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Study To Evaluate The Functional Outcome Of Communited Fracture Of Distal Femur Treated With Dual Locking Compression Plate

A study performed at the Department of Orthopedics, G.R Medical College, Gwalior (M.P.)

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Abstract

Background: Fractures of the distal femur are seen in different complexities in modern times. The management of comminuted distal femur fracture is challenging given achieving stable fixation, and regaining of range of motion at the knee joint treated with present fixation methods. Distal femur plating on the lateral aspect is a good option but in long-term follow up various complications are seen like shorting of limb, angulations, deformity at the knee due to banding of plats, poor healing of the fracture, delayed union and stiffness of knee due to immobilizations.

To overcome all these complications of double plate fixation i.e. conventional lateral pillar (LCP) fixation, augmented with medial per admission and availability of the operation theatre. Most of the cases can be operated between the 2nd to 10thday admission. After preoperative assessment cases were prepared for surgery. Under aseptic precaution and prophylactic antibiotic coverage, cases are operated on. All will be operated by dual-femur LCP.

Results: Out of all 30 patients 07(23.33%) was Excellent, 20(66.66%) was good, 02(6.66%) was fair, 01(3.33%) was poor results. Of the 30 cases, 4 (13.33%) patients have a Range Of Motion of 80-100º,26 (86.66%) patients have a Range Of Motion of 101-120º

Conclusion: All the end of this prospective study we found this method suitable for complex distal femur fractures AO Type C. The addition of a medial buttress plate resulted in better outcomes in comparison to single lateral buttress plates. Double platting was successful in achieving bony union without complications, like loss of reduction, implant failure, or breakage. Late angulation deformity or non-union was not seen in any case. Rigid fixation allowed early mobilization of the knee and enhance rehabilitation.

We conclude our study that double platting of AO Type C 1,2,&3 subtypes gave encouraging results in terms of functional outcomes in comparison to a lateral plate. We conducted an original study in all subtypes of AO types C. In last we recommend that further study on Type C specific sub-types will produce better results.

Keywords: Dual plating, distal femur platting, intra-articular fracture, locking compression plate.

INTRODUCTION

Fractures of the intraarticular distal femur are considerable challenges in management. Many methods of management are associated with these injuries. Before 1970, most supracondylar fractures were treated nonoperatively in these injuries; however, difficulties were often encountered, including knee joint incongruity, loss of knee motion, persistent angulation deformity, and delayed mobilization.(1)

During the past few decades, as operative management techniques have improved, most surgeons have favored internal fixation for the management of displaced distal intra- articular femoral fractures. The surgical goals of treatment are anatomic reduction of the articular surface, restoration of limb alignment, length, and rotation, and stable fixation that allows for early mobilization. Nonetheless, internal fixation of the distal femur fracture can be difficult for many reasons. Thin cortices, a wide medullary canal, relative osteopenia, and fracture comminution make stable internal fixation difficult to achieve. Although internal fixation of the distal femur fixation has dramatically improved clinical results, the operative management of these difficult fractures is not uniformly successful (2).

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Fractures of the distal femur difficult to treat because of unstable and comminuted and tend to have a bimodal distribution, occurring in elderly or younger multiple-injured patients. Because of the proximity of these fractures to the knee joint, regaining full knee joint movement and function may be difficult.

Treatment of comminuted, intra-articular distal femur fractures is problematic. [3] They are often difficult to treat because of high-velocity trauma, producing comminution, bone loss, and an unstable fracture pattern. [4] Müller et al[5]. classified these fractures according to their pattern. and location. Their classification divides distal femoral fractures into type A (extra-articular with three subtypes), type B (condylar or partial articular with three subtypes), and type C (bicondylar or complete articular with three subtypes). Among these, C3-type fracture involves significant articular surface so very difficult surgical challenge for operative surgeons.

