

Recent Trends In Management Of Proximal Tibial Fractures

Essay

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Contents	Page
Introduction	1-3
Aim Of The work	4
Anatomy Of The Proximal Tibia	5-13
Biomechanics & Mechanism Of Injury	14-19
Types Of Fractures & Its Classifications	20-35
Clinical Pictures & Diagnosis	36-50
Treatment (Standard & Recent Trends)	51-112
Associated Injuries & Complications	113-117
Summary	118-120
References	121-128
Arabic Summary	

Number	Figure	Page
Fig 1	Proximal Tibia Anterior View	6
Fig 2	Proximal Tibia/Fibula - Medial View	6
Fig 3	Radiographic anterior and posterior meniscal horns locations.	7
Fig 4	Superior view of tibial condyles	9
Fig 5	Wrisberg ligament	10
Fig 6	Ligaments of the right knee joint	12
Fig 7	The periosteal blood supply to the proximal tibia	13
Fig 8	Relationship of force to tibial condylar fractures.	16
Fig 9	The role of medial collateral ligament	19
Fig 10	Classification of tibial plateau fractures as described by Hohl and Moore	22
Fig 11	Hohl and Moore classification of proximal tibial fracture-dislocations	22
Fig 12	Schatzker classification of tibial plateau fractures	23
Fig 13	A split fracture (AO/OTA type B-1, Schatzker 1)	24
Fig 14	A split depression fracture (AO/OTA B-2 and -3, Schatzker 2)	24
Fig 15	A local compression fracture (AO/OTA B-2 Schatzker 3)	25
Fig 16	Medial condylar fracture dislocation(AO/OTA type B-3, Schatzker 4)	25
Fig 17	A bicondylar fracture.	26
Fig 18	A shaft dissociated fracture (AO/OTA type C-2, Schatzker 6)	26
Fig 19	AO classification of proximal tibial fractures	27
Fig 20	Three-Column classifications.	29
Fig 21-24	Representative CT images of The three column fracture	30-31
Fig 25	Revised Duparc classification	32
Fig 26	Example of a Tscherne II fracture of the proximal tibia	33
Fig 27	Valgus stress to test the medial collateral ligament	41
Fig 28	Varus stress to test lateral collateral ligament	41
Fig 29	AP and LT radiographs of a typical displaced bicondylar tibial plateau	42
Fig 30	Schematic of the average proximal tibial surface slope with the tibial shaft vertical	43
Fig 31a	Oblique projections provide additional fracture information	43
Fig 31b	AP & AP stress radiograph of a lateral tibial plateau fracture.	44
Fig 32	A, Injury film reveals a complex Schatzker type V injury with shaft dissociation and, Traction radiograph reveals generalized reduction	44
Fig 33	Method of measurements of Lateral plateau depression (LPD)	44
Fig 34	CT & CT-3D reconstruction of tibial plateau fractures	45
Fig 35	Injury film , distraction film & distraction CT film of tibial plateau fractures	46

