Original Article

Management of Fracture of Distal End of Femur by of Different Methods - A Prospective Comparative Study

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ABSTRACT

Aim: This study is done to elucidate current treatment strategies as well as their evidence based rationale. The commonly done surgical techniques with internal fixation are outlined, the rationale of indications are discussed and the rationale of selection of the procedures are concluded.

Materials and Methods: In this prospective study, carried out at Osmania General Hospital, Dept. of Orthopaedics, Hyderabad from August 2011to July 2013. A total of 52 patients were identified based on defined inclusion and exclusion criteria and constituted the sample. The following variables of each patient record were analyzed, Age, sex, mechanism of fracture, type of fracture according to the AO/ ASIF classification, surgical treatment modality, during the follow-up at postoperative weeks 4, 8 and 12 the following variables were recorded: range of motion of the knee joint, radiologic evidence of healing, and complications. The results obtained at 6th month were assessed using the Neer scale 20.

Results: 52 patients are treated with different with three deferent implants, buttress plating (18cases), Locking plating (17 cases), Retrograde nailing (17 cases). The mean age of the patients was 29 years (range, 18–79 years). 43 are men and 9 women. 22 are supracondylar (AO type A) fractures 7 partial articular(AO Type B)and 23 intercondylar (AO type C) fractures (Table). 17 fractures were open (Gr 1 & 2), and the remaining cases are closed fractures. 38 cases are high velocity and 14 cases are of low velocity. The mean time required to achieve union was 4.3 months (range, 3.0–12.6 months).The healing is good the functional outcome is good, in all cases.

Conclusion: The MIPO-Minimally Invasive Plate Osteosynthesis, LISS less invasive stabilization system is preferred. In the elderly patients with a thin metaphyseal cortex and osteoporotic bone, and wherever one expects to find osteopenic bone, LCP is preferred. Supracondylar nailing is useful for fixation of supra- condylar and less comminuted inter condylar fractures. The simplicity of the procedure also facilitates fracture fixation in patients with multiple trauma, No significant differences were found in the degree of bone healing. The recovery range movement is better with plating, more so with minimally invasive technique, of the two methods of plating locking plate is mechanically more advantageous over the buttress plate, more useful in osteopenic bones and in fractures with comminution.

Keywords: Fracture of distal of femur, neer scale, ASIF

INTRODUCTION

The fractures of distal femur are defined as those fractures involving the last 15 cm of the femur (measured from the knee joint line). It includes the metaphyseal fractures (supra condylar fractures) and the fractures of the joint surface (intra-articular fractures).[1, 2] The incidence of distal femoral fractures is approximately 37/I,00,000 person-years.[3] they are 6% of all femur fractures.[4, 5] There is bimodal distribution of fractures based on age and gender.

The mechanism of injury is of two types major types high velocity occur in males between 15 and 50 years group, mostly road traffic accidents, with soft tissue injuries complicating the fracture, minor violence in elderly in

osteoporotic women >50 years [6] with more of bone problems in the form of thin cortices, weak bone posing challenges for implant selection, and less of soft tissue issues.

In early 1960s, non-operative treatment of distal femoral fractures resulted in increased incidence of many complications.[7,8,9] even then there was a great reluctance towards operative management of this fracture because of high incidence of infection, non-union, malunion, inadequate fixation and lack of proper instruments, implant as well as antibiotics, with advent of AO methods, and invention of newer antibiotics there is shift towards the osteosynthesis.

Most surgeons agree that distal femoral fractures need to be treated operatively to achieve optimal outcomes.[10] The osteosynthesis various devices have been used for internal fixation including angled blade plates[11], dynamic condylar screw[12], Rush pins[13], Enders[14] and purpose-designed nails[15], the dynamic condylar screw has been shown to give satisfactory results [16,17] Good results have been reported after internal fixation by several authors[18]. Recently locking condylar buttress plate, minimally invasive percutaneous plate osteosynthesis (MIPPO), Liss invasive stabilization technique (LISS plate technique), Ante-grade and Retrograde intramedullary interlocking nailing arein current use.

Every system of osteosynthesis has got its own advantages and disadvantages, that makes the choice of implant which cannot be universal. This is an in depth study of the currently used osteosynthesis methods, aiming to rationalize the treatment.

