MANAGEMENT OF FRACTURES OF DISTAL FEMUR - INTRA-ARTICULAR TYPE C2 BY LOCKING PLATE OR CONDYLAR BUTTRESS PLATE

Abstract:

Background: Intra articular fractures of distal femur is a great surgical challenge when associated with metaphyseal comminution (Type C2) in terms of getting reduction and difficulty of maintaining reduction. Operative treatment is usually recommended for favorable outcome. These are frequently comminuted and intra-articular due to association with high energy trauma (in the youngsters) and osteoporotic bones (in the elderly). A wide canal, thin cortex and poor bone stock of the distal femur make open reduction in these areas a great challenge.

Materials and Methods: This study was carried out in department of Orthopaedics, Government medical college Latur from December 2009 to November 2015. 30 Patients with intra-articular fracture AO TYPE C 2 of distal femur admitted to the hospital were selected as cases. Condylar buttress plate and locking plate were used for 30 patients with distal femur fractures. Patients were followed for a minimum period of two year & relevant data like time to union, knee range of movement and complications were recorded.

Results: According to SCHATZKER AND LAMBERT CRITERIA (for assessing final outcome) Out of 30 patients, A) Locking plate:- 9,10 patients operated with locking plates, 5 (50%) had Excellent to Good results, 3 (30%) had Fair result and 2 (20%) had Poor results. B) Condylar Buttress plate:-8 Out of 20 patients operated with condylar buttress plate 12 (60.00%) had Excellent to Good result, 3 (15.00%) has Fair and 05 (25%) had Poor results.

Conclusion: Type C2 fractures with severe metaphyseal comminution, when fixed with Condylar buttress plate has great advantage in fixation of distal femur fractures as it allows and gives the freedom to place the screws at different directions in multiple planes so as to engage and fix fracture fragments located at different positions. In addition it can be used in all types of distal femur fractures and it is cheap as compared to other implants.

Locking plates are very useful when there is severe osteoporosis with less bone stock and gross comminution of fracture fragments. Shortcoming of locking plate is- It does not allow to pass screws in different directions (Cf. Condylar buttress plate), so as to engage different fracture fragment at different planes. Also, locking plate is costlier as compared to condylar buttress plate.

Meticulous reduction of distal articular surface is key to the success of management of these fractures; hence primary realignment is essential for definitive fixation.

Medial plating is not always required for medial column comminuted fractures. Good bony contact of all comminuted fragments is very essential for good fracture union which eliminated need of bone grafting in our study.

Key-words: Distal femur fracture, Distal femur locking compression plate (DFLCP), condylar buttress plate, Intra articular fracture, Hoffa fracture.
Introduction:

Intra articular fractures of distal femur is a great surgical challenge when associated with metaphyseal comminution (Type C 2) in terms of getting reduction and difficulty of maintaining reduction. Operative treatment is usually recommended for favorable outcome.1-4

These are frequently comminuted and intra-articular due to association with high energy trauma (in the youngsters) and osteoporotic bones (in the elderly). A wide canal, thin cortex and poor bone stock of the distal femur make open reduction in these areas a great challenge.5

Stewart et al. (1966) claimed that “fractures in the distal third of the femur continue to perplex the surgeon. Whether they are transverse, oblique, or comminuted, supracondylar or inter-condylar in a T, Y or V fashion their management still evokes much controversy because of the consistently poor results obtained.”

This is an era of rapid industrialization and fast pace of life which has led to concomitant rise in road traffic accidents (RTA) as well as increased life expectancy with old age population adding dangers of osteoporotic fractures.

