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Soft Tissue Injuries Associated with Proximal Tibia Fractures

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Abstract

The purpose of this study was to document the pattern of ligament and meniscal injuries that occur with proximal tibia fractures due to high energy trauma. Seventy patients with fractures of proximal tibia due to high-energy mechanisms were evaluated with magnetic resonance imaging (MRI) of the knee. All studies were reported by a single musculoskeletal radiologist who was blinded to surgical and physical findings. Of the 70 patients, there were 42 patients with AO/OTA type 41B2 (60%) fractures. On average, 70 % sustained a complete tear or avulsion of one or both cruciates. 70% sustained collateral ligament injury. 91% had lateral meniscal pathology. 40% had medial meniscus tears. Of the 70 patients, 42 patients (60%) had Schatzker type II injuries, in which 90% had lateral meniscus tear, 80% MCL and ACL tear, 66% PCL and LCL tear. We adopted chi-square test to find the association. In our study, we found that there is a significant association between footprint avulsion of PCL and lateral meniscus (p value- 0.038), between partial tear of LCL and lateral meniscus (p value- 0.048), between partial tear of ACL and medial meniscus (p value- 0.023). Also there is a significant association between complete tear of ACL and medial meniscus (p value- 0.019), between partial tear of PCL and medial meniscus (p value- 0.007). But there is no significant association between ACL, PCL, MCL, LCL and Schatzker type (p value >0.05). We conclude MRI scanning should be considered for proximal tibia fractures due to high energy mechanism, which would help to identify and treat associated soft tissue injuries.

Keywords: Soft tissue injury, Proximal tibia fracture, Magnetic resonance imaging, ACL, PCL, LCL, MCL, Medial meniscus and lateral meniscus.

Introduction

Proximal tibia is defined as the medial-to-lateral joint line width of the proximal tibia as the horizontal line (represented by the line, 1X) and one-and one-half times the M-L width as the vertical line represented by the line, 1.5X (Figure1). The proximal tibial fractures are classified according to the Schatzker classification and AO/OTA classification. Open fractures often involve much more damage to the surrounding muscles, tendons and ligaments.

Proximal tibial fractures due to high energy trauma are associated with severe comminution, ligamentous injuries and neurovascular compromise. Pain, loss of motion, and instability are among the problems associated with these injuries.

Good clinical examination of the soft tissues of the knee is often difficult in acute setting as a result of pain, swelling, and instability of the bone. Damage to ligaments and meniscus around the knee has been commonly described and may contribute to the poor outcomes associated with proximal tibial fracture.

The value of MRI in diagnosing periarticular pathology of ligaments and cartilage is well known. In addition, several studies [5, 6, 9, 10] have demonstrated improved delineation of bone fragments of tibial plateau fractures with MRI. Recently, the preoperative diagnosis of ligament and meniscal injury and its relation to a treatment plan has received considerable attention. Previous studies have used arthroscopy, in which only few of the structures can be evaluated. The clinical examination is inaccurate in the setting of acute trauma. Though the significance of damage to knee-stabilizing structures on MRI in the setting of a tibial plateau fracture has not been definitively agreed upon, preoperative knowledge of these injuries may help the surgeon more thoroughly characterize the overall injury. We hypothesized that using MRI to evaluate soft tissue structures in proximal tibia fractures would reveal a greater number of occult injuries that has previously not been appreciated.

Patients and Methods

A total of 70 patients with proximal tibia fractures reported between December 2020 to December 2022 were evaluated using MRI, ligament and meniscal injuries were correlated with their fracture pattern. Patient brought with alleged history of road traffic accident

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Figure 1: Proximal Tibia

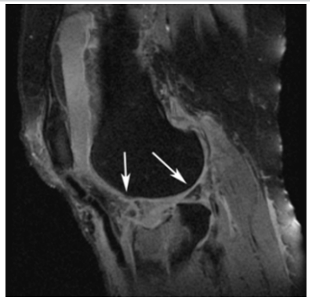

Figure 2: Sagittal T2-weighted MRI imaging reveals disruption of the anterior and posterior horns of lateral meniscus