MATERIALS AND METHODS

This observational, prospective study, considered all patients who underwent surgery in Osmania general hospital , Department of Orthopaedics, Hyderabad due to a distal femur fracture from August 2011 to July 2013.

Before starting the study, the Institutional Review Board approved this prospective study and granted a waiver of informed consent.

A Extra Articular Fracture

A1 Simple

A2 Metaphyseal Wedge And Fragmented Wedge

A3 Metaphyseal Complex

B Partial Articular Fracture

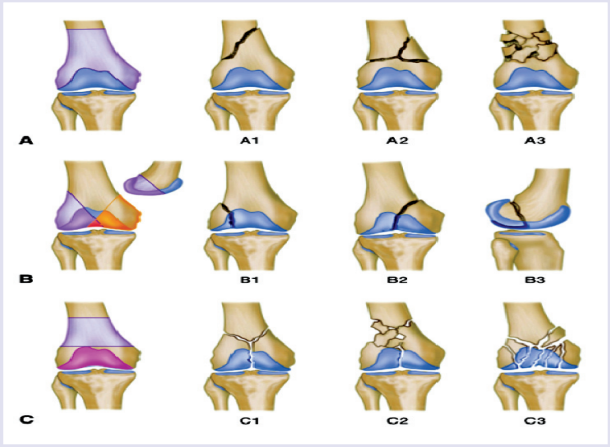
B1 Lateral Condyle, Sagital

B Medial Condyle Sagital

B3 Coronal

C Complete Articular Fracture

C1 Articular Simple Metaphyseal Simple



Fracture Classification

C2 Articular Simple, Metaphyseal Multifragmentary

C3 Articular Multifragmentary

Inclusion criteria

- complete clinical records
- patients with distal femur fracture including all degrees of severity
- the fractures must have been surgically treated either with open reduction and a plate with condylar compression screws or through indirect reduction and a less invasive stabilization system; or supra condylar nail
- patients followed-up as outpatients for at least six months.

Exclusion criteria

- Patients less than 18 years of age and greater than 80 years
- as well as those with an interval between the fracture and the surgical treatment longer than 7 days, patients with a fracture treated initially with a different type of implant, and those with a diagnosis of periprosthetic fracture.
- Gustillo Anderson Grade 3 compound fractures
- Associated any other fractures
- Open distal femur fractures presenting after 8 hours
- Distal femur fractures in children (in whom the growth plate is still open)
- Pathological distal femur fractures
- Patients lost in follow up
- Patients managed conservatively for other medical reasons
- Distal femur fractures with neurovascular compromise Applying these selection criteria, a total of 52 patients were identified and constituted the sample.

Principles of Surgical Treatment

The goals of operative treatment of distal femoral fractures are:

- Anatomical reduction of distal femoral articular surface
- Stable internal fixation with restoration of axial alignment
- Minimal soft tissue stripping
- Early active mobilization.

The surgery performed under spinal anaesthesia. In most patients, knee movement commenced 2 days after surgery. The duration before partial weight bearing varied, depends on severity of fracture. Full weight bearing was allowed only when the fracture was assessed as clinically and radiologically united. The following variables of each patient record were analyzed, Age, sex, mechanism of fracture, type of fracture according to the AO/ ASIF classification, surgical treatment modality. Based on the criteria recommended by Schatzker and Lambert, the outcome was assessed during the follow-up at postoperative weeks 4, 8 and 12 the following variables were recorded; range of motion of the knee joint, radiologic evidence of healing, and complications. The results obtained at 6th month were assessed using the Neer scale 20.

