Functional Outcome of Intra Articular Proximal Tibial Fractures Associated with Ligament Injury Treated with Locking Compression Plating

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ABSTRACT:

The goal of this study was to assess the incidence of soft tissue injury in operative tibial plateau fractures by clinical examination, stress radiography and to understand the ligament injury pattern associated with these fractures according to Schatzker's classification. A total of 50 patients who were operated for tibial plateau fracture were included in this study. Soft tissue injuries like meniscus, anterior/posterior cruciate ligaments and medial/lateral collateral ligaments injuries were assessed by clinical examination and were confirmed on stress radiography. The total incidence of soft tissue injury in our study was 58%. The rates of soft tissue injury in types IV and II (respectively, 80 and 38 %) were higher than those in other types. The meniscus injury was the most common soft tissue damage, with the incidence of meniscus injury was 26%. None of the patients in our study had a pre-operative MRI done and thereby none were preoperatively diagnosed with any soft tissue injury. The functional outcome of these patients was assessed using standard knee scores. Tibial plateau fractures frequently have important soft tissue injuries that are difficult to diagnose on physical examination. A significantly higher incidence of ligament injury is seen in high-energy fracture patterns (Schatzker type IV, V, VI) and a careful evaluation to rule out a spontaneously reduced knee dislocation is important in such patients. We believe MRI scanning should be considered for tibial plateau fractures due to high-energy mechanism, allowing identification and treatment of associated soft tissue injuries.

Keywords: Tibial plateau fractures, soft tissue injuries

INTRODUCTION:

Tibial plateau fractures are one of the commonest periarticular orthopaedic injuries encountered in a trauma setup. These fractures include 1% of all fractures and 8% of fractures in elderly. Isolated injuries to the lateral plateau account for 55% to 70% of tibial plateau fractures, as compared with 10% to 25% isolated medial plateau fractures and 10% to 30% bicondylar lesions.[1] These fractures have a bimodal age distribution. Fractures occur as a result of an axial loading force combined with a varus or valgus component that causes articular shear and depression and, as a result, causes mechanical axis misalignment.[2] The degree of knee flexion at the time of trauma dictates the fracture configuration.[3] Soft tissue injury is seen in approximately 90% of these fractures with the incidence of meniscal tears being up to 50%. Medial meniscus tears are highly associated with fractures of the medial plateau, and lateral meniscus tears are associated with lateral tibial plateau fractures; the overall incidence of which has been reported to be 39% to 99%.[4-6] Ligamentous injuries to the cruciate or collateral ligaments occurs in up to 30% of tibial plateau fractures the incidence of which has been reported to 16.7 – 57%.[4-6]

Over the past 50 years management of tibial plateau fractures has completely changed from conservative to surgical management with open anatomical reduction and fixation. Conservative methods may result in malunion and articular congruity cannot be restored. However surgical treatment can regain articular congruence and restore mechanical alignment, and can allow an early range of motion with optimal functional outcome. The failure of surgeons to diagnose and treat associated soft tissue injuries may contribute to the long-term morbidity and poor knee function frequently associated with fractures of the tibial plateau[7-13]. The soft tissue injuries associated with these fractures are often missed and left undiagnosed as bony fixation is given a priority over it. Assessment of these various injuries is essential to give the patients a stable knee and a good functional outcome. The purpose of this study is to document the incidence of soft tissue injury associated with fractures of the tibial plateau, we developed a treatment protocol that included physical examination and stress radiography on patients post stabilization of the fracture which were missed pre-operatively.

MATERIALS AND METHODS:

A prospective study of patients was conducted at the orthopedic department of Dr.D.Y. Patil Hospital. A total of 50 patients who had been operated for proximal tibial fractures were included in the study between August 2020 to September 2022.