Unstable displaced comminuted supra- and inter-condylar femur fractures can be a treatment challenge. Fractures with complex fracture patterns may be caused by high-energy injuries or weakened bone. Open reduction and internal fixation have emerged as the treatment of choice for these fractures, provided the patient's general medical condition is suitable for surgical treatment. Successful results depend on achieving a stable, anatomically aligned distal femur with appropriate fixation. A variety of nails and plates have been recommended for use in the distal femur. Although intramedullary devices, blade plates, and dynamic compression screws with side plates are commonly used for purely supracondylar fractures or supracondylar fractures with a simple intraarticular extension, condylar buttress plates are more useful for very distal fractures and those with intraarticular comminution. Cast immobilization, modified traction, or external fixation remain treatment options. The adjunctive application of a medical buttress plate to supplement lateral fixation may be advantageous in specific situations. Certain types of complex distal femur fractures, open reduction internal fixation, and plating from the lateral side should be supplemented with a medial buttress plate. Indications for duel plating are AO type C-3 fracture patterns with medial condyle "Hoffa" fracture fragments, very distal supracondylar femur fractures, and intercondylar/supracondylar femur fractures with extensive medial metaphyseal comminution or bone loss. Application of an additional medial plate may be necessary. A separate medial incision is preferred to reduce the amount of soft-tissue stripping required for plate application. Accordingly, this prospective study evaluates the results of double plating of highly unstable C3-type multiplanar distal femur fracture through a modified Olerud extensile approach.

METHODOLOGY

This study will be done prospectively in **the Department of Orthopaedics and Trauma Centre in J. A. Group of Hospitals, Gwalior (M.P.)**.The cases being selected on a routine OPD basis are those who have comminuted fracture distal femur. A Total number of 30 patients will be selected on an O.P.D. basis and will be followed up for 6-8 months after the intervention. Cases will be operated during routine hours as per admission and availability of the operation theater. Most of the cases can be operated between the 2nd to 10thday of admission. After preoperative assessment cases were prepared for surgery. Under aseptic precaution and prophylactic antibiotic coverage, cases are operated on. All will be operated by dual-femur LCP.

Materials & Methods: On admission, the general condition of the patient will be assessed concerning other associated orthopedics injuries or systemic injuries. Data will be extracted from patients directly and their medical records according to a pre-defined data extraction sheet. Patients will be operated on as early as possible.

Pre-operative Planning:

All the patients were counseled regarding the modes of treatment. Appropriate and valid written consent was taken. The patients were taken for surgery after routine investigation and after obtaining fitness for surgery. The investigations done were Hemoglobin percentage, Random blood sugar, Blood urea, Serum Creatinine, HIV (after taking the patient's consent for testing the same), HBsAg, Chest Xray, ECG, ECHO Cardiography(if required), Xray of Leg (full length) with the joints adjacent to fracture site both AP and Lateral views. Medical, surgical, and anesthetics fitness were taken.

A dose of antibiotic preferably ceftriaxone 1 gm was given preoperatively 15 minutes before the incision. The preparation of the part was done half an hour before the surgery. Instruments were checked and sterilized beforehand. General instruments like Reduction Clamps, surgical blades, Retractors, Bone levers, Needle Holders, Forceps, and scissors.

Implant Placement: In dual distal femur locking compression plating, the plate is placed lateral of the distal femur through an anterolateral approach and in the medial of the distal femur through a medial approach.

Management of closed fractures: Local examination of the injured extremity revealed swelling, deformity, and loss of function. Distal neurovascular status was assessed by the posterior tibial artery and dorsalis pedis artery pulsations, capillary filling, local temperature, pallor, and paraesthesia.

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Antero-posterior and lateral radiographs of the affected leg along with the joints both proximal and distal to the fracture site were taken and the fracture patterns were classified based on the AO/OTA classification of fractures. The limb was then immobilized in an above-knee Plaster of Paris slab till definitive fixation with a locking compression plate was done.

Management of Open Fractures: Patients with open fractures were graded using the Gustilo Anderson classification for open fractures. Antibiotics were started immediately for all patients. Injection of ceftriaxone 1 gram intravenous twice daily along with an injection of Amikacin 500mg intravenous twice daily were the antibiotics and a single dose of tetanus toxoid prophylaxis was given. [7]

After obtaining the necessary radiographs, Type I and Type II open fractures were treated by cleaning the wound with a copious amount of normal saline followed by painting the skin around the wound with Povidone iodine and surgical spirit. The limb was then immobilized in an above-knee Plaster of Paris slab till definite fixation was done. Type III fractures were not included in this study. [7]

Post-operative care: After surgery, the patient's leg was elevated, with the leg placed on a pillow; Intravenous antibiotic regimen was continued for 3-5 days (5-7 days in compound fractures) after the surgery along with pain control medications. Another 5 days of oral antibiotics were advised. Suture removal was done on the 14th postoperative day.

