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To study the functional outcome of the fracture of proximal tibia and the duration of union in proximal tibial fracture treated with LCP

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Abstract
Introduction: The knee joint is one of the three major weight bearing joints in the lower extremity. Fractures of proximal tibia that extend into the knee joint are termed as the tibial plateau or condylar fractures. Proximal tibial fractures are one of the commonest intra articular fractures, resulting from direct axial or indirect coronal compressive forces. Generally these injuries fall into two broad categories, high energy fractures and low energy fractures. It comprises 1% of all fractures.

Keywords: Proximal tibial, fracture treated, intra articular

Introduction

A man is as old as his knees! That's an old English quote, which emphasizes its importance in daily life!

The knee joint is one of the three major weight bearing joints in the lower extremity. Fractures of proximal tibia that extend into the knee joint are termed as the tibial plateau or condylar fractures. Proximal tibial fractures are one of the commonest intra articular fractures, resulting from direct axial or indirect coronal compressive forces. Generally these injuries fall into two broad categories, high energy fractures and low energy fractures. It comprises 1% of all fractures.

The majority of tibial plateau fractures are caused due to high speed motor vehicle accidents, violent trauma & fall from height [1] where fractures results from direct axial compression, usually with a valgus(more common) or varus moment & indirect shear forces [2]. Extra articular fractures of the proximal tibia usually secondary to direct bending forces applied to the metadiaphyseal region of the upper leg, as seen in bumper strike injuries, sports injures, older patients with osteopenic bone (are more likely to sustain depression type fracture because their subchondral bone is less likely to resist axial directed loads) [3].

These fractures encompass many varied fracture configuration that involve medial, lateral or both plateaus with many degrees of articular depressions & displacements. Each fracture type has its own characteristic morphology & response to treatment. These are serious injuries that frequently result in functional impairment, as they affect knee alignment, stability & movements.

The aim of surgical treatment of proximal tibial fracture is to restore congruent articular surfaces of the tibial condyles maintain the mechanical axis & restoring ligament stability & eventually an achieve functional painless & good range of movement of the knee joint [4].

Different clinical studies have established that the bone beneath a rigid conventional plate are thin & atrophic which are prone for secondary displacement due to insufficient buttressing & secondary fractures after removal of plate & the fracture site takes a longer period for osteosynthesis due to interruption of vascular supply to bone due to soft tissue & periosteal stripping.

The indications for non-operative versus operative treatment vary widely among surgeons, as do the specific methods of treatment for many fracture configurations & concomitant lesions. Earlier tibial condylar fractures were treated conservatively which resulted in joint line incongruity, osteoarthritis & knee stiffness, mal union & non-union. With advancement in management of fractures in general, open reduction & internal fixation of tibial condylar fractures were begun in view of maintaining the congruity of articular surface & thus reducing

the incidence of osteoarthritis. Thus surgical management helps in complete achievement of objectives of treatment of tibial plateau fractures which are precise reconstruction of articular surface, stable fragment fixation allowing early mobilization & repair of the concomitant ligament & other soft tissue lesions [5]. Recently more attention has been paid to the condition of the soft tissue envelope before surgical intervention.

Thus, there arose a need for the birth of a new concept of biological fixation using the plates, also called as the minimally invasive plate needed to be accurately contoured to achieve good fixation, osteoporosis also posed th same problem of poor fixation with conventional plates [6]. This leads to the development of the internal fixators. PC- fix I later PC fix II. As more & more concepts about biological fixation became clearer, the innovation of plates progressed leading to the development of less invasing stabilising system (LISS). Research to combine these two methods has lead to the development of the AO locking compression plate (LCP) [7].

This new system has been regarded as technically mature. It offers numerous fixation possibilities proven to be worth in complex fracture situations & in osteoporosis, and these are soft tissue friendly & have improved outcomes [8].

In this prospective study consisting of 25 patients, results of surgical management of tibial plateau fractures treated with LCP are reported.

Objectives

1. To study the functional outcome of the fracture of proximal tibia.
2. To study the duration of union in proximal tibial fracture treated with LCP.
3. To allow mobilization of the patient & to achieve a pain free joint.

Methodology

The study was carried out in Bangalore for 18months. The total number of cases studied were 25 with the youngest being 20years of age & the oldest 65 years old.

The intention of this study was the treatment of proximal tibial fracture with locking compression plate to obtain a stable, pain free, mobile joint & to prevent the development of osteoarthritis.

The ethical clearance study was also obtained from the institution.

