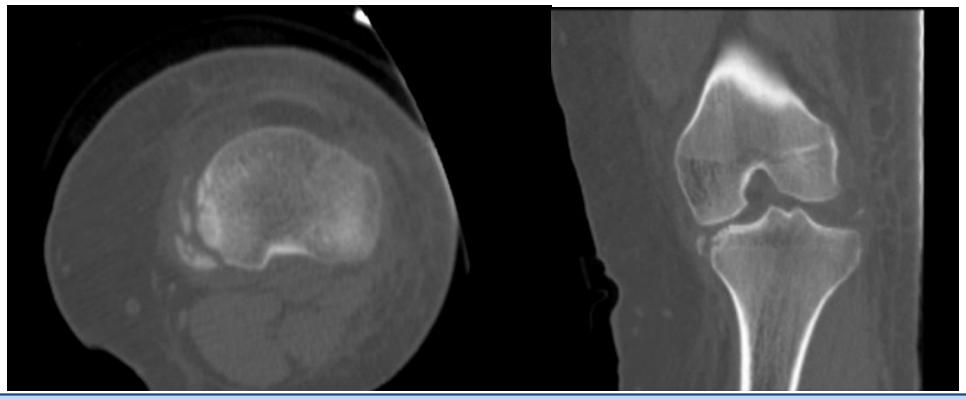


Figure 5: Axial and coronal views of a CT scan of the knee demonstrating a medial rim fracture.

Porrino et al. evaluated the relationship between tibial plateau fractures and multiligament knee injuries. In their study of 90 knees with multiligament knee injuries, 19 knees suffered a tibial plateau fracture in addition to the multiligament injury. The majority of tibial plateau fractures that occurred were isolated to one side [27]. Medial tibial plateau fractures were associated with PLC tears whereas lateral tibial plateau fractures are associated with MCL tears. In addition, they evaluated 3 tibial plateau classification systems (Schatzker, AO, and Duparc), and found that the likelihood of MCL and PLC tears increases with the grade of designation within the Schatzker and Duparc classification systems [27].

Due to the rarity of these injuries, no studies comparing treatment options for the various fracture-dislocation patterns have been conducted to date. However, Levy et al. conducted a review that focused on knee dislocations with multiligament injured knees without fractures [7]. They found four studies comparing surgical treatment with non-operative treatment. There was a higher

percentage of excellent/good IKDC scores (58% v 20%) and higher rates for return to work (72%v 52%) and return to full sport (29% v 10%) in surgically repaired patients, compared to patients treated non-operatively. Two studies compared repair versus reconstruction of damaged structures, with similar mean Lysholm scores (88 v 87) and excellent/good IKDC scores (51% v 48%).However, repair of the posterolateral corner had a higher failure rate (37% v 9%) than reconstruction based on a single study containing 57 patients [28]. Additionally, repair of the cruciates yielded decreased stability and range of motion, and a lower return to pre injury activity levels (0% v33%). There were 5 studies comparing early surgery (<3 weeks) with late surgery, which showed that early treatment resulted in higher mean Lysholm scores (90 v 82) and a higher percentage of excellent/good IKDC scores (47% v 31%), as well as higher sports activity scores (89 v 69) on the Knee Outcome Survey [7] (Figure 5&6).

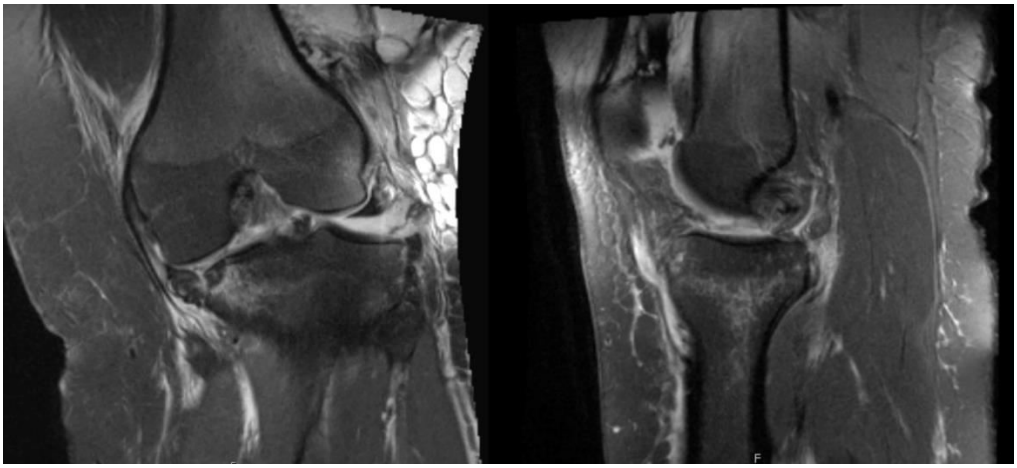


Figure 6: Coronal and sagittal views of a T2 weighted MRI after a knee dislocation with concomitant medial rim fracture that demonstrates injury to the anterior cruciate ligament and the posterolateral corner.

CONCLUSION

In general, our institution recommends emergent relocation of the dislocated knee, thorough neurovascular evaluation, including a well-documented physical examination, ankle - brachial indices, vascular surgery consultation, admission for observation of neurovascular changes or compartment syndrome and prophylaxis for deep vein thrombosis. These injuries occasionally need spanning external fixation to maintain reduction and alignment, associated injuries or skin issues. Once the clinical situation is stabilized and skin swelling is deemed appropriate and MRI imaging has been obtained for assessment of the soft-tissue injury, a surgical tactic is planned out based upon both the fracture pattern and soft-tissue injury. The fracture fixation needs to take into consideration what the expected soft-tissue surgery will entail, both in regard to acute repair and chronic/delayed reconstruction. We generally reconstruct the cruciate ligaments in a delayed fashion. However because the studies detailing treatment specifically study knee dislocations, and not fracture-dislocations, there is still a lot of work to be done in understanding fracture dislocations to ensure the best outcomes possible for patients who suffer from this devastating injury.

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