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TIBIAL PLATEAU FRACTURES – SURGICAL MANAGEMENT BY MIPPO

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ABSTRACT: BACKGROUND AND OBJECTIVES: Tibial plateau fractures are one of the most common intra-articular fractures. They are the outcome of indirect coronal or direct compressive forces. The incidence of tibial plateau fractures is 1.3% of all fractures. These fractures have varied degree of fracture configuration involving medial, lateral or both tibial plateaus with varied degree of intra-articular depressions and displacements. Due to speedy vehicles and mechanization there has been increase in the number of tibial plateau fractures. Knee joints being one of the major weight bearing joints of human body, these fractures are of big importance. **METHODS:** We studied 30 cases of tibial plateau fractures treated by MIPPO at kempegowda institute of medical sciences from June 2012 to April 2014 with minimum follow up of up to 6months. **RESULTS:** All the selected patients were evaluated both clinically as well as radiologically. The lab investigations were done and then they were taken up for the surgery. The fractures were classified as per schatzker's classification and treated accordingly. In the post-op period early range of movements were started and the patients were non weight bearing till 6 weeks. Till 12 weeks partial weight bearing was allowed and full weight bearing was allowed after radiological union of the fracture. **CONCLUSION:** Tibial plateau fractures when treated with MIPPO give articular anatomical reduction, rigid fixation and early mobolisation of the knee joint. This prevents development of osteoarthritis and includes all the advantages of minimally invasive procedure and so better patient compliance.
KEYWORDS: Tibial plateau, Mippo, Schatzker, Hohl and Moore.

INTRODUCTION: The traumatic cases are on an increase in the present day world due to rapidly expanding city life. Crowded cities, irregular traffic arrangement, fast moving vehicles are the important contributory factors causing bony injuries, and particularly polytrauma, comminuted fractures and also the soft tissue injury. Tibial plateau fracture is one very common of them. The incidence of tibial plateau fractures is 1.3% of all fractures. The surgeons all over the world are divided in their opinion regarding the management of this group of fractures – conservative or surgical. Majority is of the view that, except for undisplaced fracture, every tibial plateau fracture should be operated upon to achieve anatomical reduction and rigid internal fixation as it is intra-articular. Surgical fixation is also indicated in undisplaced tibial plateau fractures in order to prevent knee stiffness and for early mobilization of knee. We report 30 such cases of tibial plateau fractures treated with MIPPO.

MATERIAL AND METHODS: We conducted study of 30 cases of tibial plateau fractures in the age group 20-50 yrs. All cases came to KIMS Bangalore, with knee injuries. X ray of the affected knee with leg was taken AP and LATERAL views. After the x ray, fracture was classified based on SCHATZKER. Based on this the cases we reported are: SCHATZKER`S TYPEI – 3 cases,

TYPE II: 3 cases, TYPE III: 0case, TYPE IV: 5cases, TYPE V: 8 cases, TYPE VI: 11 cases. After x ray, immediate splinting was done. Then the case was planned for MIPPO. For all the cases lateral

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proximal tibial LCP or T buttress plate or L buttress plate was applied whereas for Schatzker type V and VI fractures medial T buttress plate or L buttress plate was also applied. Drain was put for the patients. Check x ray was done on first post-operative day. Check dressing was done on second post - operative day.

Active quadriceps drill started on first post-operative day. Knee flexion-extension excercises also started on post-operative day one. Suture removal done on day 14. Partial weight bearing started after suture removal. Check x rays were done at 6 weeks, 12 weeks, 24 weeks. Almost all the cases united by 6 months. The union noted were 12 weeks -6 cases, 18 weeks- 16cases, 24 weeks- 8 cases.

PROCEDURE: LATERAL PLATING: First indirect reduction is achieved under C-arm guidance. Then oblique incision is made from gerdy's tubercle to tibial tuberosity. Then sub-muscular plane is created and precontoured plate is placed under C-arm. Then subchondral screws passed and subsequently distal lockings is done through stab incisions. Then wound is closed in layers.