Figure 3: A sagittal T2-weighted MRI image demonstrates complete ACL (white arrow) and PCL (Gray arrow) injury. Meniscal injury is also seen

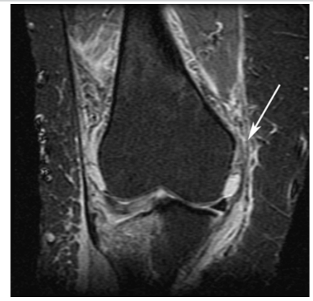

Figure 4: MCL disruption on a coronal MRI in a patient with a Schatzker II fracture pattern

were evaluated clinically by inspecting the site of injury for bruises, open injuries, deep abrasions and palpating the site of injury for tenderness and instability of the knee. The neurovascular evaluation was done for sensations and pulsations to ensure intact circulation and nerve supply in the limb. Initial radiological evaluation was done by taking radiograph of injured part to look for fracture pattern; The soft tissue injury was evaluated using MRI.

For MRI evaluation, a 1.5T (Siemens) was used to evaluate the ligament and meniscal injuries associated with proximal tibia fracture. The MRI protocol included axial, coronal, and sagittal scans with both T1- and T2-weighted sequencing. Injuries to the ACL and the posterior cruciate ligament (PCL) were classified as footprint avulsion, partial tear, or complete tear. Disruption of up to 50% of the ACL or PCL with a lack of low signal intensity caused by swelling and edema was referred to as a partial rupture. Discontinuity of the ligament with a loss of the normal structure was considered a complete rupture.

For meniscal tears, high signal intensity reaching the articular surface or contour abnormality was considered indicative of a tear.

Results

Seventy patients who sustained fractures of the proximal tibia due to high-energy mechanisms of injury were evaluated according to the protocol over a 2-year period. There were 44 males and 26 females, with 38 right and 32 left proximal tibia fractures. The mechanism of injury of our patients was as follows (number of patients): motor vehicle accidents, 40; high energy falls, 5; motorcycle accidents, 16; pedestrian struck by motor vehicle, 9. The mean age of our patients was 42.11 years, with standard deviation of 12.265 with age distribution falling in a range range of 18 to 83 years.

Fractures included in this study were classified according to both the AO/OTA and the Schatzker classifications. The breakdown of fractures based on the AO/OTA classification was as follows: AO/OTA type 41A, 0 fractures; AO/OTA type 41B, 49 fractures; and AO/OTA type 41C, 21 fractures. Using the Schatzker classification, our fractures were classified as follows: type I, 2 patients; type II, 42 patients; type III, 0 patients; type IV, 5 patients; type V, 12 patients; and type VI, 9 patients.

On average, 70% sustained a complete tear or avulsion of one or both cruciates. 70% sustained collateral ligament injuries. 91% had lateral meniscal pathology, 40% had medial meniscus tears. Of the 70 patients, 42 patients (60%) had Schatzker type II injuries, in which 90% lateral meniscus tear, 80% MCL and ACL tear, 66% PCL and LCL tear. We adopted chi-square test to find the association between fracture pattern and soft tissue injuries. In our study, we found that there was a significant association between footprint avulsion of PCL and lateral meniscus (p value-0.038), partial tear of LCL and lateral meniscus (p value-0.048). Also, there was a significant association between partial tear of ACL and medial meniscus (p value-0.023), between complete tear of ACL and medial meniscus (p value- 0.019). There was also a significant association between partial tear of PCL and medial meniscus (p value-0.007).

But there was no significant association between ACL, PCL, MCL, LCL and SCHATZKER TYPE (p value >0.05).

Meniscal tears

Lateral meniscal pathology was considered either acute intrasubstance tear or separation of the lateral capsule from the joint line. Of the 70 patients, 63 patients (91%) had lateral meniscal tear and 28 patients (40%) sustained medial meniscal tear.

Of the 42 Schatzker type II (60%), 38 patients (90%) had lateral meniscal tear and 18 patients (42%) had medial meniscus tear. Injury to the medial meniscus occurred frequently in Schatzker type IV (4 of 5 patients).