Distal femoral fractures are much less common than hip fractures and account for about 4-7% of all femoral fractures. If fractures of the hip are excluded, 31% of femoral fractures involve the distal portion.6

There is bimodal distribution of fractures. Most high energy distal femur fracture caused by motor vehicle accidents, sports and pedestrian accidents occurs in male between 15 & 50 years; while in women above 50 years with osteoporosis, fractures occurs due to low velocity trauma such as fall from standing height at home.7

Distal femur fractures remain difficult fractures to treat successfully as they are often comminuted, unstable, with multiplanar intra-articular extension and associated with severe soft tissue injury to the quadriceps mechanism and ligament disruption of knee joint.2,3

With the development of improved internal fixation devices by the AO group, treatment recommendations have changed. Operative treatment is recommended for most fractures of the distal femur. The goals of operative treatment are anatomical reduction, stable internal fixation, early rapid mobilisation of adjacent joints, and preservation of blood supply and early functional rehabilitation of the knee. Early surgical stabilization can facilitate care of the soft tissue, permit early mobility and reduces the complexity of nursing care.8

Several treatment options are available for fractures of the distal femur which require internal fixation using various plates such as 95 degree angled blade plate, condylar buttress plate, dynamic condylar screw with 95 degree side plate, locking compression plate, LISS (less invasive stabilization system) and intramedullary nails (ante grade/retrograde).11 It is not clear whether one implant is more reliable than another in achieving consistently good results and there is no consensus on the ideal implant as such due to variable fracture patterns, comminution and intra-articular extension in distal femoral fractures.

95° angled blade plate was one of the first plates; but due to problems like inadequate fixation in osteoporotic bone & difficulty in accurate insertion in three planes; it is not commonly used.

Dynamic condylar screw is the implant of choice when distal bone block of 4 cm was available for supracondylar fixation. Its advantages includes its ability to apply the interfragmentary compression across the femoral condyles for intercondylar fractures, better purchase in osteoporotic bones and the need for only two plane alignment. Main disadvantage is that, DCS fixation requires removal of large amount of bone from femoral condyles which makes revision surgery difficult (if necessary).

Condylar buttress plate found to be very useful to cases in which the femoral condyles are comminuted or there are multiple intra-articular fractures in the coronal & sagittal plane.8

Most recently condylar locked plating systems has been developed. Locking condylar plates with minimum invasive technique yields higher union rates & have better fixation in osteoporotic bones & have better knee range of motion. Locking plates are relatively costlier than other devices. Locking plates are very useful in osteoporotic bones and in comminuted fractures. In today’s orthopaedics, locking plate is one of the main treatment modality in fractures of distal femur.

Intramedullary supracondylar nail are load sharing11,10 rather than load bearing implant. Intra-medullary supracondylar nailing can be used for most AO type A fractures & may be used but not too ideal for intercondylar type C-1 & type C-2 fractures. Advantage with nailing is less tissue trauma & high union rates. Limitation for its use is that it cannot be used in intra-articular comminuted fracture.

Materials and methods:

The present clinical study was carried out in our Institute over a period
of December 2009 to December 2015. Patients with intra articular fracture of distal femur (AO TYPE C2) admitted to the hospital were selected as cases & all the necessary clinical details were recorded in proforma prepared for this study. Different treatment modalities used for 30 patients with distal femur fractures are locking compression plate, condylar buttress plate.

**Inclusion Criteria:**

1. The fractures of the distal femoral metaphyseal, metaphyseodiaphyseal with metaphyseal comminution- without any intra articular comminution.
2. Closed fractures.
3. All compound fractures

**Exclusion Criteria:**

1. Fracture in patients of age <18 years.
2. Any pathological fracture (except due to osteoporosis).
3. Associated neuro vascular Injury to limb.

Every patient was evaluated after history, clinical examination and radiological investigation and fracture pattern was classified according to AO classification. The best suitable FDA approved implant for a particular fracture pattern of distal femur was used.

**Primary Treatment:**

All the patients when received in the emergency department were subjected to a detailed history taking and thorough clinical examination for vitals, head injury, thoraco-abdominal injury and other associated injuries. The distal circulation was checked and every patient was examined for any neurovascular deficit. Immediate immobilization on Thomas Splint was done.

All patients with open injuries received prophylaxis for tetanus. They were hemo-dynamically stabilized with intravenous fluids or plasma expanders as first priority. Contaminated open injuries were covered and patient was taken for emergency debridement under anaesthesia at the earliest within 4 to 6 hours of admission. Intravenous antibiotics (Ceftriaxone and Gentamicin) were given immediately in patients with open injuries.