Figure 1 : Open Reduction & Plate Fixation

Buttress plate **Incision** **Plate insitu**

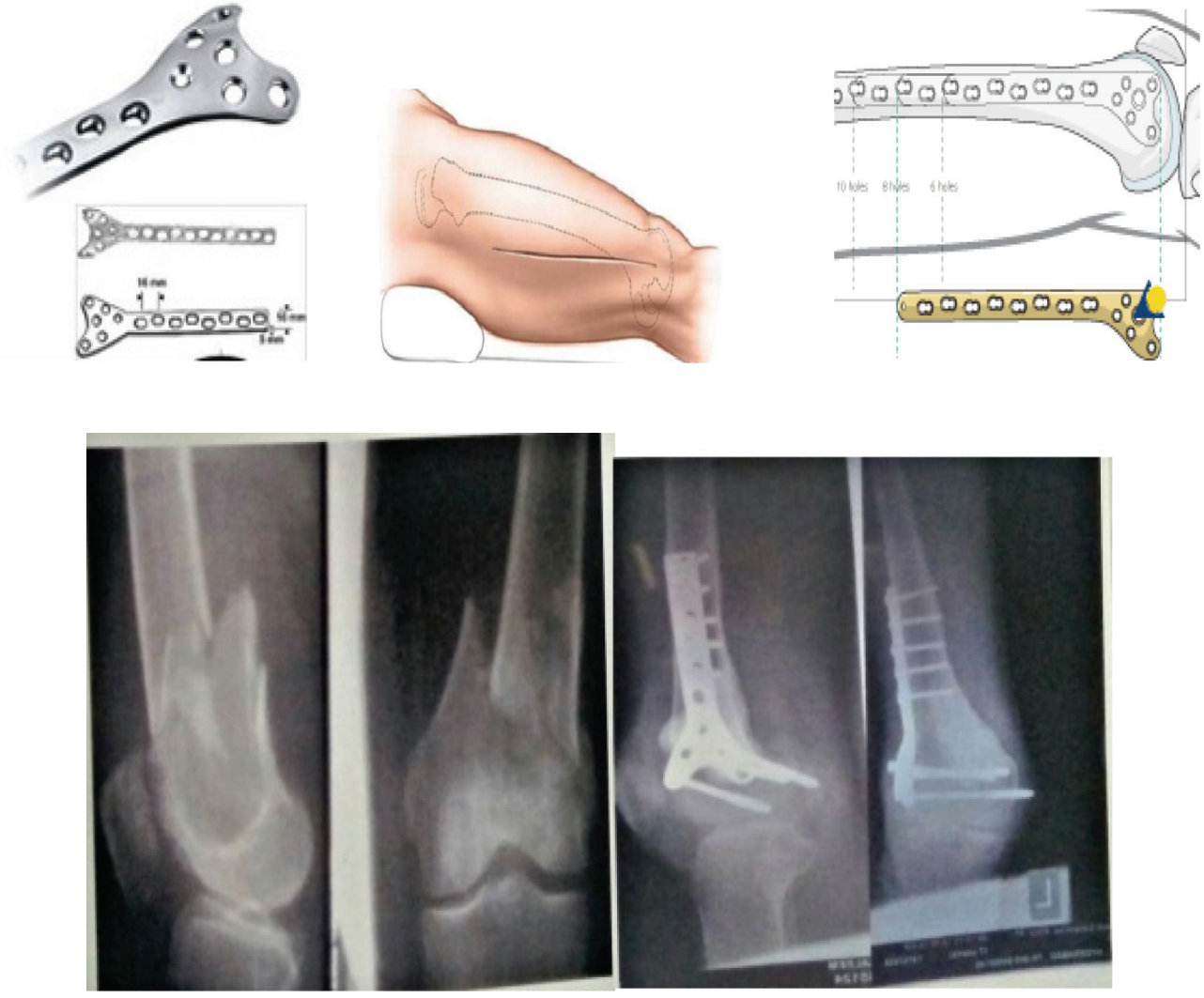
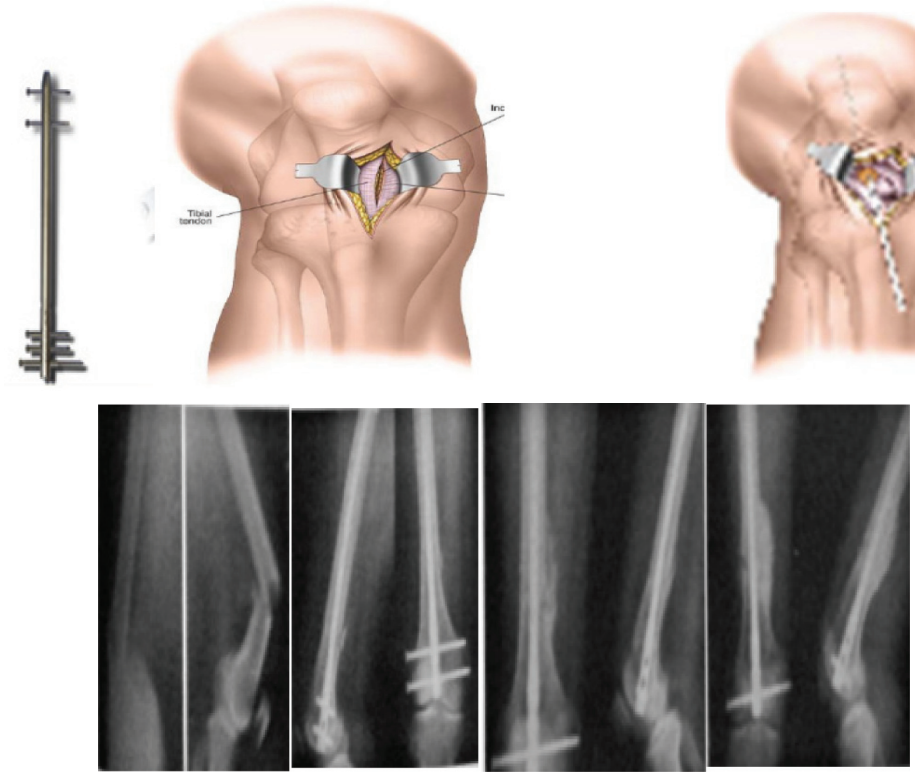