Fig 36-42	MRI of tibial plateau fracture	47-48
Fig 43	Detachment of the meniscal rim in a patient with a depression tibial plateau fracture	50
Fig 44	CT views of a Shatzker II& Arthroscopic view of depressed joint surface (DJS), fractured lateral tibial plateau (LTP),	50
Fig 45	Surgical positioning of the limb	55
Fig 46	Anterolateral approach to the tibial plateau	56
Fig 47	Posteromedial approach to the medial tibial plateau	56
Fig 48	Posterolateral Approach	57
Fig 49	AP, oblique (B), and CT views of the Schatzker II & postoperative views with a raft periarticular plate	58
Fig 50	Intraoperative view demonstrating a cannula placing the bone graft substitute	58
Fig 51	Schatzker I fracture (a). Treatment by percutaneous screw (b).	60
Fig 52-56	Schatzker II fracture fixation	61-62
Fig 57	Schatzker IV fracture with medial osteosynthesis plate	62
Fig 58-62	Schatzker VI fracture fixation	63
Fig 63	Open fracture tibial plateau management	64
Fig 64	CT scan: (a) 3D reconstruction; (b) angio CT in complex fracture of proximal tibia with stop in popliteal artery.	65
Fig 65-77	Three column fixation of tibial plateau fractures	68-69
Fig 78	Proximal tibial fractures were stabilized with two metaphyseal locking plates used as definitive external fixator.	71
Fig 79	Finite element model of internal and external plate fixation for tibia fractures	73
Fig 80-81	Installation of patient position& the surgical drapes.	75
Fig 82	By pulling on a loop passed around the meniscus, the meniscus can be retracted to expose the depression	76
Fig 83-85	Reduction of fractures characterised by pure cleavage (Schatzker type 1).	77
Fig 86-91	Reduction of fractures with isolated depression (Schatzkertype 3).	79
Fig 92	Percutaneous fixation of a lateral tibial plateau split fracture	80
Fig 93-94	Replacing lost bone	80
Fig 95	CT view of a Shatzker type II tibial plateau fracture (b)Arthroscopic view (c) Arthroscopic view following arthroscopically assisted elevation of the depressed joint surface using a tibial ACL guide. (d) Post-operative AP radiograph of the fracture fixed with three cannulated screws.	81
Fig 96	Illustration of an arthroscopic cannulated screw fixation of a tibial eminence avulsion fracture	81
Fig 97	AO 41 C3 fracture fixed by polyaxyl plate	82

Fig 98-99	Multi-plate reconstruction for severe bicondylar tibial plateau fractures	84
Fig 100-102	LISS plating for proximal tibial fractures	87-88
Fig 103-110	Tuberoplasty: Minimally invasive osteosynthesis technique for tibial plateau fractures	91-94
Fig 111-112	Schatzker type II Intraoperative fluoroscopic monitoring & Intraoperative arthroscopic control of the reduction process by balloon tibioplasty	94-95
Fig 113	IMN and compression bolts for fixation of proximal tibial fracture	96
Fig 114-117	Garnavos et al 2011 , combined use of condylar bolt(s) and intramedullary nailing in the management of selected intra-articular fragility fractures of the proximal tibia	97-98
Fig 118-127	Garnavos study in 2014 , to introduce the retropatellar approach for the management of complex fractures of the tibial plateau with intra-medullary nailing and condylar compression bolts	98-101
Fig 128-133	Tricks, and Pearls in Intramedullary Nailing of Proximal Third Tibial Fractures.	102-104
Fig 134-136	N. Ferreira et al 2014 , study the management of high-energy tibial plateau fractures through limited open reduction and fine-wire circular external fixation	108
Fig 137	K. El-Gafary et al 2014 study, Ilizarov external fixation for high-energy Schatzker Vand VI tibial plateau fractures	106
Fig 138	Katsenis et al 2009 study hybrid fixation with tension wire for the treatment of high-energy tibial plateau fractures	108
Fig 139-140	Savolainen et al 2010study the hybrid external fixation method &a mini-open reduction of the fracture and one or two securing transcondylar screws.	108
Fig 141-148	The Ariffin et al 2011 study modified hybrid external fixator for the treatment of Schatzker V and VI tibial plateau fractures	109-111
Fig 149	Skin necrosis after Schatzker V fracture treated with external fixator, Débridement and coverage	115
Fig 150	Schatzker VI fracture treated by external fixator. It was complicated by a compartment syndrome	115
Fig 151	Management of compartment syndrome by wide fasciotomy	115
Fig 152	Deep infection with hardware exposure & after soft tissue coverage .	115
Fig 153	AP (A) and lateral (B) radiographs showing varus deformity and nonunion of the medial condyle 6 months after minimal internal and external fixation of a Schatzker VI tibial plateau fracture	117
Fig 154	Coronal (CT) scan showing nonunion and displacement of the medial condyle	117
Fig 155	Posttraumatic osteoarthritis after tibial plateau fracture	117