MEDIAL PLATING: It is similar to lateral plating with oblique incision extending from tibial tuberosity to oblique proximally and medially to just below the joint line.
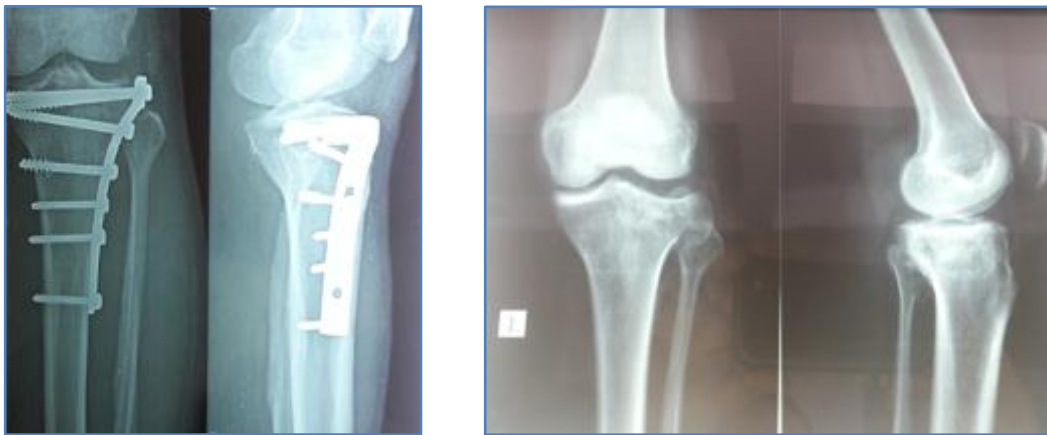
X-RAYS:

SCHATZKER'S TYPE I FRACTURES

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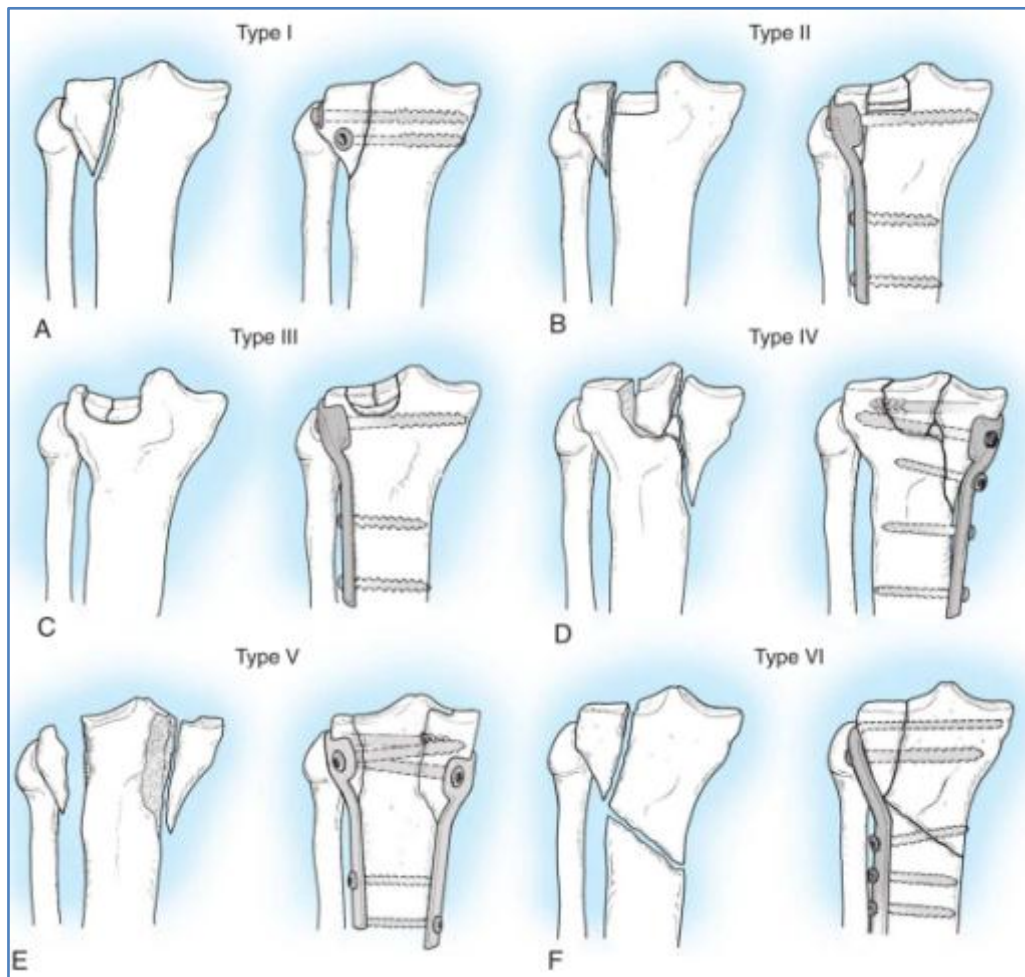
SCHATZKER'S TYPE II FRACTURES