Mobilization: Based on associated soft tissue injury, patients were advised static quadriceps exercises, and active knee and ankle mobilization on the very next day of surgery. Non-weight bearing mobilization was started after the first check dressing(after 48 hours), Partial weight bearing started after 3 to 4 weeks (as the pain subsides) and full weight bearing was allowed after 8-10 weeks after surgery.

Follow-up: Patients were regularly followed after 1,3,6 and 9 months, and every 4 weeks thereafter until radiographic healing and function are established.

OBSERVATION & RESULTS

The present study consisted of 30 cases of distal femur fractures. All the cases were fixed using a stainless steel lateral and Medial locking compression plate. The study period was from October 2016 to September 2018.

Table 1: Sex distribution

Sex	No. Of Patients	Percentage
Male	25	83.3%
Female	05	16.7%
Total	30	100%

Table 2: Side Affected

Side	No. Of Patients	Percentage
Right	20	66.6%
Left	10	33.3%
Total	30	100%

Table 3: Mode of injury

Mode of injury	No. Of Patients	Percentage
RTA	23	76.66%
Fall	6	20.00%
Assault	01	3.3%
Total	30	100%

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Table 4a: Showing clinical type of fractures

Type Of Fracture	No. of Patients	Percentage
Closed	13	43.33%
Open G.A type-I	9	30.00%
Open G.A type-II	8	26.66%

Table 4b: Showing fracture pattern Fracture Pattern

AO TYPE	Distal femur	percentage
AO.43.A1	5	16.6
AO.43A2	12	40
AO.43A3	10	33.3
AO.43B1	-	-
AO.43.B2	3	10
AO.43.B3	-	-
AO.43.C1	-	-
AO.43C2	-	-
AO.43.C3	-	-
Total	30	**100**

Table 05: Showing duration of fracture union

DURATION (Weeks)	Number of patients	Percentage (%)
16-18	00	00
>18-20	08	26.66%
>20-22	10	33.33%
>22-24	08	26.66%
>24-26	02	6.66%
>26-28	02	6.66%
Total	30	100

Table 06: Range Of Motion

Range Of Motion (In Degrees)	No. Of Patients	Percentage
<80	00	00
80-100	04	13.33%
101-120	26	86.66%

Table 07: No. of holes plates Used

No. of holes plates Used	No. of Patients	Percentage
6-8	10	33.3
9-11	20	66.6
Total	**30**	**100**

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Table 08: Showing Complications

Complication	Number of Patient	Percentage (%)
Superficial Skin Infection	01	3.33%
Arthrofibrosis	05	16.66%
Deep Infection	01	3.33%
Screw loosening	Nil	0
Implant failure	Nil	0
Delayed union	02	6.66%
Mal union	Nil	0

Table -09.Range Of Motion At Knee:

Complication	Number of Patient	Percentage (%)
Superficial Skin Infection	01	3.33%
Arthrofibrosis	05	16.66%
Deep Infection	01	3.33%
Screw loosening	Nil	0

Table 10: Showing duration of fracture union

DURATION (Weeks)	Number of patients	Percentage (%)
16-18	00	00
>18-20	08	26.66%
>20-22	10	33.33%

Table 11: Showing duration of surgery

Duration of Surgery(Mins)	No. of Patients	Percentage
90-120	23	76.66
120-150	7	23.33
Total	**30**	**100**

Table 12: Associated Injuries

Associated Injuries	No. Of Patients	Percentage
Fracture Of Proximal Tibia	01	3.33%

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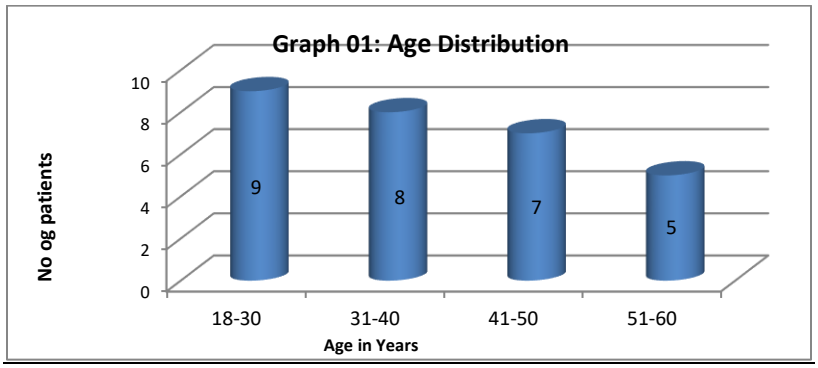

