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Functional Outcomes of Intra Articular Distal End Femur Fractures Treated with Locking Compression Plating

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Abstract

Background: Distal femur fractures represent 4-6% of all the femoral fractures and they occur within the 9 terminal centimeters. Most distal femur fractures are the result of a severe axial load with a varus, valgus or rotational force. Though various treatment options are available for the management of these injuries with their own advantages and disadvantages, treatment of these fractures with the angle stable constructs using Locking compression plating remains the most desirable treatment option. **Objectives:** To study the functional outcomes and complications of intra-articular distal end femur fractures treated with Locking Compression Plating. **Materials and Methods:** A prospective observational study was conducted over a period of 3 years on 47 patients requiring operational intervention for distal end femur fractures. **Results:** We studied different parameters like age of the patients, mode of injury, type of injury according to AO classification, duration of hospitalization, movement of knee after operation, Neer's score results, union or non-union and compared our studies with other studies we find satisfactory results in our study in outcome of the patient As per the Neer's knee score, excellent and good outcome was seen in 48.9% and 38.3% cases while fair and poor outcome was seen in 8.5% and 4.3% cases respectively. **Conclusion:** From our study we concluded that Distal femoral-LCP, the "internal fixator" was a safe and reliable implant although careful preoperative planning and case selection were important factors which determine the final outcome.

Keywords: Distal Femur Fracture, Locking Plate

1. Introduction

The knee joint is superficial joint of lower extremity and complex movements of bones takes place during the motion at knee joint. In the last few decades, rapid industrialization and the fast pace of life have brought both comforts and catastrophe like road traffic accidents and crippling many young lives. These fractures are often difficult to treat, and they are associated with many complications[1,2]. Methods of treatment vary according to type, level of fracture and age of patient and are based on assessment of advantages and disadvantages associated with each. The goal of fracture treatment is to obtain union of the fracture in the most compatible anatomical position which allows maximal and full restoration of the extremity[2]. Distal femur fractures have been reported to account for 7% of all femoral fractures[3,4]. Distal femur fractures can result from either high-energy trauma or low-energy trauma. High-energy trauma such as road traffic accidents and sports accidents are more likely in men ages 15–50, whereas low-energy trauma such as falls from standing height at home are more likely to lead to distal femur fractures in women aged 50 and above[4]. They present considerable challenges in management.

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Prior to 1970, most supracondylar fractures were treated nonoperatively; however, angulatory deformities, knee joint incongruity, loss of knee motion, as well as the complications of recumbency led to better methods of treatment. During the past 40 years, operative techniques and implants have dramatically improved, and internal fixation is recommended for most distal femoral fractures in adults. Nonetheless, internal fixation of the distal femur can be difficult for several reasons: thin cortices, a wide medullary canal, compromised bone stock, and fracture comminution that make stable internal fixation often difficult to achieve. Treatment goals include preservation of soft tissues, restoration of articular congruity, and correction of anatomic alignment in the lower extremities, ensure joint stability, and achieve full range of motion. Adequate fixation and early achievement of postoperative range of motion are important for a good prognosis and adequate postoperative functioning. A lateral locking plate can provide adequate stability for comminuted or osteoporotic plateau fractures. Internal fixation with plate and screw remains treatment of choice for most periarticular fractures and other complex fractures. New locking plate designs have been developed in an attempt to preserve the blood supply of injured bone, improve the rate of fracture healing, decrease need for bone grafting, and incidence of infections and complications[1]. Locking compression plates with its numerous advantages is of great use in metaphyseal fractures. Locking compression plate has the advantage of combination of conventional compression plating and locked plating techniques which enhances the plate osteosynthesis. Locking compression plate acts as internal external fixator. In addition, a locking compression plate has got distinct advantages of unicortical fixation and least chance of plate back out as the screw gets locked to the plate. The present study was thus conducted to evaluate the functional outcome of intraarticular distal end femur fractures treated with locking compression plate and also to study the complications associated with it.

2. Materials and Methods

Study Area: Department of Orthopaedics, of a tertiary health care centre.