SCHATZKER'S TYPE IV FRACTURES:

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SCHATZKER'S TYPE V FRACTURES:

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SCHATZKER'S TYPE VI FRACTURES:

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DISCUSSION:
SCHATZKER`S CLASSIFICATION:

Type I: Pure cleavage. A typical wedge-shaped uncomminuted fragment is split off and displaced laterally and downward. This fracture is common in younger patients without osteoporotic bone. If displaced, it can be fixed with two transverse cancellous screws.

Type II: Cleavage combined with depression. A lateral wedge is split off, but in addition the articular surface is depressed down into the metaphysis. This tends to occur in older individuals, and, if the depression is more than 5 to 8 mm, or instability is present, most should be treated by open reduction, elevation of the depressed plateau "en mass," bone grafting of the metaphysis, fixation of the fracture with cancellous screws, and buttress plating of the lateral cortex.

Type III: Pure central depression. The articular surface is driven into the plateau. The lateral cortex is intact. These tend to occur in osteoporotic bone. If the depression is severe, or if instability can be shown on stress, the articular fragments should be elevated and bone-grafted and the lateral cortex is supported with a buttress plate.
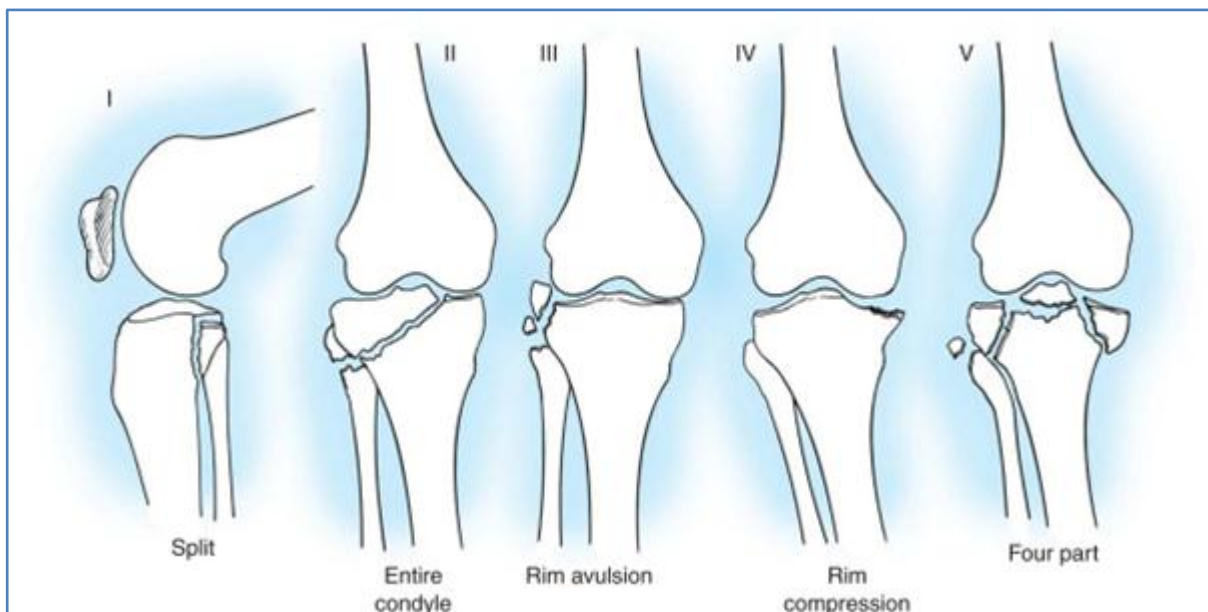
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Type IV: Fractures of medial condyle. These may be split off as a single wedge or may be comminuted and depressed. The tibial spines often are involved. These fractures tend to angulate into varus and should be treated by open reduction and fixation with a medial buttress plate and cancellous screws.