Cruciate Ligament Injury

Injuries to the anterior cruciate ligament (ACL) and posterior cruciate ligament (PCL) were classified as a footprint avulsion, partial tear, or complete tear. 49 patients (70%) sustained a complete tear or footprint avulsion of one or both cruciate. Of the 42 Schatzker type II patients, 34 patients (80%) had either avulsion or complete tear of ACL. The incidence of PCL injury was much lower with 28 patients sustaining either avulsion or complete tear.

Collateral ligament injury

Tears of the lateral collateral ligament (LCL) and medial collateral ligament (MCL) were determined from MR images as either partial or complete. Overall incidence of complete LCL and MCL tear was 70%. In Schatzker type II fractures, 66% had LCL tear and 80% had MCL tear.

Discussion

In the MRI series of proximal tibia fractures, we found an overall incidence of soft-tissue injury higher than previously reported.

Associated soft tissue injuries with proximal tibia fractures have been reported in several previous studies [5, 6, 9, 10]; however, most of these studies are of small groups of patients or relied upon physical examination or arthroscopy, both of which are unreliable in comprehensively evaluating periarticular soft tissue structures. In 1979, Schatzker et al [1] reported 8 ligamentous injuries in 94 fractures (7.4%) diagnosed by physical examination preoperatively or during operative fixation, which concurred with other early reports. Blokker et al [2] treated 60 tibial plateau fractures and reported a 31% incidence of injury to any soft-tissue structure, using operative findings and preoperative examination. Arthroscopic evaluation of 36 tibial plateau fractures revealed 17 (47%) meniscal tears, and a similar study of 30 fractures reported on the incidence of meniscal (20%), MCL (20%), LCL (3%), and ACL tears (10%).

The utility of MRI in diagnosing soft-tissue pathology in the knee has been well described. In particular, structures around the knee and their pathologic appearance on MR have been studied extensively, and MR remains the imaging modality of choice when evaluating these ligaments and menisci. In a more recent MRI study, Colletti et al [5] evaluated 29 tibial plateau fractures and reported a 45% rate of lateral meniscus tears, 21% had medial meniscus tears, 55% had MCL tears or sprains, 34% had LCL injury, 41% had ACL injury, and 28% had PCL injuries. Kode et al [6] reported a 68% incidence of concomitant soft-tissue injury using MRI in 22 tibial plateau fractures. In our series of 70 proximal tibia fractures, injury to most soft tissue elements occurred more frequently than reported in these studies.

Treatment of these associated soft tissue injuries remains controversial. In a series of 39 patients with tibial plateau fractures and concomitant ligament injury by Delamarter et al [7], 19 patients had a primary ligament repair, and 3 had poor results. Of the remaining 20 patients who did not have primary ligament repair, 8 had poor results. Twelve patients overall had residual instability of 10° or more, 10 of whom had poor results. These were attributed to MCL, LCL, and ACL insufficiency. The authors concluded that acute repair of collateral ligaments, particularly the LCL, and delayed reconstruction of cruciate ligaments was paramount to ensure knee stability, allow adequate therapy with knee motion, and decrease overall morbidity. Clearly, the nature of the fracture and the treatment of the bony injury play a major role in the outcome, but repairing collateral ligaments acutely may prevent late instability and improve function. Conversely, Moore et al [8] found that of the knees that had a "possible" collateral ligament injury following a tibial plateau fracture, none had evidence of residual laxity at follow-up and questioned the necessity of acute repair. Other authors have emphasized the importance of repairing bony avulsions of the ACL acutely, but acute ACL repair may not be effective. It is generally agreed that torn menisci should be "salvaged at all costs" due to their articular cartilage protective properties. Delayed recognition of ligament injury prior to MRI use was likely due to inaccurate physical examination secondary to the significant pain and swelling of acute trauma and inadequate surgical exploration.