Inclusion criteria

- Adults (aged over 18 yrs) both male & female.
- Type I compound fracture of proximal tibia
- Radiological diagnosis of fracture with classification based on Schatzker's classification type I, IV, V, VI.

Exclusion criteria

- Patient aged below 18 years.
- Type II & III compound fractures of proximal tibia.
- Patients who are medically unfit for surgery.
- Associated head injury, neurological disturbances & burns.
- Pathological fractures from metastasis, benign tumours, metabolic bone disorders.

On admission demographic data was recorded & through history & clinical examination was done. We assessed the soft tissue injuries even in the closed fractures followed by radiological assessment of the fracture with Schatzkers classification.

As soon as the operation was planned, certain routine procedures like;

1. Use of preoperative antibiotics & continued till the removal of suture.
2. Stabilize the patient haemodynamically & obtain physical fitness for surgery & consent for surgery
3. Preoperative planning for selection of plate. Approach MIPO technique or open reduction & internal fixation.
4. In our series, all the fractures were reduced with traction on fracture table with C-arm guidance.
5. To check for any associated fracture.

We treated 6 patients with minimally invasive plate osteosynthesis &19 patients with open reduction & internal fixation.

The approach was either anteromedial parapatelallar incision. The primary difference with the locking compression plate is the method of locking head screw insertion. Here since the locking head of the screw has to get locked in the locking part of the combi hole. The direction of the drilling has to be perfect. Hence drilling for all locking head screws has to be after fixing the screw in drill sleeve.

We also made sure that whenever using the non-locking regular screw in the fixation. They were inserted prior to the insertion of the locking screws.

Postoperative: In the immediate postoperative period, care was given to the general condition, fluid balance, IV antibiotic & analgesics as per the protocol. This helped us to mobilize the patient faster.

Mobilization

Whenever stable internal fixation was achieved, the patient was mobilized after 48 hrs after removal of the drains, for 2-3 days the range of motion allowed was 0-20° from the 5th day the range of motion was gradually allowed to be increased to 90° more after suture removal full range of movement was allowed.

Whenever there was doubt about the stable fixation. External slinting in the form of plaster of paris slab was given for support & advised to do static quadriceps exercises. Continue passive motion exercise (CPM) were done daily with temporarily removal of slab under careful supervision & splint reapplied. Partial weight bearing with walker/ crutches was delayed until 6 weeks & full weight bearing allowed after 12-16weeks.

Follow up: the first follow up was usually between 6-8 weeks & later on patients were followed up at regular interval of 6-8 weeks till complete fracture union.

During follow up

1. The course of fracture healing was documented radiologically with minimum 6weeks interval. The moment of complete healing was defined as radiologically complete bone regeneration at fracture site.
2. Evaluation of any possible loss of reduction
3. Assessment & analysis of any complication.

Follow up of out patients ranged from 16 weeks to 64 weeks.

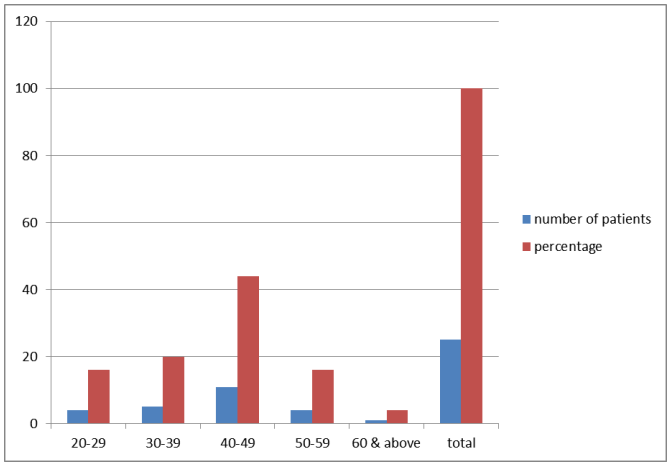
Results

Study Design: A prospective study with 25 patients was undertaken to study the management of tibial plateau fracture by LCP & were followed for a period of 18months

Table 1: Age incidence of patients studied

Age in years	Number of patients	%
20-29	4	16.0
30-39	5	20.0
40-49	11	44.0
50-59	4	16.0
60 & above	1	4.0
Total	25	100

Mean± SD:40.84± 11.06



Age in years

The observation shows that most of the patients belong to 40-49 years of age group & the mean being 40 years of age