Type V: Bicondylar fractures. Both tibial plateaus are split off. The distinguishing feature is that the metaphysis and diaphysis retain continuity. Both condyles can be fixed with buttress plates and cancellous screws. It is best to avoid stabilizing condyles with large bulky implants. In a review of their experience with tibial plateau fractures, Moore, Patzakis, and Harvey found 296 bicondylar fractures in a study group of 988 plateau fractures. Of these bicondylar fractures, 95 were treated by open reduction and internal fixation. Only 11 required medial and lateral plating. Nine (82%) of the fractures treated with medial and lateral plating underwent dehiscence or became infected. In addition, 23% of type V bicondylar fractures became infected.

Generally, the more displaced and comminuted condyle can be stabilized with a buttress plate, whereas the less involved condyle is reduced by ligamentotaxis or with percutaneous techniques and stabilized with large cancellous screws. Alternatively, the less involved condyle can be stabilized with a small antiglide plate placed at the apex of the fracture with minimal soft-tissue dissection.

Type VI: Plateau fracture with dissociation of metaphysis and diaphysis. A transverse or oblique fracture of the proximal tibia is present in addition to a fracture of one or both tibial condyles and articular surfaces. The dissociation of the diaphysis and metaphysis makes this fracture unsuitable for treatment in traction, and most should be treated with buttress plates and cancellous screws, one on either side if both condyles are fractured. More recently, pin and wire fixators also have been advocated for fixation of these difficult fractures.

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Fracture-Dislocation Classification (Hohl and Moore): The fracture-dislocation patterns classified by Hohl and Moore (Fig. 51-60), in addition to occurring with a higher incidence of associated ligamentous injuries, occur with more frequent meniscal injuries, which usually are not reparable, and a much higher incidence of neurovascular injury, increasing from 2% for type I to 50% for type V, with an overall average of 15%, approximately that of classic dislocation of the knee.

Type I: Coronal split fracture. These fractures account for 37% of tibial plateau fracture-dislocations. The fracture involves the medial side, is apparent on the lateral view and has a fracture line running at 45 degrees to the medial plateau in an oblique coronal-transverse plane. The fracture may extend to the lateral side; avulsion fractures of the fibular styloid, insertion of the cruciates and tubercle of Gerdy are common.

Half of these fracture-dislocations are stable on stress views, and although they conceivably could be managed in a cast in extension or traction with limited range of motion, we frequently use closed reduction and percutaneous screw fixation to improve reduction and allow early range of motion in a cast brace; protected weight bearing is continued for 8 to 10 weeks. If open reduction is required, the fragment usually reduces in extension and can be fixed with interfragmentary screws. Associated ligamentous injuries can be repaired along with the invariable capsular disruption.

Type II: Entire condyle fracture. This fracture-dislocation may involve the medial or lateral plateau and is distinguished from the type IV fracture by a fracture line extending into the opposite compartment beneath the inter condylar eminence. The opposite collateral ligament is involved in half of fractures, resulting in fracture or dislocation of the proximal fibula. This type constitutes 25% of all fracture-dislocations, and 12% result in neurovascular injuries. Stress testing is necessary to determine occult ligament injury. Stable fractures can be managed by cast bracing, frequent follow-up, and delayed weight bearing. Unstable or poorly reduced fractures can be fixed with inter fragmentary screws after closed or open reduction and repair of any ligament injury, cast bracing, and delayed weight bearing.

Type III: Rim avulsion fracture. Constituting 16% of fracture-dislocations, this type involves almost exclusively the lateral plateau, with avulsion fragments of the capsular attachment, tubercle of Gerdy, or the plateau. Disruption of either or both cruciate ligaments is common. Although meniscal injury is rare, neurovascular injuries occur in 30% of fractures, and nearly all type III fractures are unstable. A lateral approach allows screw fixation of the articular rim and repair of avulsed ilio-tibial band and collateral ligaments. Cruciate ligament repair or augmentation may be necessary.