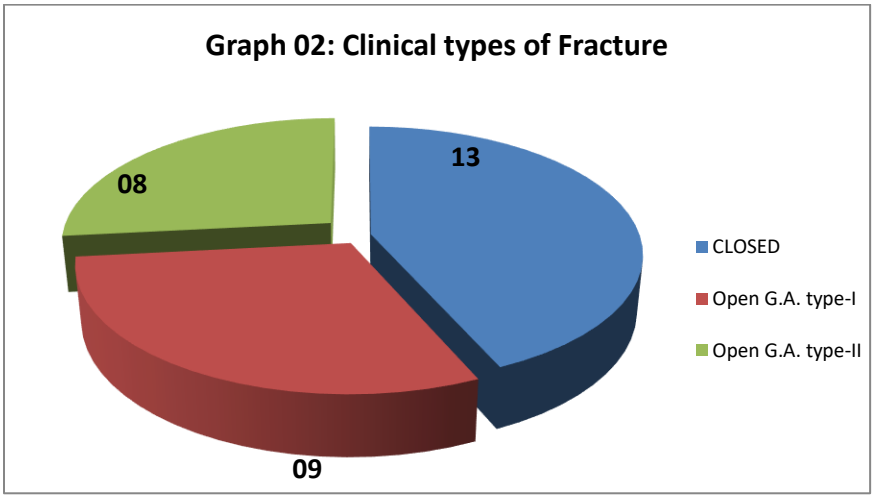

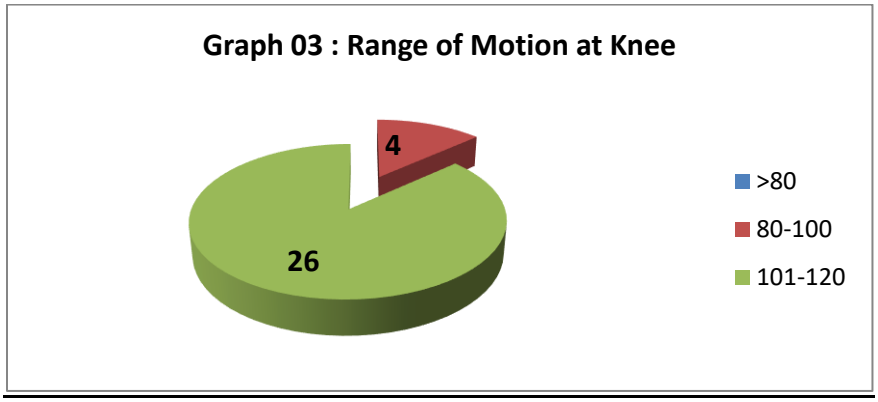

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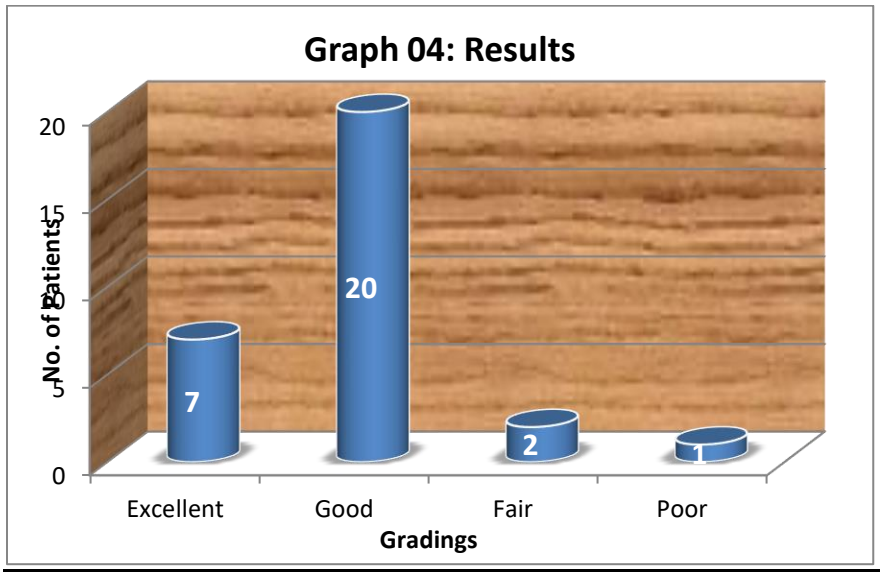