In OT, under spinal/epidural anaesthesia, thorough cleaning of wound with 3-5 liters of Normal saline to remove all foreign material, mud and grass was done. Thorough Debridement of wound done with removal of all dead tissues and until fresh bleeding comes. Wounds were not closed and re-opened after 24 hrs. for re-debridement. All patients were provisionally immobilized on Thomas or Bohler splint with proximal tibial skeletal pin traction while awaiting definitive surgery. Dressing was changed regularly when it was soaked, even sometimes twice daily initially. For compound fractures IV antibiotics (Ceftriaxone + Gentamycin) were given for 14 days and then followed with oral antibiotics for 4 weeks.

Full length roentgenograms in antero posterior and lateral views were taken of affected limb for diagnosis and to know extent of intra-articular comminution.

All fractures were classified according to the comprehensive classification of supracondylar fractures of femur given by AO / OTA. Open fractures were classified according to the Gustillo-Anderson classification. All patients operated according to standard AO- technique.

**Type-C (Complete Articular):**

They are further classified according to the pattern of articular and metaphyseal component.

- **C1.** They are simple articular and simple metaphyseal fractures (‘T’ or ‘Y’ fracture pattern).
- **C2.** They are simple articular and multi fragmentary metaphyseal fractures.
- **C3.** They are multi fragmentary articular fractures.

**Pre-Operative Planning:**

1. The routine work-up included a detailed history, physical examination including neurovascular status, a complete blood count, urine analysis, cardio respiratory and all investigations for a major surgery.
2. Antero-posterior and lateral radiographs of the knee with the distal femur were taken of affected limb for diagnosis and to know extent of intra-articular comminution. Computed tomography portrays the distal femur in cross – section, which helps to identify fracture lines in the frontal plane. Two and three dimensional reconstructions may also improve understanding of the fracture pattern in preparation for surgery.
3. In patients with associated medical co-morbidities, the procedure was delayed until the patient’s general or local condition had improved. Patients in whom surgery was to be delayed, proximal tibial pin insertion and immobilization in Thomas splint or on Bohler splint was used.
4. Pre-operatively the fracture geometry and intra-articular extension of the fracture were studied accurately. Then according to that implant is selected. The size and length of the plate to be used is decided.

**Criteria For Implant Selection:**

- Locking plates could be used in all types of AO C fracture...
pattern particularly with Osteoporosis, and in Fractures with metaphyseal comminution where the medial cortex cannot be restored, or a short articular segment, and patient is affording for cost of implant.

- Condylar buttress plate can be used when there is severe metaphyseal comminution in coronal and sagittal plane so that screws can be inserted in multiple directions to fix individual fragment.

**Operative details of plating:**

General operative principles, position, approaches and operative techniques were same for locking compression plate, condylar buttress plate.

**Anaesthesia**

Distal Femoral Plating was performed under spinal / epidural anesthesia, on a Fracture table with the aid of image intensifier in supine position.

**Position**

After giving anaesthesia patient was taken on Fracture table with well cotton padded central porch. Reduction of fracture done by giving traction to the limb which has to be operated and counter-traction to the opposite limb.

**Preoperative antibiotic and tourniquet**

Preoperative antibiotic was given before inflating tourniquet. If surgery is prolonged for more than 3 hours in rare cases antibiotic is repeated and Intra-op wash of Normal saline is given.

A proximal thigh pneumatic tourniquet was used. Tourniquet was inflated after elevating limb for five minutes and exsanguinating limb with Esmarch bandage.

**Preparation of parts**

Under all aseptic precautions scrubbing, painting and draping done. Surgeon personally scrubs the extremity with chlorhexidine and betadine scrub for 05 minutes and cleans with sterile towel. Painting was done with 10 % povidone iodine, kept for 03 minutes and then cleaned with spirit.