Inclusion criteria for our study was age 18 to 60 years of either sex with operated proximal tibial fractures with ORIF with locking compression plating which were radiologically as well as clinically united. All Schatzker’s classification type 1 to 6 were included. Exclusion criteria were all open fractures of the upper tibia or fractures associated with other fractures in the same extremity, or fractures who presented with a distal neurological or vascular deficit. Demographic data, including mechanism of injury, mode of injury, age, sex, injured side and pre-operative investigations were obtained on all patients. None of the patients had a pre-operative MRI done of the affected knee. All Patients who met the inclusion/exclusion criteria were further assessed with a clinical examination for assessment of instability with special tests such as Lachman’s, Anterior and posterior drawer’s, Pivot shift test, varus/valgus stress test and joint line tenderness/McMurray’s test for evaluating meniscal tears. Patients who gave a history of knee instability while activity and who also were clinically showing signs of ligament laxity following assessment with special tests were investigated further with stress radiographs of the affected as well as normal limbs and a probable clinico-radiological diagnosis was made. All grade 2 and grade 3 positive tests which correlated with clinically incompetent ligaments on examination were considered to be torn for the purposes of this study. Statistical evaluation was performed and descriptive statistics are reported as percentage or mean.

RESULTS:

Fifty patients who sustained fractures of the tibial plateau were evaluated over a period of two years. Average patient age was 30.5 with a range from 20 to 60 years. The incidence of this fracture was higher in males (76%) as compared to females. Highest incidence of these fractures was to be in the third decade of life. The mode of injury was motor vehicle accident in 42 patients, fall from height in 7 and sports injury in 1 patient. Fractures included in this study were classified using the Schatzker's classification. In our study, we identified 8 type I (split), 21 type II (split and depression), 8 type III (depression), 7 type IV (medial plateau) and 5 type V (bicondylar) and 1 type VI (Bicondylar fracture with metaphysio-diaphyseal dissociation fractures). Based on patient's recollection of past events, we noticed that the mechanism of injury was a varus force in 8% of the patients, 24% reported a valgus force to the knee, 20% patients reported axial compressive with or without a varus/valgus component, whereas 48% had no recollection of events. On examination, patients who had one or more ligament laxity and/or suspected meniscal tears were categorized according to Schatzker's classification. All patients with suspected ligament injury and meniscal tears were further evaluated using stress radiography of the affected as well as the unaffected joint. Patients who were suspected for a MCL or LCL injury, joint openings were compared with the unaffected side. A wider opening on the affected knee was considered positive for the respective ligament injury. For patients with a suspected ACL or PCL tear, tibial translations of the affected limb were compared with the unaffected limb. Increased anterior translations were considered positive for an ACL injury. Table 1 summarizes the details regarding the occurrence of ligament and meniscal injury based on the Schatzker classification. In our study, we found the overall incidence of soft tissue injury to be 58% with the highest incidence of injury to the meniscus of 26%; 4% to the ACL; 16% to the MCL and 12% to the LCL. Functional outcome of all patients who were operated for tibial plateau fractures were assessed using the Oxford Knee Score and Lysholm Knee Scoring system and are summarized in table 2.

Table 1: Incidence of ligament and meniscal injury according to Schatzker's classification

Schatzker type	Medial/lateral meniscus injury	Anterior cruciate ligament (ACL) injury	Posterior cruciate ligament (PCL) injury	Medial collateral ligament (MCL) injury	Lateral collateral ligament (LCL) injury
1 (n = 8)	0 (0%)	0 (0%)	0	0 (0%)	2 (25%)
2 (n = 21)	8 (38%)	0 (0%)	0	4 (19%)	3 (14%)
3 (n = 8)	0 (0%)	0 (0%)	0	0 (0%)	0 (0%)
4 (n = 7)	2 (28.57%)	2 (28.57%)	0	0(0%)	0 (0%)
5 (n = 5)	3 (60%)	0 (0%)	0	4 (80%)	0 (0%)
6 (n = 1)	0 (0%)	0 (0%)	0	0 (0%)	1 (0%)
TOTAL = 50	**13 (26%)**	**2 (4%)**	0	**8 (16%)**	**6 (12%)**