Figure 2 : Minimally invasive Plate Fixation

LISS plate | Incisions | Plate insertion

Figure 3 : Retrograde Nailing

SC Nail | Incision | Entry point

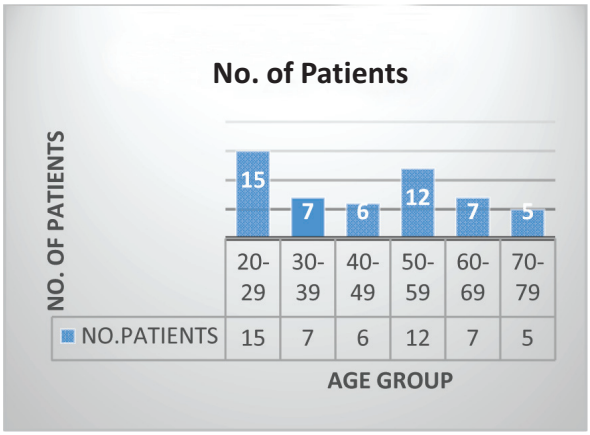


RESULTS

In our study, the mean age of the patients was 29 years (range, 18–79 years). 43 are men and 9 women. Majority of patients are in young age group prone for high velocity trauma, also open fractures, the elderly patients are 12 from 60-80 are prone from low velocity trauma, osteopenic bones, comminution.

Fracture types

22 are supracondylar (AO type A) fractures, 7 partial articular(AO type B) and 23 intercondylar (AO type C) fractures (Table). 17 fractures were open (Gr 1 & 2), and the remaining cases are closed fractures. 38 cases are high velocity and 14 cases are of low velocity. The mean time required to achieve union was 4.3 months (range, 3.0–12.6 months). Fracture alignment, limb length measurement, and range of knee movements were based on the last recorded clinical evaluation. 13 patients developed a knee movements restriction, The mean range of knee movement on last review was (103.8). There were 4 cases of deep infection. There is 1case of implant bending (LISS plate)