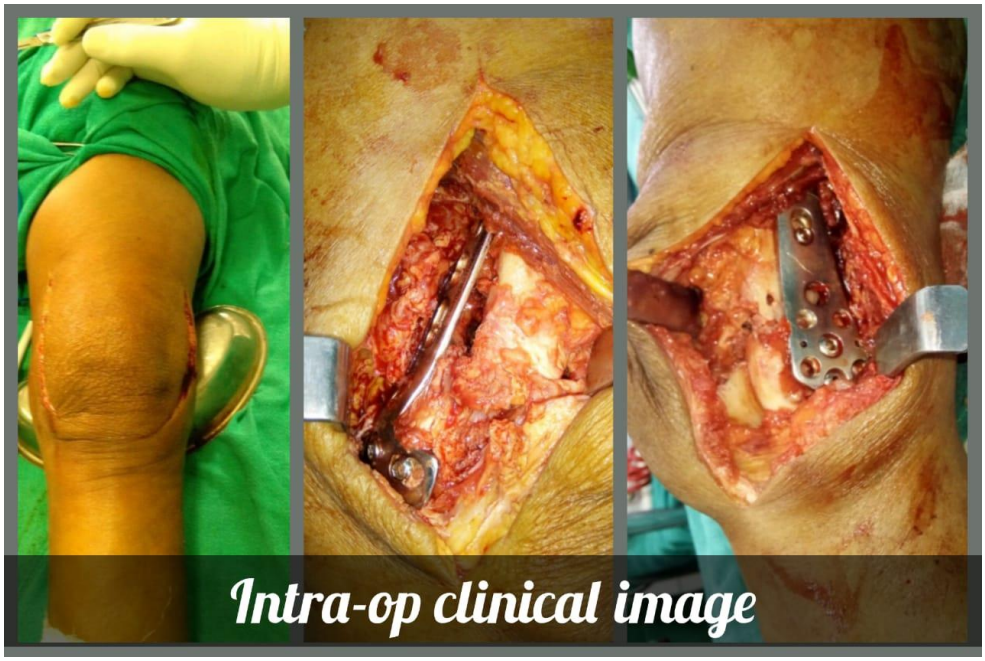

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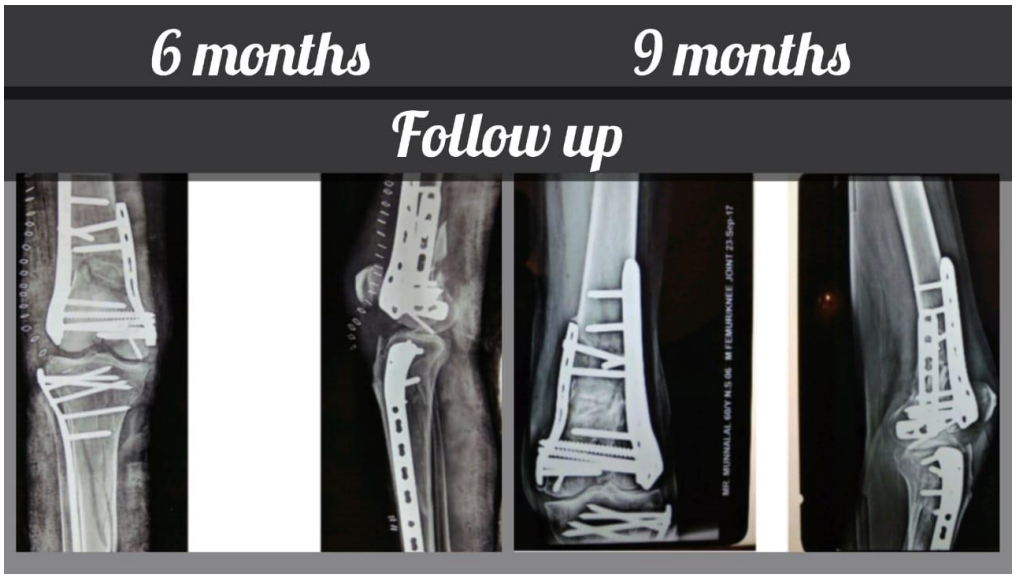

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DISCUSSION

Complex C2 and C3 fractures of the distal part of the femur are distinguished from simpler fractures by their metaphyseal comminution, associated femoral shortening, and, in the case of C3 fractures, severe articular comminution. (8)In such fractures, rigid stabilization is difficult. The use of intramedullary nails is rarely indicated. Ninety-five-degree blade plates and condylar screws can be used after inter-fragmentary fixation of the condylar fragment. The insertion of a blade plate may, however, loosen the condylar fixation because of the pounding that is needed for insertion. The use of a condylar screw necessitates that at least four centimeters of intact condyle be available for purchase, because of the large diameter of the screw[(4).]