Type IV: Rim compression fracture. This injury accounts for 12% of all fracture-dislocations. It is almost always unstable.

The opposite collateral ligament complex and usually (75% of patients) the cruciate ligaments are avulsed or torn, allowing the tibia to sublux to the extent that the femoral condyle compresses a portion of the anterior, posterior, or "middle" articular rim.

Stable injuries can be treated by casting until the ligaments heal. If surgery is necessary, a parapatellar approach allows debridement of small fragments, elevation and stabilization of larger

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fragments, and repair of cruciate and opposite collateral ligaments. Postoperative mobilization is largely dictated by the nature of the ligamentous injury and repair.

Type V: Four-part fracture. Constituting 10% of all fracture-dislocations, this injury is nearly always unstable. Neurovascular injury occurs in 50% of fractures; the popliteal artery and the peroneal nerve are injured in more than one third. Both collateral ligament complexes are disrupted with the bicondylar fracture, and the stabilization provided by the cruciates is lost because the inter condylar eminence is a separate fragment.

Although a bicondylar approach has been recommended, others have been more cautious, recommending plating of the more comminuted plateau and lag screw fixation of the more intact condyle.

Realizing the high incidence of infection and dehiscence with bicondylar plating and the extensive exposure necessary, Mast described a method of lateral plateau plating with temporary medial external fixation.

MODALITIES OF TREATMENT: The lack of information about fractures of the proximal articular surfaces of the tibia leads to confusion and an inability to agree on a universally acceptable name for these injuries. A workable classification based on clearly defined clinical, radiological entities to separate plateau fractures dislocation on one hand and knee dislocations on other was made.[1]

Apley[2] showed good results of union, satisfactory knee motion in lateral condyle fractures treated with skeletal traction and early mobilization. The fracture of tibial plateau and proximal tibia which extend into the knee joint can produce major disability. At university of Iowa authors began treating tibial plateau and bicondylar proximal tibial fractures with early application of a cost brace. They encouraged early motion, weight bearing to tolerance and unrestricted activities using crutches or other supports only when necessary lead to improved knee function.[3]

Now, various methods of percutaneous fixation of tibial plateau fractures are available. Percutaneous fixation offers its best in isolated undisplaced fractures, split unicondylar(lateral) fractures, elderly osteoporotic and in badly comminuted ones. The advantages are decreased operative time, less blood loss, smaller incision, short hospital stay and early rehabilitation.[4]

An evaluation of doubtful fractures by x-rays taking AP oblique inclined 10 degree caudally. Various approaches are dealt depending on the fracture geometry. It also gives information regarding associated tibial shaft fractures by intramedullary nailing coupled with buttress plate.[5]

In the early half of the 20th century an author reported two studies having satisfactory percentage of good to excellent short and long term results with surgical method of treatment.[6,7]

In another published study of 159 cases of tibial plateau fracture of all types, treated by conservative (46%) and surgery (54%), evaluated by Hohl and luck method reported better good-excellent results in surgery (84%) than conservative(62%) methods.[8]

Roberts [9] in 1968 reported 100 cases of tibial condyle fractures treated by conservative and surgical. The results were good in 72% conservative, 80% tractions – mobilization and 81% surgical. He advocated early mobilization, preservation of menisci and repair of torn ligaments for best results.

Another study of 68 cases, non- surgical and surgical methods observed excellent-good results in 96% of cases by conservative methods with depression less than 10mm, 47% in depression more than 10mm and 80% in surgical methods. They advocated good anatomical reduction for best results.[10]

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Schatzker,[11] in 1979, reported 70 cases of tibial plateau fractures of all types treated by conservative (56%) and surgical(44%) with average follow up of 28 months. Acceptable results were obtained in 58% of cases of conservative group and 78% by open methods. Fractures treated by ORIF with buttress plate and bone grafting achieved 88% acceptable results.