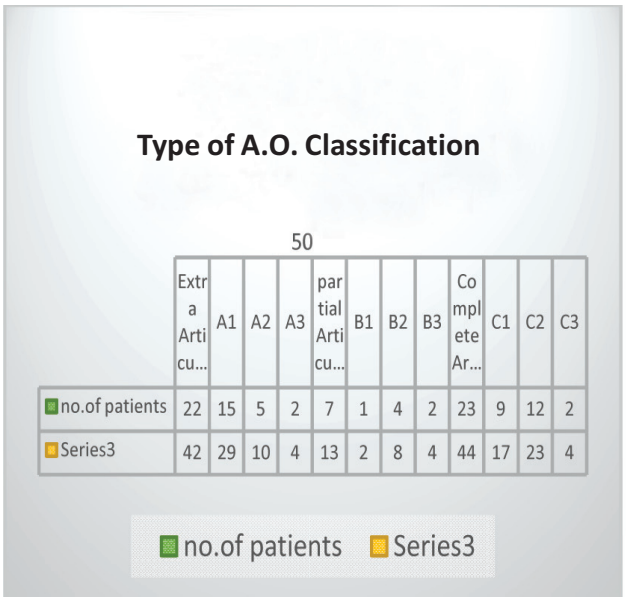


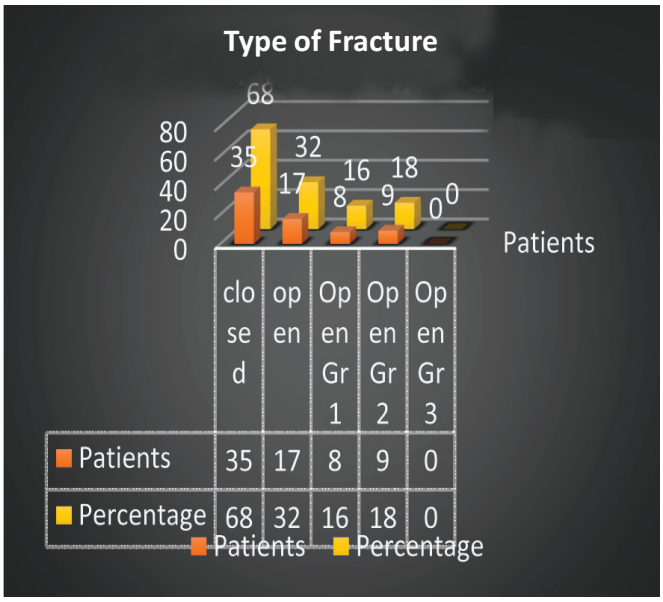
Based on the criteria recommended by Schatzker and Lambert, the outcome was assessed as excellent in 35 cases, good in 11 cases, fair in 4 cases and poor 2 cases. The outcome in 4cases was graded as a failure (poor) due to loss of knee movement post surgery, these patients sustained open compound high velocity fracture. The time to union of 4.3 months with no case of non-union seen in this study compares favourably to other treatment methods reported in the literature.[19, 20, 21]

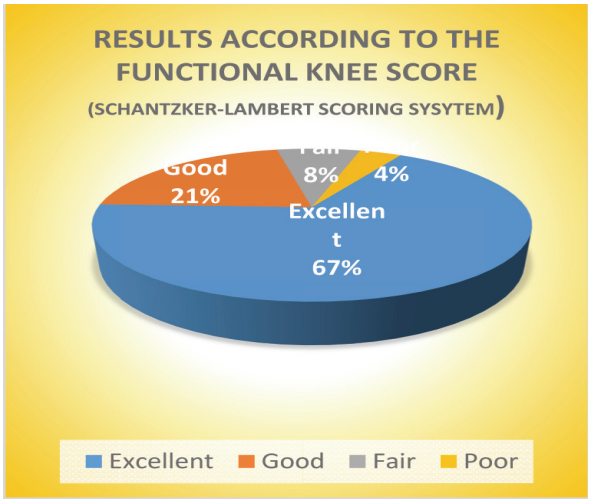
Complications noted in 33 out of 52 cases, they are Shortening in 12 cases, malunion in 8 cases, stiffness in 13 cases. In cases with shortening (12), Buttress Plate (6/12), Liss (5/12), Retrograde nail (1/12) is noticed. C type of fractures (10/12) are more prone for shortening, plating is more prone for shortening.

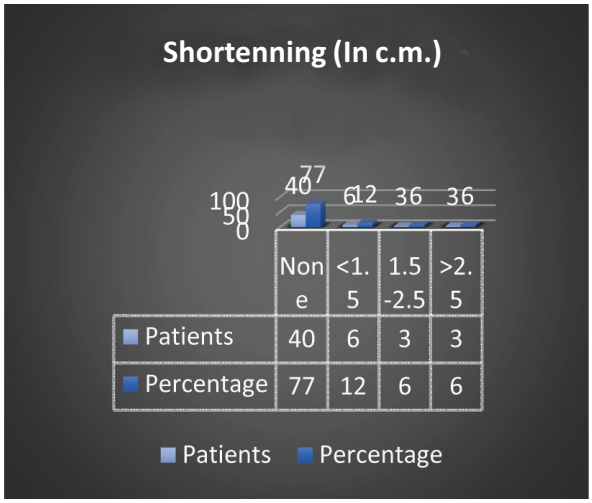
In(13) cases with stiffness, LISS (4/13), Buttress plate (3/13), Retrograde nail (6/13). Retrograde nail associated with most of cases with stiffness, the same with c type of fractures, due to comminution with very small or comminuted condylar fragment, in addition the breach of knee joint by intra articular entry point adds to the stiffness.