Number	Content	Page
Tab. 1	Oestern and Tscherne Closed Fracture Classification	34
Tab. 2	Gustillo-Anderson Open Fracture Classification	34
Tab. 3	Key Points Regarding Entry Portal for IMN of Proximal Third Tibial Shaft Fractures.	102
Tab. 4	Surgical Options for IMN in Proximal Third Tibial Shaft Fractures	102

Abbrev.	Meanning
2D CT	Two-dimensional computed tomography scans
3D CT	Three-dimensional computed tomography scans
3DMCT	Three-dimensional images from multidetector computed tomography scans
ACL	Anterior cruciate ligament.
AO	Association for Osteosynthesis = Arbeitsgemeinschaft fur Osteosynthesefragen
AO/ASIF	Association for Osteosynthesis/Association for the Study of Internal Fixation
AP	Antero-posterior
BI	Bicondylar fractures
C.T	Computed tomography.
CAD	Computer-aided design
CPM	Continuous passive motion.
DCP	Dynamic compression plate
DJS	Depressed joint surface
DVT	Deep venous thrombosis.
EPFs	External plate fixations
FE	Finite element
IMN	Inter medullary nail
IPF	Internal plate fixation
K-wires	Kirschner wires
LC-DCP	Low Contact- Dynamic compression plate
LCL	Lateral collateral ligament.
LCP	Locking compression plate
LISS	Less invasive stabilization system.
LISS-PT	Less Invasive Stabilization System-plate
LM	lateral meniscus
LPD	Lateral plateau depression.
L-plate	Lateral plate
LPW	Lateral plateau widening

LTP	Lateral tibial plateau
MCL	Medial collateral ligament.
MFLs	Menisco-femoral ligaments.
MIPO	Minimally Invasive Percutaneous Osteosynthesis
MRI	Magnetic resonance image.
ORIF	Open reduction internal fixation.
OTA	Orthopaedic Trauma Association
PCL	Posterior cruciate ligament.
PM	Posteromedial fractures
PMMA	Polymethylmethacrylate
PSI	Pounds per square inch
ROM	Range of motion.
SC	Spinocondylar fractures
S-I,VI,V	Schatzker type I ,VI ,V
TBW	Total bearing wieght
TPF	Tibial plateau fracture
UL	Unicondylar Lateral fractures
UM	Unicondylar medial fractures

Introduction

The knee joint is one of three major weight-bearing joints in the lower extremity. Fractures that involve the proximal tibia affect knee function and stability. These fractures can either be intra-articular (tibial plateau) or extra-articular (proximal fourth). Generally, these injuries fall into two broad categories: low-energy and high-energy fractures. The spectrum of associated injuries, potential complications and outcomes varies with fracture pattern. There are many classification schemes to describe these injuries, with no clear consensus on indications for surgical treatment of certain fracture patterns. ⁽¹⁾

Fractures of the tibial plateau are severe injuries, accounting for 5-8% of all fractures of the lower leg. The most frequent reasons for these injuries are falls, traffic accidents and sports trauma. In recent years, the incidences of these fractures have risen due to increase in motorization and alternative sport activities and an increasingly aging population. ⁽²⁾

The mechanism of injury is based on the presence of an initial axial load, which fractures the tibial articular surface resulting in impaction. In most of the cases the initial load is combined with angular forces, leading to comminution not only of the articular surface, but of the metaphysis as well. The medial compartment is split in a medio-lateral direction with a postero-medial main fragment, combined with various amounts of multi-fragmental lateral compartment depression. ⁽³⁾

Tibial plateau fractures are commonly classified using the Schatzker classification, which subdivides these injuries into six types. ⁽⁴⁾ The OTA/AO classification can be used to classify these injuries, both intra- and extra-articular ones. The Gustillo-Anderson and the Tscherne classifications are used for open and closed injuries respectively. ⁽⁵⁾