Study Population: All the patients with intra articular distal end femur fractures coming to our hospital and giving informed consent.

Study Design: A Prospective observational study

Sample Size Calculation: A total of 47 cases of intra articular distal end femur fractures were operated by Locking compression plating.

categories:

Study Duration: 2018 August – 2020 December.

Inclusion Criteria

1. Age > 18 years, irrespective of gender.
2. Category I and Category II of Neer and Associates classification Type 3 and Type 4 of Seinsheimer classification Type B and Type C of AO classification system – Muller and Associates.
3. All patients who gave their wilful consent to participate in the study.

Exclusion Criteria

1. Open fractures
2. Pathological fractures (Inflammatory Disorders, Infection, Inherited Disorders, Cancer, etc.).
3. Peri-prosthetic fractures

2.1 Methodology

A detailed history was taken mechanism of injury noted and relevant examinations done. X-rays knee AP and lateral taken to diagnose and classify the fracture. The other associated bony and soft tissue injuries also ruled out by clinical examinations and radiological investigations. The fractures were classified according to the AO/OTA classification.

Patients were given plaster slab or knee brace for temporary immobilization. Patients and relatives were thoroughly explained regarding the nature of study.

Informed consent was taken from all patients, fitting the inclusion and exclusion criteria.

In the operating room after induction of the patient by the anaesthetic team, pre-operative preparations like shaving and scrubbing of part, betadine paint and draping were done.

2.2 Surgical Techniques

1. **Position:** Patient is placed supine on a radiolucent table with a pillow below the knee. Knee is placed in slight flexion over a small sandbag or a triangular frame.

2. **Approach:** We commonly used extensile lateral approach for most intra articular distal femoral fracture. By avoiding dissection of the medial soft tissues in the distal femoral metaphyseal region, healing should proceed predictably.

3. **Reduction:** We first anatomically reduce articular fragments and provisionally stabilize them with k wires. Then the proper sized plate is selected, and the fracture is fixed. Then we insert minimum 5 screws including lag screws and locking head screws in distal expanded part and minimum 4 screws (8cortises) in proximal femoral diaphysis.

2.3 Surgical Steps

Postoperatively the patients were put on Intravenous Antibiotics and analgesics. Foot end elevation was advised for all patients. Sutures were removed on 12th to 14th postoperative day. Patients were taught quadriceps strengthening exercises and knee mobilization in the immediate post-operative period. For all stable fractures partial weight bearing was started on 3rdweek, for unstable fracture weight bearing was delayed up to 6thweeks or even later. Full weight bearing was started at 6 to 8 weeks for stable fractures, in case of unstable fracture weight bearing was started at the end of 10–12 week. Patients were advised to follow up on 2nd week (for suture removal), 6th week, 3rd month and 6th month. Functional Outcome in Patients was assessed using the Neer's Knee Score[22].

Interpretation (Neer's Knee Score)
Excellent: 86-100 points
Satisfactory: 70-85 points
Unsatisfactory: 55-69 points
Failure: < 55 points

2.4 Statistical Analysis

Statistical Analysis The quantitative data was represented as their mean ± SD while categorical and nominal data was expressed in percentage. The paired t-test was used for analysing quantitative data while categorical data

Figure 1. Patient positioning and draping.