Table 2: Mode of injury

Mode of injury	Number of patients	%
Fall	7	28
RTA	18	72
Others	0	0
Total	25	100

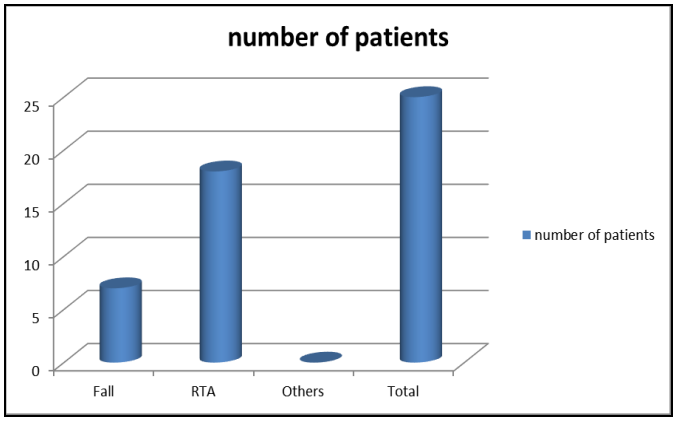


Table 3: Method of reduction and fixation

Method of reduction and fixation	Number of patients (n=25)	%
MIPO	6	24
ORIF	19	76

Although ORIF was used in a majority of patients with good results, MIPO was followed only in 6 patients in the study but gave excellent results (reduced soft tissue injury and duration of procedure) and the healing time was 18.6 weeks on an average as compared to 18.8 weeks with ORIF.

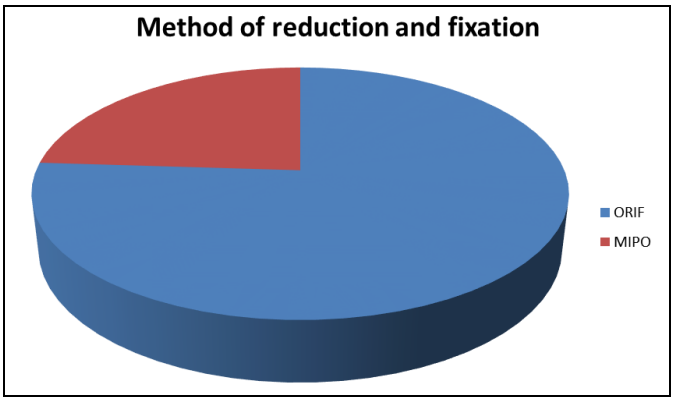
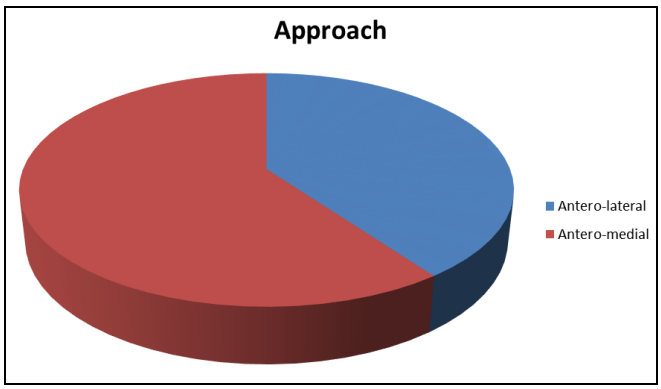
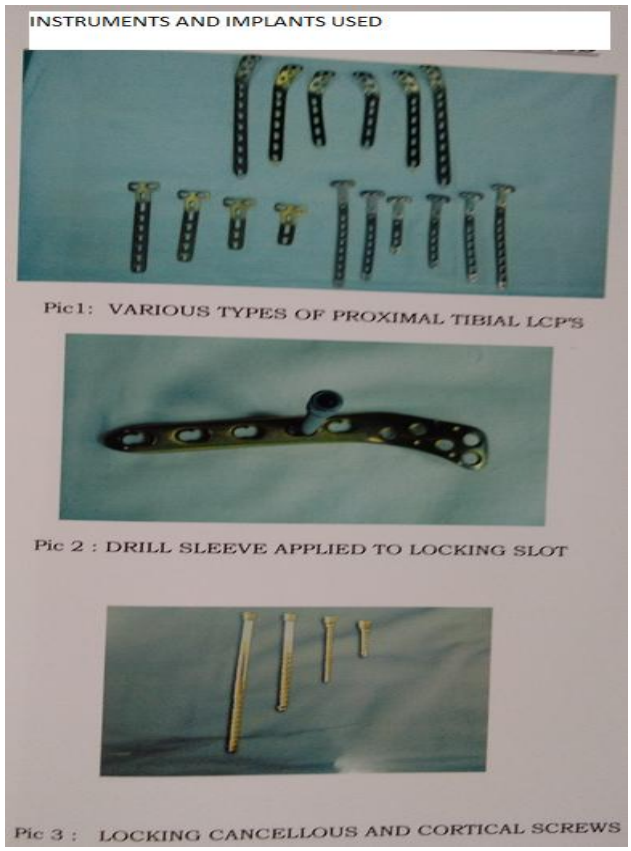