According to Schatzker's classification ⁽⁴⁾, these fractures are divided into six groups: S-I to S-VI. Of these types, those involving both condyles (S-V) and those separating tibial metaphysis from diaphysis (S-VI) are the most challenging fractures for the Orthopedic surgeon to treat not only for the osseous damage but for the restoration of the soft tissue envelope as well. Schatzker's type V and VI

tibial plateau fractures represent serious injuries with substantial residual limb-specific and general health deficits.⁽⁶⁾

Standard radiographic imaging includes anteroposterior and lateral views. Suspicion of distal extension of the fracture mandates that full-length tibia and fibula x-rays should be obtained. The CT scan is becoming more and more useful in the evaluation of the size, comminution and orientation of the articular fragments, allowing proper classification and preoperative planning, thus facilitating reduction, especially for the less invasive techniques of treatment.⁽⁷⁾

Over the years, many treatment modalities have been proposed for these complex fractures. All of them, from simple traction to demanding surgery, presented fair results but also serious complications. Traction, in terms of ligamentotaxis and casting, do not properly reduce the articular surface and lack the necessary stability, leading to unacceptable rate of varus/ valgus deformity, collapsed articular surface and post-immobilization stiffness. On the other hand, open surgical procedures, despite their good reduction results, do not protect the already damaged “soft-tissue envelope”, leading to skin or muscle necrosis and to high rates of infection.⁽⁷⁾

The goals of treatment are restoration of joint congruity, normal alignment, joint stability, and a functional range of knee motion. Closed management of these injuries has proven ineffective, and is therefore not usually recommended. Open reduction of the fracture allows a good control of the articular surface, but combined to dual plating requires extensive dissection of soft tissues, with a consequent increase in the risk of deep infection and necrosis. In order to avoid these common difficulties, several new concepts have been developed. These include techniques of percutaneous intra-articular fragment manipulation, percutaneous plates, and the ring and hybrid external fixator, a “minimal invasive technique”.⁽⁸⁾

Arthroscopically assisted fixation and minimal percutaneous pinning have also been reported to give good results, but these modalities are suitable for simple split-depression and local compression fractures.⁽⁹⁾

Moreover, the technology of minimally invasive percutaneous osteosynthesis (MIPO) can be easily applied. This allows minimum soft-tissue damage at the fracture site, offering all the theoretical advantages of biological osteosynthesis.⁽⁹⁾

The indications for the LISS (The Less Invasive Stabilization System) for proximal tibial fractures include all extra- and intra-articular fractures which cannot be managed by screws alone. The benefits of the LISS plate include reduced blood loss and infection rates, a reduction of varus and flexion deformity and reduced dissection of the bone fragments associated with periosteal stripping.⁽¹⁰⁾

Recently, locking plates have been designed to have polyaxial technology, thus allowing screw positioning with a variable degree of freedom for fixation. This versatility can be considered as an advantage, allowing for more stable osteosynthesis of highly comminuted or osteoporotic fractures.⁽⁹⁾

The aim of the work

Focusing a spotlight on the recent trends in the management of different types of proximal tibial fractures.

Anatomy of Proximal Tibia

General Osteology:

The upper end of the tibia has got its own bony features, trabecular bony arrangement and soft tissue attachment as being part of the knee joint. The upper tibia flares from the shaft proximally in the subchondylar area, providing contours and bony prominence for the ligaments and tendon attachments, a small articulation for the proximal tibio-fibular joint and relatively flat articular surface to support the femoral condyles. Depression of the weight bearing portion of the tibial condyles results in some degree of valgus or varus changes at the knee⁽¹¹⁾.

The expanded cancellous proximal end of the adult tibia overhangs the shaft on either sides and is supported from below by thin cortical bone. The tibial condyles are thus more frequently the site of fractures than the opposing femoral condyles which are subjected to the same mechanism of injury⁽¹²⁾.

Bony Architecture:

The proximal tibial surface (often referred to as the tibial plateau). The tibial plateau forms the articular portion of the proximal tibia which articulates with the femoral condyles to form the knee joint⁽¹³⁾.