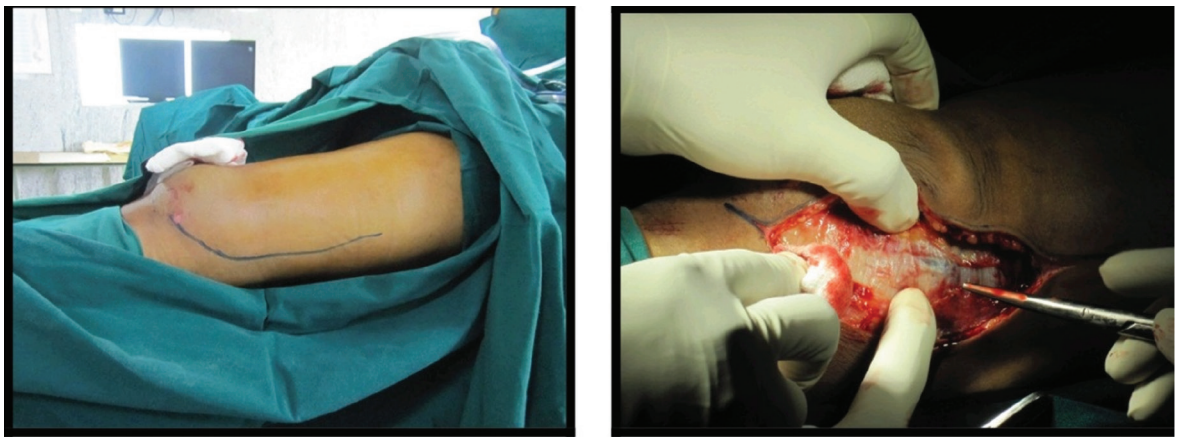

Figure 2. Incision and exposure.

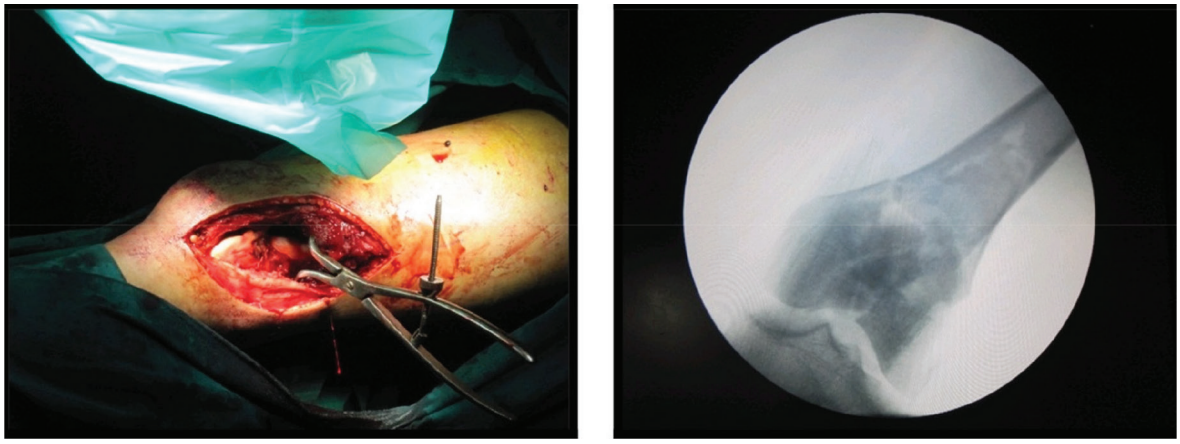

Figure 3. Fracture reduction under C ARM guidance.

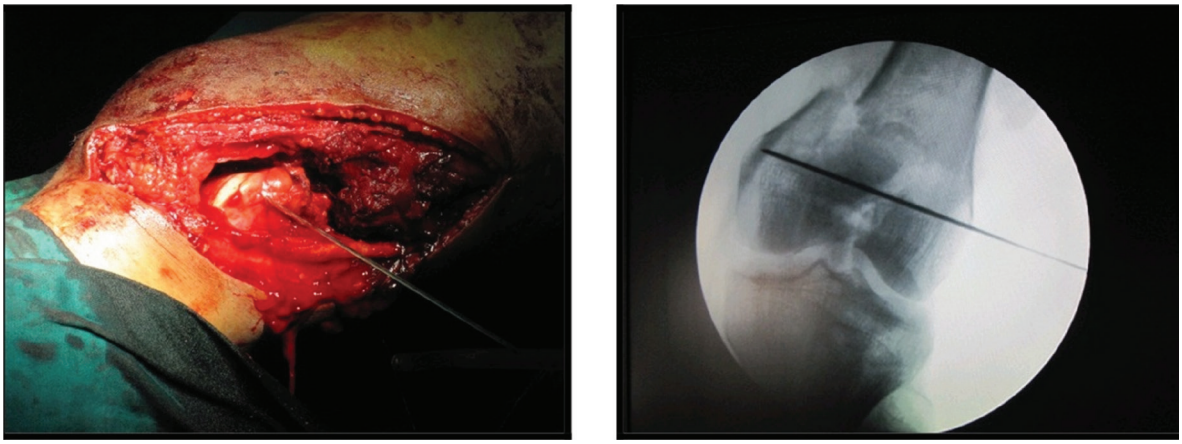

Figure 4. Provisional fixation with k wire and check under C-arm.