**Approach**

All fractures were operated by using the standard lateral approach. The procedures were performed under control of image intensifier.

**Wound closure**

A negative suction drain was used after the surgical procedure completed. All wounds were irrigated copiously with normal saline. The joint capsule, the iliobial tract and subcutaneous tissue were closed using absorbable sutures. The skin was closed with non-absorbable sutures. Sterile dressing was applied. Before shifting the patient, the distal pulsations were checked after releasing the tourniquet.

**Biomechanics:**

The normal biomechanical axis which follows a line from the center of the femoral head, through the center of the proximal tibia and then through the center of the ankle joint was checked intra operatively by using a piece of cable, such as the diathermy cord, to get an approximate estimate of the axis. Normally, the knee joint axis is parallel to the ground, and the anatomic femoral axis subtends an 81° lateral distal femoral angle relative to the knee joint axis. For each patient it is important to confirm this angle with the opposite femur. At the time of surgical reconstruction, the correct femoral valgus angulation (Anatomical axis) can be recreated and the knee joint kept parallel to the ground.4,5,10

**Approach Used In The Study (Lateral Approach)**

The lateral approach to the distal femur allowed for visualization, reduction and fixation of articular fractures of the distal femur. The lateral approach relies on a non-traumatic elevation of the vastus lateralis from the lateral aspect of the distal femur, and a lateral arthrotomy for joint visualization. Articular reduction and implant application were both achieved with the same approach.

- **Incision**-

The skin incision was begun in the mid-lateral line of the femoral shaft and curved anteriorly over the lateral femoral condyle, towards the tibial tubercle. If joint visualization was required, the incision was carried to the level of the tibial tubercle.

- **Division of the iliobial band**-

The iliobial band (tract) was divided in line with the skin incision. Since the fibers slope anteriorly towards the tibial tubercle distally, the incision through the iliobial band followed the fiber orientation.

- **Elevation of vastus lateralis**-

The muscle fascia investing the Vastus lateralis just anterior to the lateral intramuscular septum was incised and the muscle fibers off the septum were elevated, working from distal to proximal as the muscle fibers of the vastus lateralis are minimal in the distal 8-10 cm of the femur. Thus vastus lateralis was elevated anteriorly from distal to proximal by blunt
dissection and held in place with bone lever. Advantage of lifting of vastus lateralis rather than splitting was less blood loss, better union rate and increase in patient’s compliance for physiotherapy postoperatively as in our approach quadriceps mechanism was untouched.

• Joint capsule arthrootomy for articular surface visualization-

For cases in which the articular surface needed to be exposed for C-type fractures, a joint capsule arthrootomy was performed.

• Joint debridement-

The intra-articular hematoma was removed and the joint was rinsed thoroughly with Ringer lactate solution.

Operative Techniques

General consideration:

The type C distal femoral fractures are characterized either by a simple, or complex, fracture line into the articular surface. Meticulous reconstruction of distal articular surface is key to the success of management of these fractures. As with any articular injury, anatomical restoration of the joint surface was obtained. This was done under direct vision, with clamp application, provisional fixation with k-wires and then by lag screw fixation. Once the condyles were reassembled and stabilized, this assembly was then connected to the shaft of the femur.

Protocol for fixing intercondylar comminuted fractures was as follows-

• First we reassembled comminuted fragments of condyle.
• Then we did condyle to condyle reduction and fixation with subchondral k wires to have one bone block of two condyles.
• We fixed condylar block to shaft spanning metaphysical comminution and thus avoided any Varus or valgus Mal-alignment.
• We reduced metaphyseal comminuted fragments in alignment of shaft and condylar block to have good bony contact. Good bony contact of all comminuted fragments was very essential for good fracture union which eliminated need for bone grafting in future.

1. Reduction of intercondylar fracture

• Temporary reduction- The fragment was reduced using a periosteal elevator and reduction was held using a large pointed reduction forceps.

Temporary fixation with K-wire insertion was then done. K-wires were fixed into the subchondral bone which gives good hold to the fragment being the most compact bone of this region.