The condylar buttress plate is the accepted alternative when these implants cannot be used. The design of this implant, however, necessitates a stable medial buttress. Methods of creation of this buttress include direct anatomical reduction, techniques of indirect reduction, or the use of external support, such as a cast brace. In most fractures, stable fixation can be achieved with the use of the condylar buttress plate alone, with good results, and a second plate is unnecessary.

The results of our study suggest that, for the treatment of patients who have a difficult fracture in whom stable fixation of the distal part of the femur cannot be achieved with a condylar buttress plate because of medial cortical comminution, a short distal condylar fragment, or loss of metaphyseal bone, double-plating is indicated. The distal screw holes of the condylar buttress plate, while allowing the surgeon to place the screws in the condyles selectively and accurately, lack a locking mechanism for the screw heads to prevent shifting at the screw-plate junction. If there is an inadequate medial buttress, the collapse of the distal fragment of the fracture can occur with the loading of the extremity. The stability of the fracture must therefore be assessed after the application of the lateral plate. This can best be accomplished by inspection of the interface of the bone and the screw plate for motion during flexion and extension of the knee and during varus and valgus stress on the distal part of the femur. Any noticeable motion at the interface medicates unstable fixation, with the need for a medial plate and bone graft. The specific type of medial plate appeared Unimportant in our series, provided it was sufficiently strong to buttress the distal part of the femur during healing and consolidation of the bone graft. The efficacy of a medial plate and bone graft in the maintenance of reduction during the loading of early active motion is demonstrated by the fact that all 29 fractures healed without loss of reduction and breakage and loosening of the implant.

Despite the achievement of a union in satisfactory alignment, the motion of the knee was uniformly limited in our patients.

The fractures of the distal part of the femur that are reported here are the most severe and are caused by high-velocity trauma with resultant muscular and capsular injury. Comminuted fractures about the distal part of the femur causing extensive adhesions of the quadriceps mechanism" 2"3'4. [(9)]

Despite its use in this series, the excellent motion of the knee and restoration of normal function could not be achieved. Decreased flexion of the knee occurred regardless of the operative approach that was used.

These results are medial plate, which necessitated additional dissection of the probably attributable to the high-energy nature of these in-soft tissues, contributed to the contractures about the knee.

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Injuries and their attendant damage to the soft tissues. It is we are unaware, however, of any other types of fixation also possible that the need for additional stability that can adequately stabilize these severe injuries.

1. Age And Sex: Lin D et all(2010)[10] conducted a study, that show 11 cases in his study there were 7 males and 4 females with an average age of 43 years (range, 27-55 years). Zhang ZM et all(2012)[11] conducted a study, that show 12 cases Among them, there were 8 males, and 4 females with an average of 40 years (ranging, from 25 to 55 years).

In our study, we show The age of the patients ranged from 18 to 60 years with which 9 (30%) patients were between 18-30 years.9 (30%) patients between 31-40 years. and 7 (23%) patients between 41-50 years. 5 (17%) patients between 51-60years(**Graph -1),** and Out of 30 patients, 25 (83.3%) patients were males and 5 (16.7%) patients were females showing male preponderance(**Table 1)**

2. Side Affected: Lin D et all(2010)[10] conducted the study, and they show The locations were left side in 6 cases and right side in 5 cases. Zhang ZM et all(2012)[11] conducted a study, that showed were left side in 6 cases and the right side in 5 cases**.** In our study, were 20 (66.6%) patients with right-sided fractures and 10 (33.3%) patients with left-sided fractures. **(Table 2)**

3. Mode Of Trauma: Lin D et all(2010)(10) conducted a study, that show Fracture was caused by a traffic accident in 8 cases and falling from height in 3 cases. Zhang ZM et all(2012)[11]conduct a study, they show. The fracture was caused by a traffic accident in 8 cases and falling from height in 3 cases.