A study of 278 cases of tibial plateau fractures with an average follow up of 2.5yrs, all treated by surgical methods. 89% acceptable results when surgery was done by inexperienced surgeons, 97% when done by experienced. They concluded the prognosis improves with the experience and with accurate reconstruction of articular surface. They also said post traumatic osteoarthritis was directly proportional to the amount of displacement.[12]

The fracture of the proximal end of the tibia, particularly intra-articular ones, are considered to be difficult management problems because of the misalignment, incongruity and instability that frequently result from their surgical or non-surgical treatment. Cadaveric and clinical studies reproduced the same results. They concluded that loss of articular congruity leads to the degenerative arthritis and is less likely to produce so if joint function is maintained. However there is no general agreement or clear understanding as to the degree of incongruity, malalignment or residual instability necessary to produce such clinical symptoms.[13]

More TM[14] reported 132 cases of tibial plateau fractures-dislocation treated by conservative(35%) and surgical (65%) methods. He concluded that Moore's group III, IV and V had unstable knee and also associated neurovascular impairment. A retrospective study of 110 tibial condyle fractures between 1972-78, reviewed using Hohl's 100 point knee rating system treated by all methods showed overall the results were acceptable in 84% of patients.[15]

A review and assessment of 60 patients with tibial plateau fracture over an average follow up of 3 years treated conservatively and surgically showed that single most factor in predicting the outcome was adequacy of reduction.[16]

Lansinger O[17] in 1986 did a 20 years follow up of his earlier study extended in a series of 260 fractures of one of both condyles. 90% of the patients achieved excellent-good results and 10% achieved fair or poor result. The inferior results were seen in the unstable split-depressed and depressed fractures in which a depression of articular surface more than 10 mm persisted. They also advocated bone grafting for depressed and split depressed fractures.

Poul S Rassmussen[18] in 1973 did a study on 260 fractures of one or both tibial condyles, the main indication for surgical treatment was clinical instability of the extended knee joint. Follow up of 78% of the patients revealed that 87% of them had acceptable knee function. The functional end results were graded as per the 30 points scoring system.[18]

A published report studied 43 displaced tibial plateau fracture treated by surgical methods (AO-ASIF principles) and followed for an average of 2.7 years. They obtained excellent-good results in 93% cases. Poor results were due to technical faults or absence of bone graft.[19]

In another study they evaluated the long term results of 109 tibial plateau fracture treated by skeletal traction and early knee motion and 48 treated by surgery at an average follow up of 70 months the functional results were much the same, though meniscectomy had been performed in almost half of the surgical procedure. Time in bed and hospital stay was less in surgical group. They concluded that conservative management is a valid alternative to surgery, but should probably be reserved for cases where operation is desirable.[20]

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The tibial plateau fractures are associated with soft tissue injuries in 10-30% of cases; need to be evaluated pre-operatively as well as after fixation. The ligament injuries to be treated immediately or after fracture union. The instability can be overcome by adequately treating such injuries is shown by recent studies.[21,22]

A study of 24 patients with high energy tibial plateau fractures with Ilizarov fixator and trans fixation wires, followed for an average of 2 years.

Average time of union was 14.4 weeks with satisfactory result. They concluded that Ilizarov fixator is an ideal method for treatment for these fractures when extensive dissection and internal fixation are contraindicated due to trauma to the soft tissue, deficiency of bone stock and bony comminution.[23]

Segal D[24] in 1993 published a report on treatment of 86 lateral tibial plateau fracture treated by conservative (49%) and surgical (51%) methods. All tibial plateau fractures with depression more than 5mms were operated. Overall 95% of patients with hohl type I, II or v had satisfactory results. Type III fracture treated operatively had good results.