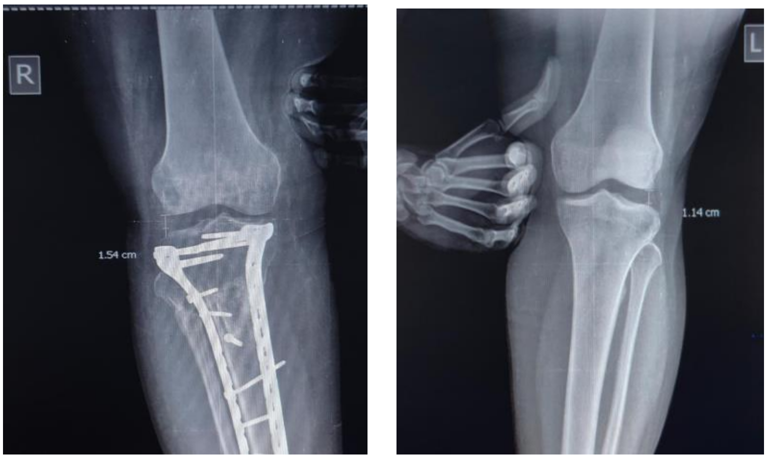

IMAGE 1 SHOWING A POST OP UNITED SCHATZKER TYPE 6 WITH A LATERAL JOINT OPENING OF 1.54 CMS ON GIVING MANUAL VARUS STRESS OVER THE AFFECTED KNEE (RIGHT SIDE) AND JOINT OPENING OF 1.14 CMS ON GIVING VARUS STRESS OVER THE UNAFFECTED KNEE (LEFT SIDE)

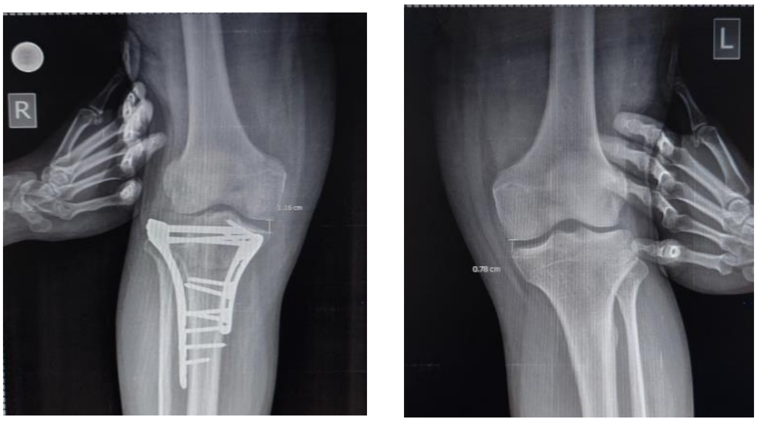

IMAGE 2 SHOWING A POST OP SCHATZKER TYPE 5 WITH A MEDIAL JOINT OPENING OF 1.16 CMS ON GIVING VALGUS STRESS OVER THE AFFECTED KNEE (RIGHT SIDE) AND JOINT OPENING OF 0.78 CMS ON GIVING VALGUS STRESS OVER THE UNAFFECTED KNEE (LEFT SIDE)