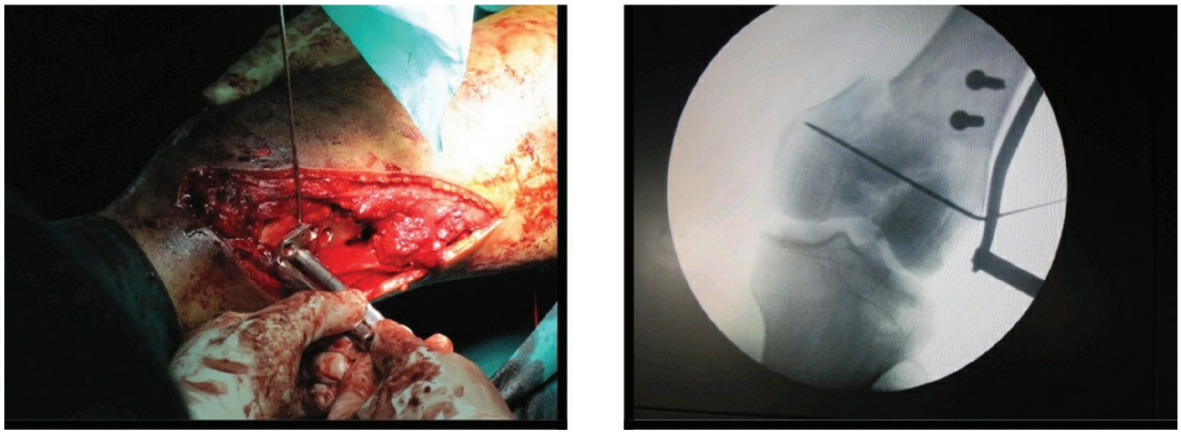

Figure 5. Placement of LCP and check under C-arm.

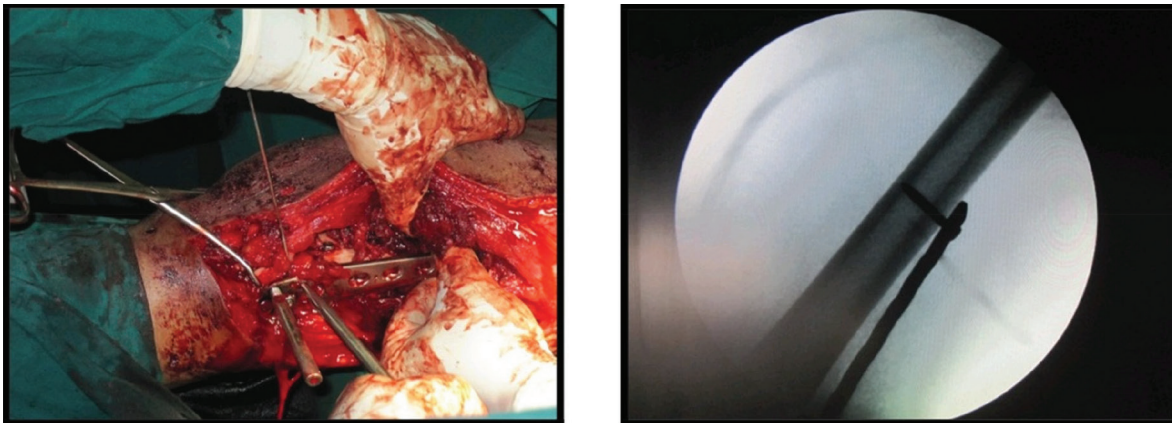

Figure 6. Shaft exposure and screw insertion.

was analysed by using chi-square test. The significance threshold of p-value was set at <0.05. All analysis was carried out by using SPSS software version 21.