2. Plate fixation

The “safe zone” for internal fixation, which crosses the femur from lateral to medial, was outlined by the cortical margins. It lies between intra medullary line and posterior cortical line. We had fixed the plate in this area 2cm s above the distal articular margin of lateral condyle.

Initially plate was fixed with k-wires through the slots provided in the plate distally and proximally and checked whether plate is in center in lateral aspect of shaft proximally.

3. Insertion of Guide-wires for cannulated screws

The screws were inserted at points along the mid shaft axis of the femur. The area distal to the Blumensaat’s intercondylar roof line was avoided in order not to violate the notch. In addition, the area of the lateral knee recess was also avoided.

The distal femur has a unique anatomical shape. Seen from an end-on view, the lateral surface has a 10° inclination from the vertical, while the medial surface has a 20-25° slope. A line drew from the anterior aspect of the lateral femoral condyle to the anterior aspect of the medial femoral condyle (patellofemoral inclination) slopes approximately 10-20°. These anatomical details are important when inserting screws. In order to avoid joint penetration, screws were inserted parallel to the patella-femoral and femoral tibial joint planes.1,8,9

• Insertion of guide-wires: The appropriate guide-wires for 6.5 mm and 4 mm cannulated screws were inserted. Depending on the size of the fragment, 2 to 4 screws were necessary.
• Guide-wire position check: The image intensifier was used to make sure that the tips of the guide wires just penetrated the far cortex. In order to assess the exact length of the guide wire an AP view with 30° internal rotation of the lower extremity was obtained. This was done considering the fact that the distal femur tapers from the posterior to the anterior. Therefore, if a straight AP view...
is obtained, the guide wire can appear to be inside the bone. If it appears to be outside the bone, it is most likely too long.

Screw length determination: The appropriate screw lengths were determined using the Depth gauge and 6.5 mm cannulated screws were inserted over the guide wires. If fragment size was too small then 4 mm cannulated screw was used to fix the fragment.

4. Reduction of fracture at metaphyso-diaphysial junction

It was held with bone holding forceps along with the plate. After insertion of condylar screws the plate was loosely secured to the proximal femur. Care was taken to restore the mechanical axis of the femur in all planes. Consideration was given to fracture reduction in:
- Varus/valgus
- Flexion/extension
- Internal/external rotation
- Translation
- Lengthening/shortening

Hoffa’s fracture fixation

Reduction & Screw Insertion

Screw insertion for Hoffa’s in progress

Articular surface compressed

Reduced and screw inserted

C Arm Image of Hoffa Screw Fixation

Implant

Locking compression plate

Locking compression plate also known as “locked internal fixators”, creates a fixed angle at each screw hole where the individual screw head is secured to the plate by different locking mechanisms. Since the plate does not depend on the friction created at the bone – plate interface to provide stability, the plate does not have to contact the bone directly that preserves the periosteal blood supply.\(^\text{12,1,10}\)

Locking plates are fixed angle devices, prevent Varus collapse, and prevent toggle and sequential screw loosening particularly in osteoporotic bone.

General operative principles, position, approaches, operative techniques, reduction methods were mentioned in operative details of plating.

Main steps in fixation of locking plate:

- Reduction of fracture: Two major condylar fragments were manipulated by using k wires inserted through two major fragments. Reduction was achieved and then condylar fracture was temporarily fixed with multiple Kirschner wires in subchondral bone in different plane away from the expected site of locking plate.
- Using anatomic landmarks and c-arm imaging, the plate of appropriate length and corresponding side was mounted on the intact/reconstructed condyle without attempting to reduce proximal portion of the fracture.
- Initially plate was fixed with k-wires through the slots provided in the plate distally and proximally and checked whether plate is in center in lateral aspect of shaft proximally. Then guide wires were inserted for condylar screw fixation.
- Guide wires were inserted in through the central hole and kept parallel to both distal femoral joint axis and patello-femoral joint.
- Length of screw was measured using measuring device and then partially or fully threaded Locking 6.5mm cannulated cancellous screws were inserted in lag mode through the plate. This
was an alternative to inserting independent lag screws outside of the plate.