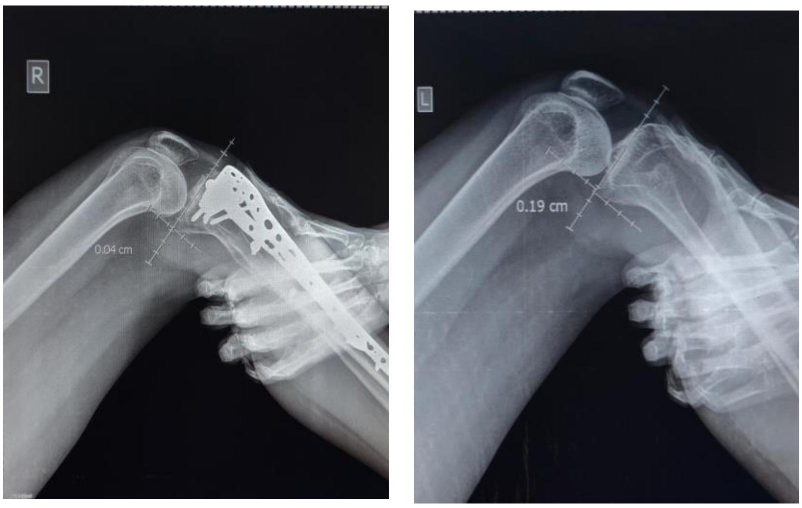

IMAGE 3 SHOWING A UNITED POST OP SCHATZKER TYPE 4 WITH INCREASED ANTERIOR TRANSLATION OF THE TIBIA WHILE PERFORMING AN ANTERIOR DRAWER OVER THE AFFECTED SIDE (RIGHT KNEE) AS COMPARED TO THE UNAFFECTED KNEE (LEFT)

Table 2. Functional outcome of patients according to Lysholm and Oxford knee scores

GRADE	% ACCORDING TO LYSOLM SCORE	GRADE	% ACCORDING TO OXFORD SCORE
Excellent (>90)	6% (3)	Excellent (40-48)	54% (27)
Good (84-90)	70% (35)	Good (30-39)	46% (23)
Fair (65-83)	24% (12)	Fair (20-29)	0
Poor (<65)	0%	Poor (0-19)	0

DISCUSSION:

In a tertiary care hospital in Pune, Maharashtra, 50 patients who had been previously operated for intra-articular proximal tibial fractures with locking compression plating participated in this hospital-based study. The incidence of injury to the soft tissue structures in this study were similar to the incidences reported in other studies (Table 3). However, unlike our study these studies relied on MRI or arthroscopic evaluation, both of which are reliable for periarticular soft tissue evaluation.

Bennett and Browner[14,15] first discovered the concurrent soft tissue damage brought on by tibial plateau fracture in 1994. Using imaging, a physical examination, and diagnostic arthroscopy, the rate of soft tissue injury in 30 patients with tibial plateau fractures was recorded. They discovered that 56% of patients had soft tissue injuries overall, 20% of whom had meniscal and/or medial collateral ligament (MCL) injuries, 10% had anterior cruciate ligament (ACL) injuries, and 3% had lateral collateral ligament injuries (LCL). They also demonstrated a higher rate of soft tissue injury in Schatzker II and Schatzker IV type fractures by following the Schatzker classification.[16] They noticed that meniscal injury was more common in type IV fractures, whereas MCL injury was more common in type II fractures which are similar to the incidence found in our study.

In a following article, Colletti and colleagues[6] found that 28 out of 29 (97%) acute tibial plateau fractures had some level of soft tissue injury, further emphasizing the high occurrence of internal soft tissue derangement. The following structures had a higher incidence of soft tissue damage: 55% MCL, 45% lateral meniscus, 21% medial meniscus, 34% LCL, 41% ACL, and 28% PCL.

In 2005, Gardner and colleagues[17] performed prospective MRIs on 103 individuals who had operative tibial plateau fractures. According to Colletti's research, 99% of patients experienced some sort of related damage. In 91% of cases, patients had lateral meniscus pathology, the most common soft tissue diagnosis. The ACL (57%) was the ligament that was injured the most frequently, followed by the LCL, MCL, and PCL, which all had similar incidences. In 68% of the 103 people, either the popliteofibular ligament, the popliteus tendon, or both were torn.

The most comprehensive analysis of soft tissue injuries linked with tibial plateau fractures was probably reported by Stannard and colleagues[18] in 2010. They evaluated the ligamentous and meniscal injury in 103 tibial plateau fractures using MRI. Similar to Gardner's findings, 53% of patients had multiple ligament groups affected, while 71% of patients had at least one major ligament group afflicted. In this study, there were fewer meniscus tears overall (49%). The authors observed that as compared to lower energy kinds, higher energy fracture types (type IV–VI) had a considerably higher incidence of soft tissue damage.