Table 4: Approach

Approach	Number of patients (n=25)	%
Antero-lateral	10	40
Antero-medial	15	60

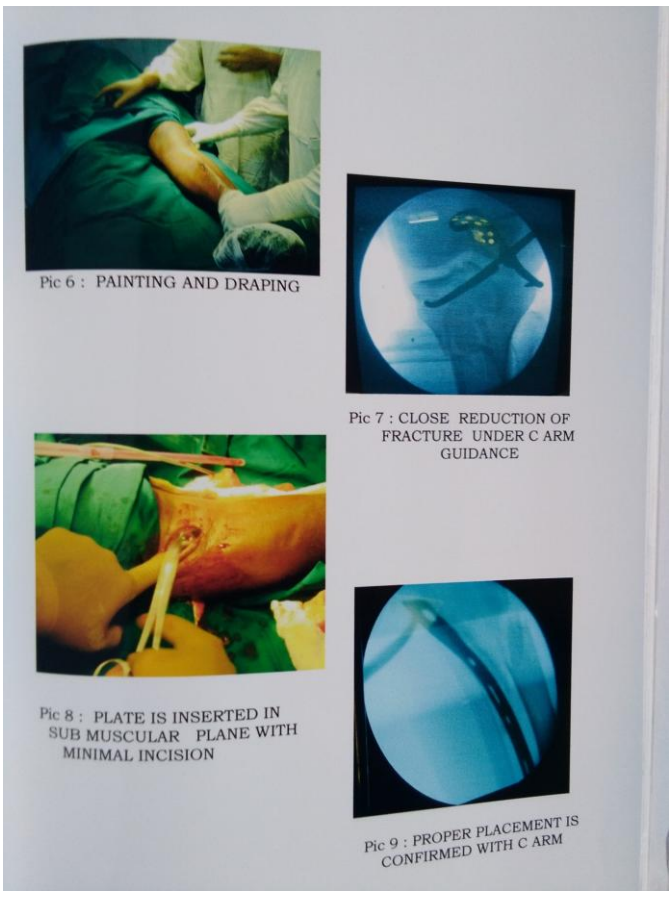
Anteromedial approach was followed in 15 patients along with Mipo yielding good results who has sustained medial condylar displacement. Anterolateral approach was followed in 10 patients sustaining lateral condylar displacement.