3. Results

Table 1. Distribution of study subjects based on age group

Age group (yrs)	N	%
21-30	13	27.7%
31-40	3	6.4%
41-47	17	36.2%
51-60	9	19.1%
61-70	5	10.6%
Total	47	100.0%
Mean age - 43.4 +/- 13.90 years		

Mean age of the study subjects was 43.4 years with almost half of the subjects were between 41-60 years of age (Table 1).

Table 2. Distribution of study subjects based on Gender

Gender	N	%
Female	15	31.9%
Male	32	68.1%
Total	47	100.0%

Male predominance was observed in the study with 68.1% males to 31.9% (Table 2).

Table 3. Distribution of study subjects based on mode of injury

Mode of Injury	N	%
Fall	16	34.0%
RTA	31	66.0%
Total	47	100.0%

Most common mode of Injury was road traffic accident (66%) followed by fall (34%) (Table 3).

Table 4. Distribution of study subjects based on AO classification

AO Classification	N	%
B1	5	10.6%
B2	11	23.4%
B3	2	4.3%
C1	9	19.1%
C2	9	19.1%
C3	11	23.4%
Total	47	100.0%

The above table shows the AO classification of distal femur fractures. Most common type was AO type B2 and C3 (23.4% each). The overall prevalence of type B and C fractures were 38.3% and 61.7% respectively (Table 4).

Table 5. Distribution of study subjects based on radiological union time

Radiological Union	N	%
16-18 weeks	12	25.5%
18-20 weeks	19	40.4%
20-22 weeks	6	12.8%
22-24 weeks	5	10.6%
> 24 weeks	3	6.4%
Non union	2	4.3%
Total	47	100.0%
Mean - 18.06 +/- 2.5 weeks		

Mean radiological time for fracture union was 18.06 weeks with delayed union i.e. union beyond 24 weeks and non-union was seen in 6.4% and 4.3% cases respectively (Table 5).

Table 6. Distribution of study subjects based on presence of pain at follow up visit

Pain	N	%
3 months	12	25.5%
6 months	5	10.6%
12 months	2	4.3%

Pain at 3rd month follow up was seen in 25.5% cases while at 6th and 12th month follow up was seen in 10.6% and 4.3% cases (Table 6).

Table 7. Distribution of study subjects based on incidental complications

Complications	N	%
Delayed Union	3	6.4%
Mal union	2	4.3%
Infection	1	2.1%
Non-union	2	4.3%
None	39	83.0%

Delayed union was seen in 6.4% while mal-union and non-union was seen in 4.3% cases each. Superficial infection was seen in 1 case (2.1%) (Table 7).

Table 8. Distribution of study subjects based on functional outcome

Functional Outcome	N	%
Excellent	23	48.9%
Satisfactory	18	38.3%
Unsatisfactory	4	8.5%
Failure	2	4.3%
Total	47	100.0%

As per the Neer's knee score, excellent and good outcome was seen in 48.9% and 38.3% cases while fair and poor outcome was seen in 8.5% and 4.3% cases respectively (Table 8).

4. Discussion

Fractures around knee are challenging injuries despite improvements of fixation techniques and plate designs. Some authors[5] have demonstrated the ability of locked plates to absorb more energy before failure compared with conventional non-locking plates, angled blade plates, thereby having a lower incidence of loss of fixation. Although no agreement exists on management of complex fractures, the results reported by several authors suggest modern locking plates represent an advance for fixing different fracture patterns in this region[6–13]. Present hospital based observational study was conducted at Department of orthopaedics of a tertiary care centre. The aim of the study was to evaluate the functional outcomes and complications of intra-articular distal end femur fractures treated with Locking Compression Plating. Study included a total of 47 patients coming to our hospital with distal femur intra-articular fractures and giving informed consent to participate in the study. The fractures were classified according to the AO/OTA classification. Functional outcome in patients was assessed using the Neer's knee score at 12th month.