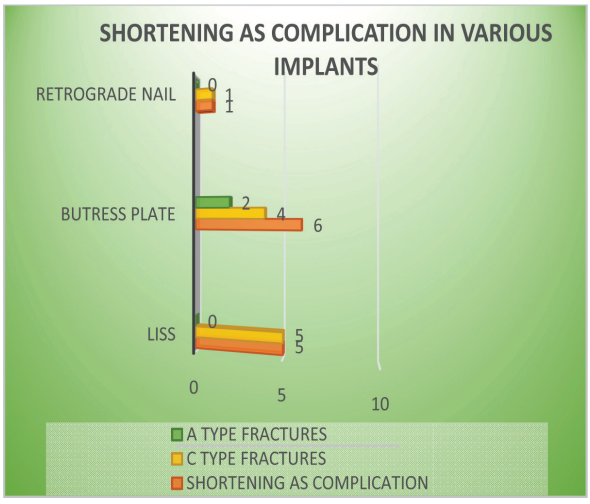
Out of 52 cases 37 patients resumed to pre injury job with ease, 8 patients with difficulty, 7 patients limited to light work or part time job.

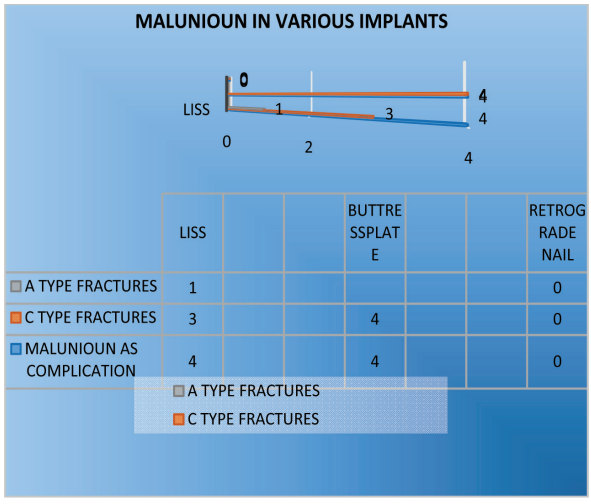


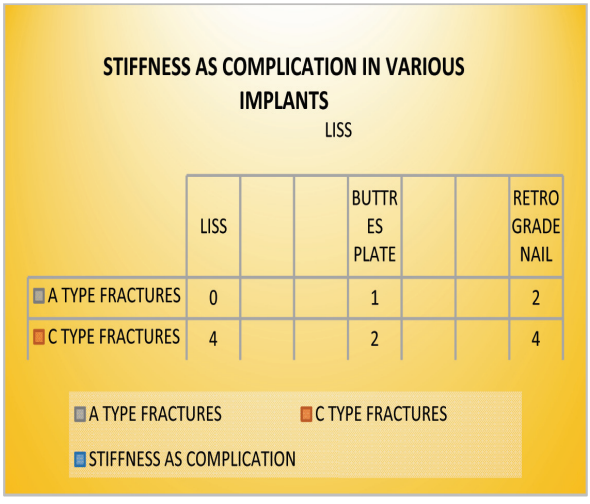



RESULTS ACCORDING TO THE FUNCTIONAL KNEE SCORE
(SCHANTZKER-LAMBERT SCORING SYSYTEM)
Good 21%
8%
4%
Excellent 67%
Excellent
Good
Fair
Poor


Shortenning (In c.m.)
100
50
0
40
77
6
12
3
6
3
6
None
<1.5
1.5-2.5
>2.5
Patients
Percentage
Patients
Percentage


SHORTENING AS COMPLICATION IN VARIOUS IMPLANTS
RETROGRADE NAIL
BUTRESS PLATE
LISS
0
1
1
2
4
6
0
5
5
0
5
10
A TYPE FRACTURES
C TYPE FRACTURES
SHORTENING AS COMPLICATION


MALUNIOUN IN VARIOUS IMPLANTS
LISS
0
1
3
4
4
0
2
4
LISS
BUTTRESSPLATE
RETROGRADE NAIL
A TYPE FRACTURES 1 0
C TYPE FRACTURES 3 4 0
MALUNIOUN AS COMPLICATION 4 4 0
A TYPE FRACTURES
C TYPE FRACTURES