In another study of 'complex trauma', authors suggest a 4 grade classification system of closed and open soft tissue injury. Preferred treatment is ORIF in all displaced and unstable tibial plateau fracture. Primary treatment includes closed reduction, wound debridement, if necessary ORIF and complex bone and soft tissue reconstruction are performed in a second operation after the soft tissue recovery. A follow up study of 190 of 244 cases between 1981-87 showed good results after operative treatment, even in extensive fractures with tolerable complication rate. The functional recovery was relatively impaired in multiple injured patients and in complex knee trauma.[24]

Even in depressed fractures the arthoscopic assisted internal fixation with bone grafting has shown good results in another study.[25]

There is another report of treating 212 tibial plateau fractures of all types. The residual radio-anatomic changes influencing the functional subjective and clinical outcome of 131 cases were studied. They concluded that a medial unicondylar fracture with any displacement and all medially tilted bicondylar fractures should be operated upon. In fractures of lateral condyle, ORIF is indicated when lateral tilt or valgus mal-alignment more than 50, articular step off more than 3mm or condylar widening more than 3mm.[26]

An evaluation of 18 tibial plateau fractures in which extensile meniscal detachment approach was used. They had 72% excellent and 38% good results. They concluded that for patients with significant comminution and depression of lateral tibial plateau this was a safe and effective method for excellent exposure and accurate reduction.[27]

A study of 21 complex tibial plateau fractures treated with closed reduction, interfragmentary screw fixation and application of a unilateral half pin external fixator. All the fractures healed. They concluded that external fixator with limited internal fixation is a satisfactory technique for the treatment of complex fractures.[28] Another method of accurate anatomical reduction could be achieved by arthroscopy. The joint congruity restored to near normal has been well shown using arthroscopy.[29]

A published data of evaluation of 76 tibial plateau fractures treated by limited internal fixation. Instability in extensions was used as the primary indication for surgery and obtained 87% good results with minimum follow up of 1 year. They concluded that limited internal fixation with early mobilization is a good method except in AO type C-3 fractures.[30]

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In another evaluation of 24 patients with Schatzker type III, treated with small wire external fixator with or without limited internal fixation. They had acceptable results at the end of 12 months and concluded that this technique is an alternative to open plate osteosynthesis.[31]

In high energy tibial plateau fractures, although soft injury may make ORIF difficult, in many instances it has certain advantages over external fixation. The goals of both treatments include anatomic reconstruction of articular surface, restoration of limb axis, spanning metaphyseal comminution if present. All these are met by ORIF. Potential advantage of ORIF over other techniques include the ability to recognize and repair associated menisci and collateral ligament injuries, greater visualization of articular surface, avoidance of prolonged immobilization and wires.[32]

Most recently the minimal invasive methods of fixation like MIPPO had made a difference in treating tibial plateau fractures. A published report in 2005 has shown excellent results with key hole incision and using locking compression plate. The results of this study are encouraging because of less infection rate, minimal soft tissue damage, high rate of early fracture union and above all it is a biological fixation.[33]

CONCLUSION: Before deciding the line of treatment one must bear in mind the following facts:
1. Extent of damage in tibial plateau fracture is often greater than what is seen on x-ray.
2. Malunion is extremely common whereas non-union is unknown.
3. Painful knee and stiffness are the most serious and common complications of the tibial plateau fracture.

Surgical fixation has now –a- days a wide acceptance that is open or closed reduction, internal fixation and early mobilization. MIPPO has gained popularity because of minimal soft tissue damage, preservation of the blood supply to the bone, small size surgical scar. In our case series MIPPO TECHNIQUE had the highest patient as well as surgeon compliance than open technique. Surgical fixation remains the most satisfactory method to both the patient as well as surgeon over conservative approach.

MIPPO technique preserves most of the osseous vascularity and fracture hematoma thus providing for a more biological repair. There is rapid fracture consolidation due to preserved vascularity. There is decreased need for bone grafting and incidence of infection is less due to limited exposure. So the advantages of MIPPO are:

MIPPO relies primarily on the indirect reduction of the fractures using various techniques and in this way the fracture environment is better preserved.

- The osteogenic fracture hematoma is preserved.
- The blood supply to the bony fragments is not disturbed.
- The chances of infection is decreased.
- There is decreased need for bone grafting.
- The surgical trauma to the bone and surrounding soft tissue is less.
- The surgical dissection is less.
- There is rapid fracture consolidation.
- It is more biological repair.

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DISADVANTAGES:

- In displaced and comminuted fractures it is difficult to restore optimum anatomy of the bones as near as possible.
- The surgeon is dependent on intraoperative fluoroscopy to confirm adequate reduction.
- Radiation exposure during application of the plate to the bone is more.

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