Then the reconstructed condylar block with plate was fixed to shaft of femur spanning the metaphyseal comminution with end to end bone contact. This assembly was held with bone holding forceps.

- The plate shaft was fixed on to the shaft of femur with 5 mm locking cortical screws.
- Implant position and reduction was checked, using the image intensifier in AP and Lateral view.
- Wound closure: Thorough wound wash was given before closure. Negative suction drain was inserted. Then joint capsule and the iliotibial band were closed using absorbable sutures. Skin closed with non-absorbable suture. Wound was closed layers with a suction drain.

**To Get Good Knee Rom:**

Post operatively after 4 - 6 weeks, we had given vigorous physiotherapy (both active and passive assisted) under supervision along with static and dynamic quadriceps exercises.

We do quadriceps adhesion release from fracture site by lateral approach. If quadriceps is found to be adhered at metaphyseal comminuted raw area by fibrosis, it has to be meticulously released from fracture site.

After fracture unites, in few cases to improve Knee ROM after quadriceps adhesion release, we go for arthroscopic release of intra-articular fibrosis and supra-patellar adhesions.

With both these techniques we were able to get 90°-100° ROM in type C2 fractures.

**Results:**

- In this study, patients were of age group between 20-70 years. Average age was 46.12 years. The ratio between male to female was 2:1.
- In our study, 66% of the fractures were because of Road traffic accident, 32% of fractures were because of fall, and only 2% were due to other causes such as assault. In this series, Road traffic accident constitutes the major cause of morbidity (81.81%) in < 50 years of age whereas self-fall mainly results in morbidity (64.71%) in > 50 years of age.
- In this study, 66% of fractures were closed and 34% of fractures were compound.
- In this study, 62.5% of the patients operated with Locking compression plate had blood loss >300ml whereas 37.5% had blood loss <300ml. Average blood loss was 284.38 ml
- 57.2% of the patients operated with Condylar buttress plate had blood loss >300ml whereas 42.8% had blood loss <300ml. Average Blood loss was 282.14ml
- Average period of union in our study was 14.16 weeks.
- The average weight bearing in our study was at 15 wks
- In this study, 75% patients fixed with Locking plate had no shortening, 18.75% had <1.5 cm shortening, while 6.25% had 1.5-2.5 cm of shortening, 85.72% patients fixed with Buttress plate had no shortening, 7.14% had <1.5 cm and 7.14% had 1.5-2.5 cm shortening.
- In this study, 43.75% patients fixed with Locking compression plate had knee flexion >110 degrees, 43.75% patients had knee flexion between 110-90 degrees, while only 12.5% had knee flexion < 90 degrees. Average knee flexion for locking plate was 109.
- 28.57% patients fixed with condylar buttress plate had knee flexion >110 degrees, 50% had knee flexion between 110-90 degrees and 21.42% had flexion <90 degrees.
- Average knee flexion for condylar buttress plate was 105 degree.

- In this study, 31.25% of the fractures fixed with locking plate had excellent results, 43.75% had good results, and 12.5% had fair results, whereas only 12.5% had poor results. 21.45% of fractures fixed with buttress plate had excellent, 42.85% had good results, 14.28% had fair and 21.42% had poor results.
- Whereas only 60.17% patients with intra-articular fractures had excellent to good results.

**Type C2 fracture pattern:- (Table 01)**

- In this study, 81.81% patients having closed fractures were having excellent to good results as compared to 57.13% of Gr-I compound and 66.37% of Gr-II Compound fractures with excellent to good results. Closed fractures had 18.18% of fair to poor results whereas Gr-I compound had 42.85% and Gr-II Compound had 33.33% fair to poor results.
- In this study, superficial infection in the form local stitch abscess developed in 1 patient operated with Locking plate which subsided after local drainage and i.v. antibiotics. Deep infection in the form of frank pus from the operated site developed in 1 patient operated with condylar buttress plate which has associated ipsilateral Grade III
compound fracture calcaneus and same case has gone into delayed union which eventually united on 24th week postoperatively.