STIFFNESS AS COMPLICATION IN VARIOUS IMPLANTS
LISS
LISS
BUTTRES PLATE
RETRO GRADE NAIL
A TYPE FRACTURES 0 1 2
C TYPE FRACTURES 4 2 4
A TYPE FRACTURES
C TYPE FRACTURES
STIFFNESS AS COMPLICATION


PRE JOB INJURY/LIFESTYLE
7
8
37
RESUMED
WITH DIFFICULTY
LIGHT WORK/PART TIME JOB

DISCUSSION

The distal femoral fractures should be limited to those fractures with extension into or distal to the metaphyseal flare of the femur. Fragmentation of the metaphyseal component and intra articular involvement are common. The amount of fragmentation is determined by the energy causing the fracture and by the individual's bone quality.

In young individuals, these fractures are usually the result of motor vehicle these high energy mechanisms may have quite complex articular involvement associated with the multiple fragments seen in the metaphyseal area. Fractures in elderly patients more commonly occur due to indirect violence resulting in less articular involvement but with more in a multi fragmentary metaphyseal fracture and possible intra articular extension fracture results in shortening, with the distal articular segment in varus, extension position.

Intra articular involvement is of two types 1). extension into the femoro-tibial articulation in the inter condylar area 2). involvement of the patella-femoral articulation. The articular involvement results in rotational mal alignment between the two condyles. Less commonly, fractures occurring in the coronal plane (Hoffa fractures).

The goals of operative treatment of distal femoral fractures are, anatomical reduction of distal femoral articular surface, restoration of axial alignment, soft tissue preservation, stable internal fixation, early active mobilization.

In the early open reduction techniques the emphasis is on accurate anatomical reduction and rigid fixation on the table, to allow early rehabilitation[22], in the pursuit of achieving anatomical reduction and rigid fixation, the biology is compromised, resulting in poor outcome.[23]

The idea of non anatomical reduction and intra medullary fixation with preserved biology and good outcome prompted the use of same principles in plating Kinast et al proved that anatomical reduction is not necessary for the healing.[24] Mast et al[33], expanded the concept of indirect reduction and internal fixation and advocated that maintaining the axis of the extremity, length of bone, correction of angular deformity in sagittal and coronal plane, correction of rotation in horizontal plane, and there is no need for the anatomical reduction in the meta and diaphyseal region.

The studies of Bolhofner, [25] and Ostrum and Geel. [26] showed that maintaining the soft tissue viability and blood supply at meta and diaphyseal region gives good biological response, early consolidation of fracture, no non unions, this concept is further expanded using techniques of sub muscular plating as described by Krettek et al [27, 28], has prompted the shift from open reduction and internal fixation to Minimally invasive, Less invasive techniques with indirect reduction, biological plating. This technique had decreased incidence of implant failure and infection, allowed for earlier fracture callus formation, and reduced the need for secondary bone grafting procedures in numerous clinical series. [29]

Conversely, the lack of direct visualization of the meta- and diaphyseal areas makes the procedure more technically demanding and obliges an increased use of fluoroscopy. Several authors alluded the significance of a learning curve, characterised by an elevated mal-union and revision rate. [30, 31]

The implant options, are plate osteosynthesis with either open reduction and internal fixation, or closed reduction and minimally invasive plate osteosynthesis (MIPO). Intramedullary nailing, external fixation. Different plating options are available, including fixed-angle devices like the angled blade plate (ABP) or the dynamic condylar screw (DCS), buttress plate fixation, and locking plates.

Plating is used splint the articular block to the diaphyseal region along the lateral aspect of the femoral shaft, and also provides angular stability to control against varus collapse and allow correction of sagittal plane deformities after insertion of the screw. [32] The angled blade allows excellent rotational, frontal plane, and sagittal plane control of the distal fragment. Its insertion, however, is technically demanding as its placement must be controlled in three planes simultaneously.

The dynamic condylar screw (DCS) was developed to allow a slightly less technically demanding insertion utilizing familiar instrumentation (Dynamic Hip Screw). The DCS may exhibit sagittal plane rotational instability in this circumstance where additional distal screw fixation is not possible, and the DCS requires more bone removal for insertion, which may compromise future reconstruction options.