The surface of the tibial plateau slopes posteriorly and inferiorly 10 to 15 degree in the coronal plane. This tilt, which is maximal at birth and decrease with age. In the sagittal plane the plateau lies nearly at a right angle to the axis of the tibial shaft, forming an angle of 3 degrees of varus. This varus makes the lateral plateau being higher than the medial plateau. The height of the lateral plateau compared with the medial plateau must be considered when placing screws across the joint line so that the screws placed from the lateral side don't enter the medial joint line. Proximally the slight varus alignment of the tibia results in slight eccentric load distribution across the tibial plateau. In a normally aligned lower limb, the medial plateau bears more weight than the lateral plateau (**Fig .1,2**)⁽¹⁴⁾.

This asymmetric weight bearing contributes in increasing medial subarticular bone formation, results in the medial plateau being stronger and denser. This may contributes to lower the incidence of medial plateau fracture, and when medial

plateau fracture occurs it usually involves high energy trauma and often associated with other soft tissue injuries. ⁽¹⁵⁾

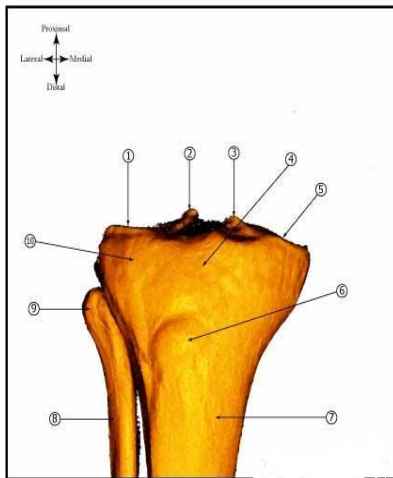


Figure (1) Proximal Tibia Anterior View ⁽¹⁴⁾

1. Lateral tibial Plateau: convex, smaller than medial plateau
2. Lateral intercondylar eminence
3. Medial intercondylar eminence
4. Starting point for IM nail
5. Medial tibial plateau: concave, larger than lateral plateau
6. Tibial tubercle: insertion of patellar tendon
7. Tibial shaft
8. Fibular shaft
9. Fibular head: Styloid process of fibular head is the insertions of the lateral collateral ligament.
10. Gerdy's tubercle: insertion site of iliotibial band

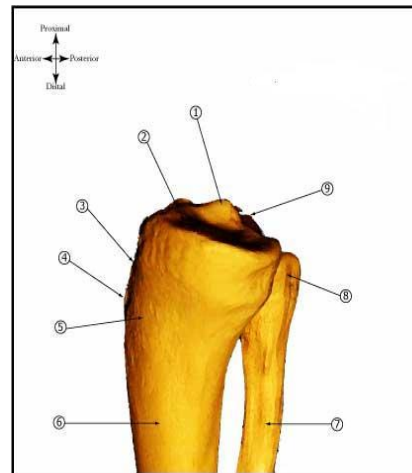


Figure (2): Proximal Tibia/Fibula - Medial View ⁽¹⁴⁾

1. Medial intercondylar eminence
2. Medial tibial Plateau
3. Starting point for IM nail
4. Tibial tuberosity
5. Insertion site for Pes tendons
6. Tibial shaft
7. Fibular shaft
8. Fibular head
9. Lateral intercondylar eminence

Inspection of the tibial plateau and the femoral condyles suggest that they are not consistent. The larger medial tibial plateau is nearly flat and has a squared-off posterior aspect that is quite distinct in a lateral radiograph ⁽¹⁶⁾.

In distinction, the articular surface of the narrower lateral tibial plateau borders on convexity. Both have a posterior inclination with respect to the shaft of the tibia approximately 10 degrees. In the intact knee, the menisci enlarge the contact area and increase the conformity of the joint surface ⁽¹⁶⁾.

Intercondylar Area:

The rough surfaced area between the condylar articular surfaces is narrowest centrally where there is an intercondylar eminence, the edges of which project