After initial evaluation, plain radiographs serve as the first diagnostic step in any orthopaedic injury. Along with the usual anteroposterior (AP) and lateral views, getting oblique pictures or a modified AP view (beam shoots down the posterior slope of the tibia) of the affected knee is also helpful.[19]

Prior to the development of modern imaging techniques, ligamentous injury was commonly identified using preoperative stress radiography.[20]

Computed tomography (CT) and/or MRI have now replaced the role of these radiographs preoperatively, however stress imaging following fracture stabilization is still routinely performed.

CT provides excellent details on the morphology of the bones and the fracture characteristics, but it lacks soft tissue detailing.[21,22]

MRI has considered as the gold standard in evaluating soft tissue injuries around the knee, but its role in evaluating patients with tibial plateau fractures is currently debatable.[18,19,23]

Several studies have attempted to correlate fracture patterns with injury to soft tissue components of the knee in an effort to replace the need for a MRI to detect soft tissue injuries. 62 patients with Schatzker II tibial plateau fractures underwent evaluation by Gardner and colleagues[24]. They used MRI to correlate their measurements of condylar widening and articular depression with the incidence of meniscal pathology. The lateral meniscus was observed to be torn 83% of the time when the patient had more than 6 mm of lateral articular depression and 5 mm of condylar widening. 8 mm, as opposed to 6 mm, appeared to correlate with injury to the medial meniscus.

Another study that studied at the correlation between fracture patterns and ligamentous injury found similar figures. After evaluating 54 patients with tibial plateau fractures, it was found that lateral plateau depression of more than 6 mm or lateral condylar widening of more than 8 mm were indicative of concomitant cruciate and collateral ligament injuries.[25]

It is still debatable whether or not MRI has a role in evaluating and treating tibial plateau fractures, most likely because of the cost, time, and lack of availability. Although simple radiography and CT scans are quicker, less expensive, and more accessible, they may not provide the information needed to manage these complex injuries optimally. Since it has been challenging to develop reliable radiographic indicators of soft tissue injuries, several investigators recommend adopting MRI to evaluate at least high-energy tibial plateau fractures, if not all of them.[15,18,23,25]

The management of soft tissue injuries in association with tibia plateau fractures is currently insufficiently documented. Clinical outcomes and specific soft tissue injuries associated with tibial plateau fractures have rarely been correlated with each another. In 2018, Warner and associates[26] evaluated MRI scans and made an effort to correlate those results to patient outcomes. Interestingly, they were unable to demonstrate a correlation between soft tissue injuries and patient outcomes.

The evaluation techniques and management of soft tissue injuries in patients with tibia plateau fractures continues to evolve. We now know that many patients have injuries to the ligaments or menisci.[6,14,18,20,23-25] Despite the fact that we are aware of the existence of these injuries, we do not currently know if and when we should do operate them. We suggest use of a pre-operative MRI scan for early evaluation of these injuries and thereby provide better management to the patients.

In order to establish which injuries may benefit from primary or secondary repair or reconstruction and which injuries can simply be ignored, further research has to be carried out to evaluate treatment algorithms in a prospective manner. Obviously, prospective randomized trials would be ideal, but they are quite challenging due to the complex spectrum of injury.

TABLE 3. Reported Incidence of Associated Soft Tissue Injury in Tibial Plateau Fractures

Method of Evaluation (Reference)	Total Fractures	% Meniscal Injuries	% Cruciate Ligament Injuries	% Collateral Ligament Injuries	% Overall Soft Tissue Injury
MRI (3)	27	33	18	26	63
MRI (4)	31	87	23	19	—
MRI (5)	21	29	19	19	48
MRI (10)	29	66	69	45	97
MRI (12)	22	55	32	23	68
MRI (13)	20	80	10	30	90
Arthroscopy (15)	23	48	9	—	57
Arthroscopy (16)	36	47	14	8	—
Arthroscopy (17)	31	23	26	10	52
Arthroscopy/exam (18)	30	20	10	23	56
OR findings (27)	76	50	8	—	—
OR findings (28)	406	16	—	—	—
OR/exam (19)	94	—	—	—	7
OR/exam (20)	196	—	8	13	18
Physical exam (21)	47	2	21	21	28
Physical exam (22)	64	13	9	16	31

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