Plating can be used in most Type A and C fractures, however, these fixed angle devices are not suitable in multiplane intraarticular fractures where, due to the fixed angle, the implants may interfere with or disrupt fixation of the articular segment, both may be difficult to use in fractures with a small distal articular segment (2-3 cm). plate and screw constructs eg. Condylar Butress plate, should be reserved for C2-C3 fractures especially those with coronal plane components.

Their major disadvantage is the lack of a fixed-angle screw fixation distally, which may increase the possibility of varus collapse prior to union. Because of this, it is

advocated to use a push-screw from the plate into the medial femoral condyle, or supplemental fixation in the form of a medial plate or external fixator. [33-36] Newer plate systems developed by the AO allow for multiple distal fixed angled screw positions and are adaptable to sub muscular plating techniques. These may allow for the benefits of both the blade plate and the lateral screw plate devices and facilitate biological plating.

The locking condylar plate functions much as the blade plate but allows for the possibility of multiple points of distal fixation. Locking plates are typically indicated in patients with osteoporosis, fractures with metaphyseal comminution where the medial cortex cannot be restored, or a short articular segment.

Intramedullary device inserted through the knee was developed by Henry et al.[37,38], to address complex supra condylar fractures of the femur. This was reported to allow direct reduction of the articular surface, followed by indirect reduction and stabilization of the metaphyseal fracture using an intramedullary nail. Ante grade Nailing usually require at least 5 centimetres of distal bone for fixation and are admittedly limited for type A fractures, and C l-C2 fractures. Given the appropriate fracture patterns, ante grade IM nailing has been associated with angular deformities because of inability of distal interlock of the Ante grade nail to achieve control of the small and often osteoporotic distal fracture fragment. [42]

Retrograde insertion of the nail can be done with an open technique, or percutaneously. The disadvantages of this device are due to the intra articular insertion point of the nail and the possible long-term effect on the knee. Proponents of nail fixation advocate its use in all Type A and C fractures.

The use of plates and screws has the inherent drawback of producing a load shielding device. The resultant osteopenia creates a substantial risk of refracture proximal to the plate. [40,41] Intramedullary nails offer potential biomechanical advantages over plates and screws because their intramedullary location results in less stress on the implant, they have the potential for load sharing, and can be inserted with minimal stripping of soft tissue, but However in all B, in low trans condylar (some C2) and most comminuted condylar (C3) fractures, standard open reduction and internal fixation of the condyles with lag screws and then soft tissue sparing biological plate fixation with indirect reduction of the shaft to the condyles with condylar buttress plate.

Condylar locking plate is used when there is possibility of collapse and deformity in comminuted fractures, or when the bone is osteopaenic. No significant differences were found in the degree of bone healing or in the recovery of the ranges of motion between all three modalities. During the overall evaluation of the results using the Neer scale, no significant difference was found based on the implants used. However, a significantly earlier mobilization was observed in the patients treated with the less invasive stabilization system, However, it was seen that the lesser soft tissue morbidity and the lower pain intensity are important factors for better patient outcomes with the less invasive stabilization system.

Minimal invasive procedures hold biological advantages as the incidence of delayed or non-union, infection, and the need for bone grafting are significantly decreased. However, MIPO inherits the disadvantage of a potentially higher mal-union rate and is technically demanding. The prognosis, though, seems to be less depended on the implant than on the type of fracture.

CONCLUSION

1. The outcome depends on the type of fracture than on implant.
2. The outcome depends upon the strict attention to the details of fixation, need for bone grafting, bone quality, soft tissue damage, in the pursuit of achieving anatomical reduction and rigid fixation, the biology should not be compromised, biological fixation is always preferred.
3. MIPPO, Minimally invasive or LISS less invasive techniques is preferred.
4. LCP, Locking Condylar plate is preferred implant for plating in elderly patients and in Osteoporotic bones, in fractures with Communition of metaphysic with loss of medial metaphysis.
5. Plating is indicated in all B, in low trans condylar (some C2) and most comminuted condylar (C3) fractures.
6. Intramedullary implants is a viable option in A and C fractures. Ante grade methods usually require at least 5centimetres of distal bone for fixation and are admittedly limited for type A fractures, and C l-C2 fractures.
7. Retrograde Nailing is indicated in fractures where there is proximal insertion is not available as in dysplastic hips, and when the distal fragment is less than 5 cms.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

FUNDING : None.

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