Recent Trends In Management Of Proximal Tibial Fractures

Essay

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Abbrev.	Meanning
2D CT	Two-dimensional computated tomography scans
3D CT	Three-dimensional computated tomography scans
3DMCT	Three-dimensional images from multidetector computated 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	Computated 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 injures, 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 injues. [15]

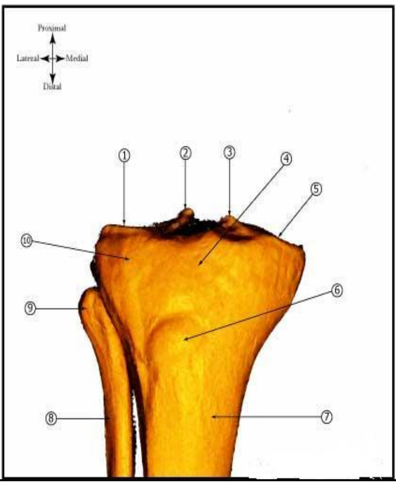

Figure (1) Proximal Tibia Anterior View [14].

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

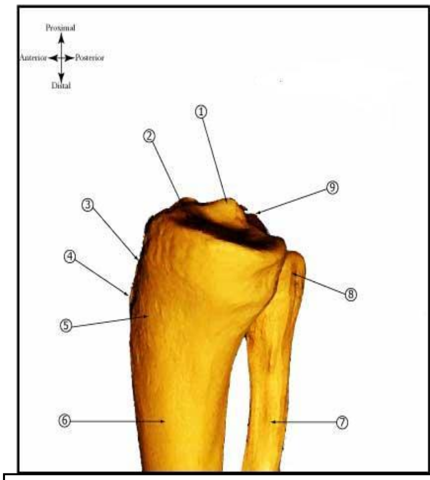

Figure (2): Proximal Tiba/Fibula - Medial View [14].

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