Pic 4 : POWER DRILL WITH K WIRE

Pic 5 : SOFT TISSUE INSTRUMENTS WITH PATELLA CLAMP

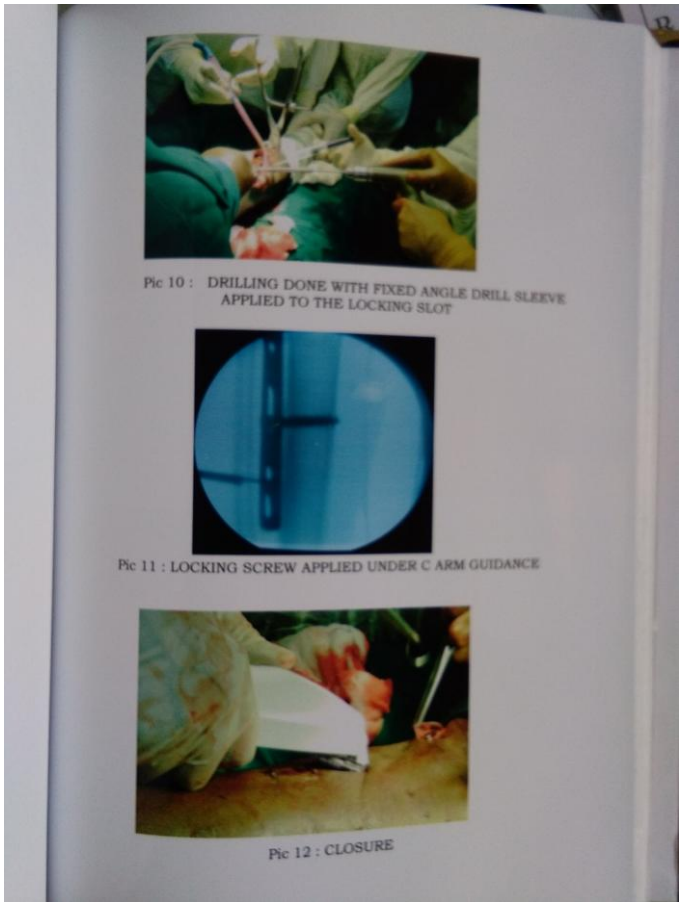


Pic 6 : PAINTING AND DRAPING

Pic 7 : CLOSE REDUCTION OF FRACTURE UNDER C ARM GUIDANCE

Pic 8 : PLATE IS INSERTED IN SUB MUSCULAR PLANE WITH MINIMAL INCISION

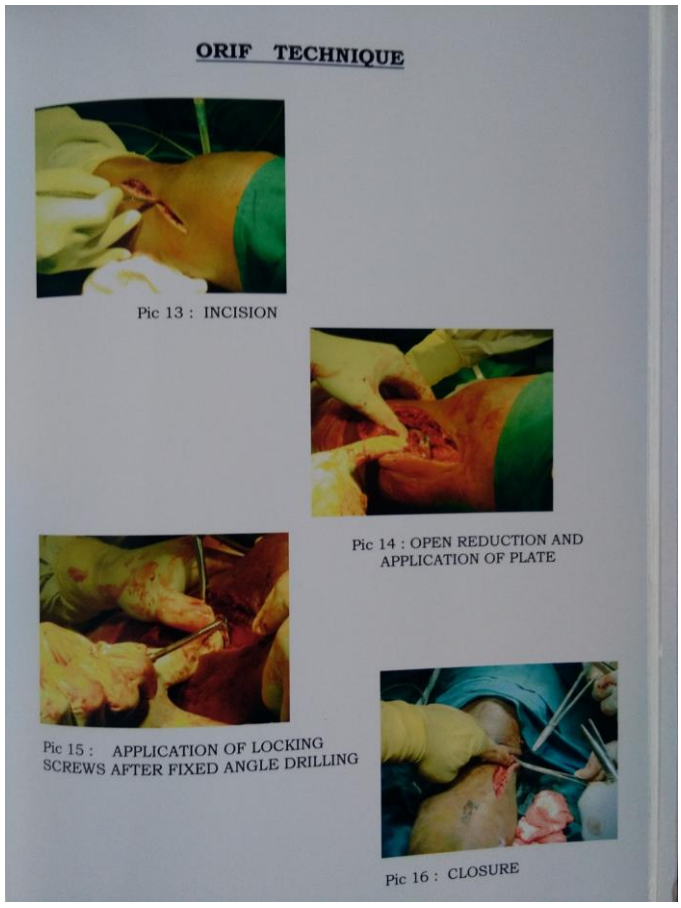
Pic 9 : PROPER PLACEMENT IS CONFIRMED WITH C ARM



Pic 10 : DRILLING DONE WITH FIXED ANGLE DRILL SLEEVE APPLIED TO THE LOCKING SLOT

Pic 11 : LOCKING SCREW APPLIED UNDER C ARM GUIDANCE

Pic 12 : CLOSURE



ORIF TECHNIQUE

Pic 13 : INCISION

Pic 14 : OPEN REDUCTION AND APPLICATION OF PLATE

Pic 15 : APPLICATION OF LOCKING SCREWS AFTER FIXED ANGLE DRILLING

Pic 16 : CLOSURE

Discussion

Proximal tibial fractures one of the commonest intra articular fractures, incidence of these fractures are increasing regularly due to RTA & at the same time surgical treatment options for the same time surgical treatment options for the same are also

being modified continuously. The analysis reports were made on 25 proximal tibial fractures, age, sex, distribution, laterality of fracture, mode of injury, analysis of the type of fracture, method of reduction and fixation, principle of LCP fixation, surgical approach and complications. Age group was 18-65 years, with maximum incidence in 40-49 years, the p value was 0.645, which does not have much significance.

Majority of patients, 80% were males this is attributed to our Indian detup where the female population largerly work indoor & do not travel much. P value found to be 1.000, has no significance.