When the need for operative fixation based on the fracture pattern is unclear, MRI visualization of soft-tissue injury preoperatively may lead the surgeon to consider open or arthroscopic intervention. In nondisplaced or minimally displaced fractures, preoperative knowledge of some injuries may lead the surgeon to more aggressive treatment. Though the clinical significance of all injuries is not fully known, diagnosis of a meniscus or collateral tear may change the management from nonoperative to surgical intervention and may dictate the surgical approach. In displaced fractures, the meniscus may be torn and wedged into the fracture site, requiring arthrotomy, disimpaction, and repair.

The role of MRI in evaluating fractures has not been as well delineated as it has for soft tissue injury. Several studies [5, 6, 9, 10] have compared MRI to conventional radiographic studies for tibial plateau fractures. Barrow et al [9] reported on 31 tibial plateau fractures and concluded that comminution was depicted more clearly with MRI that with tomography. In a series of 21 tibial plateau fractures, Holt et al [10] reported that MRI changed the fracture classification (most to a more severe grade) in 48% and changed the management including surgical approach and internal fixation in 19%.

We have used our soft tissue findings to develop a protocol for treatment of patients with multiligament knee injuries and associated proximal tibia fractures. Our outcome data for these patients have been encouraging using a staged protocol that includes open reduction and internal fixation of tibial plateau fracture and reconstruction of the ligament injuries a few weeks later. Our postoperative rehabilitation includes immediate motion of the knee after ligament reconstruction.

Conclusion

Proximal tibia fractures are associated with a high incidence of injury to many of the knee-stabilizing soft tissue elements. Diagnosis of these injuries may allow for appropriate treatment plans, through both surgical approach and tailored rehabilitation protocols. The accuracy of MRI for both the soft tissue and bony structures has been proven, and MRI may become the preferred ancillary imaging study for proximal tibia fractures. Early reliable detection of concomitant injuries allows for possible acute repair. However, whether early surgical intervention for certain soft tissue injuries will result in better outcomes is unknown, and aggressive treatment may impose unnecessary surgical trauma. Large prospective trials will be required to address this question. Until this information is known, because of the high incidence of soft tissue injury and detailed bony visualization afforded by MRI, the surgeon should give consideration to MR imaging of every patient with proximal tibia fracture to more fully characterize the overall injury.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his/her consent for his/her images and other clinical information to be reported in the Journal. The patient understands that his/her name and initials will not be published, and due efforts will be made to conceal his identity, but anonymity cannot be guaranteed.

Conflict of interest: Nil **Source of support:** None

References

1. Schatzker J, McBroom R, Bruce D. The tibial plateau fracture. The Toronto experience 1968–1975. Clin Orthop.
2. Blokker CP, Rorabeck CH, Bourne RB. Tibial plateau fractures. An analysis of the results of treatment in 60 patients. Clin Orthop. 1984:193– 199.
3. Vangsness CT Jr, Ghaderi B, Hohl M, et al. Arthroscopy of meniscal injuries with tibial plateau fractures. J Bone Joint Surg Br. 1994;76:488– 490.
4. Bennett WF, Browner B. Tibial plateau fractures: a study of associated soft tissue injuries. J Orthop Trauma. 1994;8:183–188.
5. Colletti P, Greenberg H, Terk MR. MR findings in patients with acute tibial plateau fractures. Comput Med Imaging Graph. 1996;20:389–394.
6. Kode L, Lieberman JM, Motta AO, et al. Evaluation of tibial plateau fractures: efficacy of MR imaging compared with CT. AJR Am J Roentgenol. 1994;163:141–147.
7. Delamarter RB, Hohl M, Hopp E Jr. Ligament injuries associated with tibial plateau fractures. Clin Orthop. 1990:226–233.
8. Moore TM, Meyers MH, Harvey JP Jr. Collateral ligament laxity of the knee. Long-term comparison between plateau fractures and normal.
9. Barrow BA, Fajman WA, Parker LM, et al. Tibial plateau fractures: evaluation with MR imaging. Radiographics. 1994;14:553–559.
10. Holt MD, Williams LA, Dent CM. MRI in the management of tibial plateau fractures. Injury. 1995;26:595–599.

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