- Significant Shortening (>1.5cm) developed in 3 patients out of which 1 patient was fixed with Locking plate (2cm shortening), 1 fixed with Buttress plate (2cm shortening) 1 patient was fixed with Supracondylar nail (2.5 cm shortening).
- Significant extension lag of 15 degree developed in 2 patients (1 with Locking plate, 1 with condylar buttress plate).
- Knee stiffness developed in 4 patients (1 patient fixed with locking plate, 2 with condylar buttress plate.)

Knee stiffness developed in 8% patients (6.24% patient fixed with locking plate, 14.28% with condylar buttress plate).

**Probable Reasons for knee stiffness:**

1. Arthro-fibrosis
2. Quadriceps injury healed by fibrosis
3. Adhesion of quadriceps musculature to the rough fracture site surface at metaphysis and diaphysis, which in most of the cases extends about 5-10 cms in length on anterior, medial and lateral side. So also fibrotic adhesions at suprapatellar pouch.

Both this factors prevents free gliding of quadriceps, which is essential and mandatory to achieve full flexion of knee joint.

4. Injury to ligaments of knee joint.
5. Improper physiotherapy by patients

• One patient fixed with buttress plate had Loosening.

**Discussion:**

**Table 01:- Average union rate**

<table>
<thead>
<tr>
<th>Period (wks)</th>
<th>Locking plate</th>
<th>Buttress plate</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-15</td>
<td>3</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>16-18</td>
<td>2</td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td>19-24</td>
<td>5</td>
<td>8</td>
<td>13</td>
</tr>
<tr>
<td>&gt;24</td>
<td>0</td>
<td>0</td>
<td>00</td>
</tr>
<tr>
<td>Total</td>
<td>10</td>
<td>20</td>
<td>30</td>
</tr>
</tbody>
</table>

- The average period of weight bearing in our study was at 15 weeks.

Extensive physiotherapy in the postoperative period is an important step for achieving good knee range of movements and better results for the patients. Mean knee flexion in this study with locking plate, Condylar buttress plate.

**Table 02:-Comparison of Locking plate with Other Studies**

<table>
<thead>
<tr>
<th>Study</th>
<th>Average knee flexion (Degrees)</th>
</tr>
</thead>
<tbody>
<tr>
<td>This study</td>
<td>109.37</td>
</tr>
<tr>
<td>EJ Yeap et al3</td>
<td>107.7</td>
</tr>
<tr>
<td>Khan et al 34</td>
<td>110</td>
</tr>
<tr>
<td>Supanich V</td>
<td>114.81</td>
</tr>
</tbody>
</table>

28.57% patients fixed with condylar buttress plate had knee flexion >110 degrees, 57.14% had knee flexion between 110-90 degrees and 14.28% had flexion <90 degrees. Average knee flexion for condylar buttress plate was 105 degree. In study conducted by Nagy et al, 21.73 % had knee flexion >110 degrees, 65% had between 110-90 degrees and 21.73% had flexion <90 degrees. In the study conducted by Ali Ibrahim abduliatiff hussain, 73.86% had flexion >110 degrees, 2% had 5-10 degrees extension lag and remaining 15.78% had knee flexion <90 degrees.

HOFFA’S FRACTURE In our study, out of 30 patients, 06(20.00%) patients were having Hoffa’s fracture. All patients were fixed with 6.5 mm/4mm fully or partially threaded cancellous screws or Herbert’s screws. Bony union of Hoffa’s fracture was achieved in all cases. There was no loss of fixation.

**Schatzker and lambert criteria for assessing final outcome:**

<table>
<thead>
<tr>
<th>Schatzker and Lambert criteria</th>
<th>Locking Compression Plate</th>
<th>Condylar Buttress plate</th>
<th>Total Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>2</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Good</td>
<td>3</td>
<td>8</td>
<td>11</td>
</tr>
<tr>
<td>Fair</td>
<td>3</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Poor</td>
<td>2</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>Total cases</td>
<td>10</td>
<td>20</td>
<td>30</td>
</tr>
</tbody>
</table>

Out of 30 patients, A) Locking plate:-10 patients operated with locking plates, 5(50%) had Excellent to Good results, 3 (30%) had Fair result and 2 (20%) had Poor results.