Occupationally it was seen in people with high level of activity, movement & travel. It was most commonly seen with people who travel like businessman, agriculturist.

The commonest mode of injury was RTA's 72%, other being fall from height 28%. P value was 0.637, not much significance. only 16.7% of fall cases had complications, whereas 83.3% of RTA causes reported complications.

Most of the patients fall in type IV(32%), type V(24%) & type VI(28%), type II & III were not included in the study, as they needed bone grafting, and this would vary the outcome in the duration of the union of the fracture. the type of fracture has a p value of 0.037, which shows a moderate significance, meaning that different types of fractures have different healing time & type IV has the highest incidence of complications compared to the rest. In this study the indications for the surgery were the same standard indications as for the tibial plateau fractures i.e 3mm depression.

MIPO was used in 6 patients 24%. In which both duration of procedure & soft tissue injuries are less compared to ORIF, aso wound healing is better & faster compared to ORIF, but it requires more surgical proficiency. P value being 0.278, has little significance.

Combined principle of fixation was used in 13 patients (52%) and achieved good articular reconstruction & protection from collapsing during post-operative period. bridging type principle of fixation was used in 8 patients (32%) including metaphyseal comminution fractures and a osteoporotic patient where bone graft would usually be needed, but it was not done as LCP implant system provides good fixation & prevents collapse of fracture during post-operative period.

Compression type of principle of fixation was used in 4 pts, where both rigid fixation & buttress effect were needed, but post operatively due to toggling of condylar screws (non-locking screws) there was collapse of condyle in 2 pts which lead to varus deformity in 1 of them. The p value being 0.017 shows moderate significance fr the type of fixation, which means that the principle of fixation used makes a difference in the healing process. Thus statistically proving that the principle of fixation has an impact on the incidence of complication.

Coming to the surgical aspect in this study, 15 pts were approached with antero medial incision which needs less soft tissue stripping from the bone & can contour plate to bone appropriately, MIPPO technique was preferred in anterolateral approach in 10 pts with lateral condylar displacement fracture & soft tissue injury on medial side of proximal tibia. The p value here is 0.175, has no significance.

There were no cases of any purely implant related complications & average time of union of fracture was 18 weeks.

6 pts had complications. 1 pt with knee stiffness due to associated ipsilateral intercondylar femoral fracture, was treated with physiotherapy & he regained 70° of flexion & in another patient present with knee stiffness at the end of 6 months of post op period, he was treated wth physiotherapy & he regained a range f movement from complete extension to 90° flexion. 1pt developed superficial infection. 1 pt developed collapse of medial condyle at the end of 6weeks post op, treated with above knee POP for 12 weeks. 1 pt has associated ACL injury, he was given knee support till fracture union. The period of immobilization was again individualized depending on security of stable fixation benefits of early knee mobilization include reduction in knee stiffness & improved cartilage healing (regeneration) & promotes good callus formation & remodelling.

Inspite of all these complications excellent results were achieved in 64% cases & good results in 24%, with standard surgical care.

Conclusion

- Proximal tibial fractures are increasing with urbanisation leading to increased RTA & falls from high rise buildings.
- Needs optimum treatment as most of them are in productive age group if not treated properly full Rom not possible
- Pre op soft tissue status & their repair at the right time significantly changes the outcome.
- The anchorage of the locking head screw was found to be excellent even in osteoporotic bone. Drilling the holes for the locking head screw should always be through a screw in drill sleeve.
- While bridging a fracture, care must be taken to select a strong plate & leave at least 2-3 plate hole, without inserting screws over the fracture. This prevents the stress concentration & achieves an elastic fixation which is very essential for secondary fracture union.
- Even in osteoporotic bone bone graft is not essential for defect in metaphyseal region as LCP internal fixator system acts as single implant & prevents collapse of fracture intraoperatively & postoperatively subsequently bone which is deficient will heal by callus formation
- When LCP is used as combined principle of fixation we can reconstruct tibial plateau with compression & prevent it from collapse by bridging principle.
- In our study LCP as compression plate was not as good as combined ans bridge plate type of fixation
- Fractures treated with MIPO healed rapidly by secondary fracture union & hence achieving strong bone union across the fracture at a much earlier time compared to open reduction & internal fixation due to less soft tissue injury leads to minimal blood supply interruption to proximal tibia.
- Thus we conclude that locking compression plate system with its various type of fixation, acts as a good biological fixation including difficult fracture situations.
- But this involves the risk that may occur unless properly planed pre operatively & follow guided principles intra op.

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