4.1 Demography

Mean age of the study subjects in present study was 43.4 years with almost half of the subjects were between 41–60 years of age (55.3%). Male predominance was observed in the study with 68.1% males to 31.9% females. In a study by

Singh *et al.*[6] for fractures around knee joint, mean age of the patients were 36 years and there were 20 males and 2 females. Machhi *et al.*[14] in their study observed that out of 20 patients, 14 were males and 6 were females with mean age of 41.7 years. Mean age in the study by Jhatoth *et al.*[15] was 44 years with 75% males to 25% females. Bhimani *et al.*[16] in their study observed the mean age as 44 years with 70% males to 30% females. The male predominance can be attributed to more outdoor activities by males, so they are more prone to vehicular accident and falls while most females our study were housewives who were less exposed to road traffic accidents.

4.2 Mode of Injury

In present study, common mode of Injury was road traffic accident (66%) followed by fall (34%). In the study by Singh *et al.*[6] most of the injuries were caused by road traffic accidents (70%) affecting mostly males. Jhatoth *et al.*[15] observed mode of injury as RTA in 75% cases and fall in remaining 25% cases. Most common mode of injury observed in the study by Bhimani *et al.*[16] was RTA (63.3%) followed by history of fall (36.7%). Lee *et al.*[17] in a similar study, observed an incidence of RTA in 80% cases, 11.4% due to fall from height, 5.8% due to blow and 2.8% due to shotgun injury Thus results observed in our study were in sync with other studies that most of the fractures around the knee are caused by road traffic accidents and falls.

4.3 Type of Fracture

In present study, most common type was AO type B2 and C3 (23.4% each). The overall prevalence of type B and C fractures were 38.3% and 61.7% respectively. Out of the 9 distal femur fractures observed by Singh *et al.*[6], there were 7 type-3c fractures and 2 type-3a fractures. In a study by Menon *et al.*[8], out of 25 cases of distal femur, there were eight cases of C3 type, seven A2, six A3, two C2 and a case each of C1 and A1 type according to AO/ OTA classification system. Jackson *et al.*[17] in their study of 36 patients of fracture around knee joint reported 27 type-C patients and 9 type-B patients. Machhi *et al.*[14] in their study observed that out of 20 cases, 4 patients had C1, 10 had C2 and 6 had C3 type of fracture according to AO classification. Jhatoth *et al.*[15] observed that according to the AO/ Muller's classification of distal femur, n = 4 (12.5%) fractures were Type A1, n = 11 (34.37%) Type C1, n = 11 (34.37%) Type C2 and n = 6 (18.75%) Type C3.

Figure 7. Pre-operative radiograph.

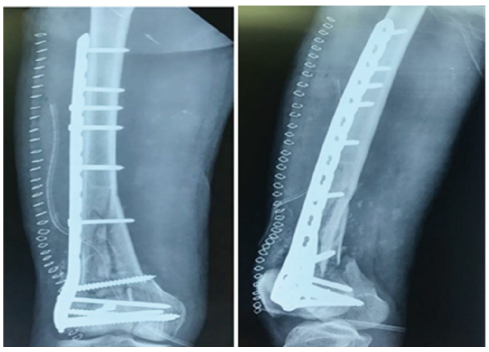

Figure 8. Immediate post-operative radiograph.

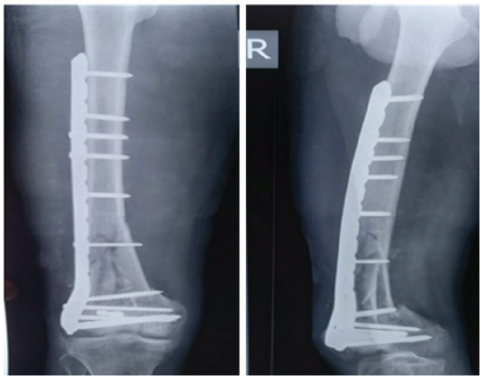

Figure 9. 6 weeks post-operative radiograph.