B) Condylar Buttress plate:- Out of 20 patients operated with condylar buttress plate 12 (60.00%)had Excellent to Good result, 3 (15.00%) has Fair and 05 (25%) had Poor results.

**Conclusion:**

Type C2 fractures with severe metaphyseal comminution, when fixed with Condylar buttress plate has great advantage in fixation of distal femur fractures as it allows and gives the freedom to place the screws at different directions in multiple planes so as to engage and fix fracture fragments located at different positions. In addition it can be used in all types of distal femur fractures and it is cheap as
compared to other implants.1,4,10

Locking plates are very useful when there is severe osteoporosis with less bone stock and gross comminution of fracture fragments. Shortcoming of locking plate is- It does not allow to pass screws in different directions (Cf. Condylar buttress plate), so as to engage different fracture fragment at different planes. Also, locking plate is costlier as compared to condylar buttress plate.

Meticulous reduction of distal articular surface is key to the success of management of these fractures; hence primary realignment is essential for definitive fixation.2,5,6

Compound fractures were having less favorable outcome than closed fractures because in compound fracture:

a) Fracture hematoma is lost which is very essential for fracture healing
b) High incidence of infection which delays fracture healing
c) Post traumatic Stripping of soft tissue attachments of comminuted small bony fragments which actually de-vascularize them to greater extent.

Advanced age group had less favorable outcome than younger group as advanced age group patient has:

a) Osteoporosis which is itself less favorable for fracture union
b) Osteoporotic bones are weak and brittle so generally have significantly comminuted fractures.

HOFFA’S FRACTURE: Had good results and required accurate reduction of articular surface to have good functional outcomes. We Fixed Hoffa’s fracture first with 4mm cc screws under direct vision and then reconstruction of femoral condyles proceeded in usual manner which yield good results.

Varus – Valgus Malalignment - There was no Varus or valgus Malalignment in any case. Reasons for these are:

a) Fracture was operated on fracture table in traction and under IITV control.
b) In Intercondylar comminuted fractures we reassemble fragments of condyles first, then condyles are fixed to each other and then this condylar block is fixed to shaft of femur spanning the metaphyseal comminution and aligning metaphyseal comminuted fragments to shaft and condyles.

Need Of Medial Plating -Medial plating is not always required for medial column comminuted fractures.

As in our study we had not used medial plating in any case because indirect reduction of medial comminuted column was done and as the fragments were not dissected and exposed, soft tissue attachments of fragments are maintained along with periosteal blood supply. So, no any Bone grafting or additional medial column plate is needed in any case.

Bony Contact - Good bony contact of all comminuted fragments is very essential for good fracture union which eliminated need of bone grafting in our study.

References:
10. Brett D, Crist MD, Gregory J,
Della Rocca, Yvnne M. treatment of acute distal femur Fractures.
Orthopedics 2008; 31: 681.

Figure 1 A) pre op AP & LAT

Figure 1 B) post op AP & LAT

Figure 1 c) F/U AP & LAT with union

Figure 2 A) Pre op AP & lateral

Figure 2 B) Post op AP & lateral

Figure 2 C) Follow up AP & lateral with union

Figure 3 A) pre op AP & LAT

Figure 3 B) postop AP & LAT

Figure 3 C) F/U AP & LAT with union

Figure 4 A) pre op AP & LAT

Figure 4 B) post op AP & LAT

Figure 4 C) F/U AP & LAT Fracture union
Figure 5 A) Pre-op AP & LAT

Figure 5 B) Post-op AP & LAT

Figure 6 A) Pre-op AP & LAT

Figure 6 B) Post-op AP & LAT

Figure 6 c) F/U AP & LAT with union