In our study, 23 (76.66%) of 30 patients sustained an injury following road traffic accidents and 6 (20%) patients sustained an injury following a fall, and 1 (3%) patient sustained an Assault injury. This shows Road traffic accident is the major mode of injury. **(Table 3)**

4. Fracture Pattern: In our study All 30 patients show a Type C fracture pattern,30 patients were distributed in type C, Subtype 1, Subtype 2, and Subtype 3 randomly. Our results were seen in all type C, more focused and better outcomes would be expected if further study is conducted in the type C subtype.

Out of the 30 cases, 13 (43.33%) cases were closed fractures and 17 (56.66%) cases were open fractures. The classification of open fractures was based on Gustillo Anderson classification of open fractures. **(Table 4a)**

5. Duration Of Surgery: Lin D et all(2010)(10) conduct a study, that show The average time of operation was 128 minutes (range, 105-150 minutes). Zhang ZM et all(2012)[11] conducted a study, and they show. The operation time was from 110 to 160 min, with an average of 135 min, In our study, all 30 cases treated with Stainless steel locking compression plates 23 (76.66%) took 90-120 minutes and 07(23.33%) took 120-150minutes. The average time duration was 98 minutes. **(Table 11)**

6. Duration Of Fracture Union: Lin D et all(2010)[10] conducted a study, that show bone union was achieved within 3-6 months (4.4 months on average). Zhang ZM et all(2012)[11] conducted a study, that show Bone healing time was for 18 to 24 weeks with an average of 21 weeks. (5.1 months) (**Table 10)**

In our study, All the fractures radiological united with an average of 20 weeks ranging from 16 to 28 weeks (4 to 7 months)

7. Associated Orthopaedic Injuries: Associated Orthopaedic injuries were present in 01 (3.33%) patients. **(Table 12)**

8. Results: Lin D et all(2010)[10] conducted a study, that show 11 cases in his study the results were excellent in 4 cases, good in 5 cases, fair in 1 case, and poor in 1 case. Zhang ZM et all(2012)[11] conducted a study, that show 12 cases Among them 4 cases got excellent results, 6 good, 1 fair, and 1 poor.Out of all 30 patients 07(23.33%) was Excellent, 20(66.66%) was good, 02(6.66%) was fair, 01(3.33%) was poor results. **(Graph 04)**

9. Range Of Motion At Knee: Chapman et all (1995) [12]) conducted a study that show 9 cases. The authors reported that none of their patients achieved flexion beyond 110 degrees (average,89.4 degrees) with four of the nine patients having a 5-degree deficit of extension. In their conclusion, the authors reflected on the likelihood that the high-energy injury by itself was the cause of this loss of motion but admitted that the additional medial arthrotomy and femoral exposure might have also been a contributing factor. we find that the addition of a medial buttress plate in selected cases is advantageous in maintaining alignment.

Of the 30 cases,4 (13.33%) patients have a Range Of Motion of 80-100*, 26 (86.66%) patients have a Range Of Motion of 101-120***(Table -09)** (**Graph 03)**

10. Complications: Lin D et all(2010)[10] conducted a study, that showed, Shallow local skin flap necrosis occurred in 2 cases. Zhang ZM et all(2012)[11]conduct a study, that show No infection, reduction loss, nonunion, or deep vein thrombosis occurred.

We had 9(30%) patients with complications. complications includes Superficial infection in 1(3.33%) patients, Joint stiffness in 5(16.66%) patients, Deep Infection in 1(3.33%) patient, Delayed union in 2(6.66%) patient and No Screw loosening , Implant failure &Mal union. (**Table 08).**

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CONCLUSION

All the end of this prospective study we found this method suitable for complex distal femur fractures AO Type C. The addition of a medial buttress plate resulted in better outcomes in comparison to single lateral buttress plates. Double platting was successful in achieving bony union without complications, like loss of reduction, implant failure, or breakage. Late angulation deformity or non-union is not seen in any case. Rigid fixation allowed early mobilization of the knee and enhance rehabilitation.

We conclude our study that double platting of AO Type C 1,2,&3 subtypes gave encouraging results in terms of functional outcomes in comparison to single lateral plates. We conducted an original study in all subtypes of AO types C. In last we recommend that further study on Type C specific sub-types will produce better results.

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