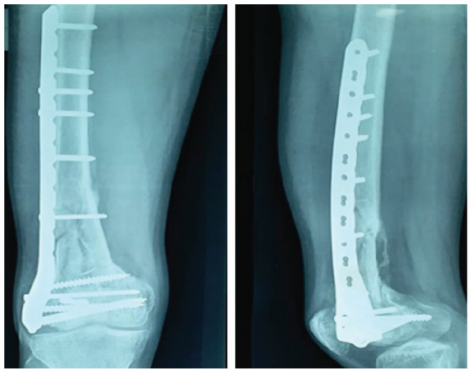

Figure 10. 12 weeks post operative radiograph.

Figure 11. Post op 12 weeks knee range of motion.

4.4 Radiological Union

Mean radiological time for fracture union was 18.06 weeks with 25.5% showed union by 18th week, 66.0% showed union by 20th week and 88.7% showed union by 24th week. Virk *et al.*[18] in their study observed that union was achieved in all patients with mean time to radiological union being 19 weeks. Average time for fracture healing was 20 weeks in the study by Machhi *et al.*[14]. Jhatoth *et al.*[15] observed that 87.5% cases showed radiological union within 20 weeks and the average time for union was 16 weeks. Bhimani *et al.*[16] observed meantime for fracture union was clinically 16 weeks and radiologically 20 weeks.

4.5 Complications

Pain at 3rd month follow up was seen in 25.5% cases while at 6th and 12th month follow up was seen in 10.6% and 4.3% cases. Delayed union was seen in 6.4% while mal-union and non-union was seen in 4.3% cases each. Superficial infection was seen in 1 case (2.1%). Sahu *et al.*[19] in their study observed mal union was seen in 5.83% while delayed union was seen in 2.5%. Virk *et al.*[18] in their study observed 12% patients developed complications in the form of infection (8%) and mal union (4%) during our study. Machhi *et al.*[14] in their study observed superficial infection and non-union rate as 5% each. Jhatoth *et al.*[15] observed mal-union and non-union rate of 3.12% each in their study while delayed union was seen in 6.25% cases.

4.6 Functional Outcome

As per the Neer's knee score, excellent and good outcome was seen in 48.9% and 38.3% cases while fair and poor outcome was seen in 8.5% and 4.3% cases respectively. Overall proportion of excellent to good outcome was 87.2%. Sahu *et al.*[19] in their study observed that results were excellent in 66.47% (113/170) patients, and good in 22.35% (38/170) patients. Virk *et al.*[18] in their study observed excellent to good outcome in 80% cases. In the study by Machhi *et al.*[14], among 20 patients there were 9 (45%) excellent result, 5 (25%) good results, 3 (15%) had fair results and 3 (15%) had poor results. Ramu *et al.*[20] observed in their study that overall, 9 cases (30%) had excellent rating, 14 cases (45%) had satisfactory rating and 7 cases (25%) had unsatisfactory rating. Jhatoth DS *et al.*[15] observed Out of n = 32 subjects, the functional outcome was Excellent in n = 19 (59.38%) subjects, Good in n = 6 (18.75%), Fair in n = 5 (15.63%) and Poor in only 2 (6.25%) cases. Functional outcome was analysed by Choudhary *et al.*[21], according to the NEERS knee scoring system, where 10 (40%) observed excellent result, 5 (20%) observed good results, 7 (28%) observed fair result and 3(12%) observed poor results. Bhimani *et al.*[16] observed that out of the 30 cases, 19 patients had an excellent result (63.3%); 6 had good (20%); 4 had fair (13.3%), and 1 (3.3%) had poor result according to Neer's Scoring system.

5. Conclusion

Study concluded that locking compression plate represents an evolutionary approach to the surgical management of distal femoral fractures, but it does not completely solve the age-old problems of non-union and mal-union. It is an economical and safe fixation system for the treatment of fracture of any part of the long bones. The rate of union as well as increased range of motion, improved healing

rate, restoration of articular surface, better biomechanical stability, decreased complication rates, decreased incidence of re-operation, early rehabilitation makes it a good treatment option. Therefore, if preoperative planning and biomechanical principles are followed, LCP may provide excellent fixation in difficult situations offering good treatment option.

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