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Evaluation of the Outcome of Open Reduction and Internal Fixation with Distal Femoral Locking Plate for Closed Supracondylar Fracture of Femur

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Abstract

Background: *Supracondylar fractures of femur are historically difficult to treat because they are highly unstable and comminuted and tend to occur usually in young and multiply injured patients due to high velocity trauma. This study is designed for closed supracondylar fracture of femur AO or Muller's type 33-A to assess the final outcome fixed with distal femoral locking plate by ORIF technique.*

Objective: *To evaluate the outcome of open reduction and internal fixation (ORIF) with distal femoral locking plate for closed supracondylar fracture of femur of AO or Muller's type 33-A.*

Materials & Methods*: This study was carried out at the Department of Orthopaedic Surgery, Faridpur Medical College Hospital, Faridpur, Bangladesh from 01st June 2017 to 31st July 2018. It was a descriptive observational study. By purposive sampling technique, 22 cases (n=22) were included according to the inclusion and exclusion criteria. Data was collected by face to face interview. All patients were managed initially according to ATLS guidelines. Proper preoperative evaluation was done for anesthesia. The patients were evaluated clinically and radiologically for 6 months after operation with 5 follow up and final outcome was assessed by NEER's knee score. 1st follow up:1st week, 2nd follow up: 2nd weeks, 3rd follow up: 6th weeks, 4th follow up: 3rd months & 5th follow up: 6th month.*

Results: *The present study shows that among the patients, 16 (72.7%) were male and 6 (27.3%) were female. Most of the patients 10 (45.5%) were belonged to the age group 40-60 years. The mean age of the patients was 42.7±11.4 years and age range were 18 to 68 years. Highest 11 (50.0%) patients had grade 2 soft tissue injury. Maximum 9 (40.9%) patient's radiological type of fracture was comminuted (A_3). Out of 7 (31.8%) patients with comorbidities; 4 (18.2%) patients had Diabetes Mellitus and 3 patients had HTN. In postoperative period, plaster duration of 13 (59.1%) patients were 2 weeks. All patients (100%) were radiological features of healing after 5th follow up (6 months) but 2 patients shown delayed union. The average length of hospitalization was 15 days with a range of 10 to 25 days. The average number of days from injury to surgery was 9 days with a range of 5 to 14 days. After final follow up; 16 (72.7%) patients shown excellent outcome, 4 (18.2%) patients shown good result, 2 (9.1%) patient shown fair result and no patient shown poor result according to Neer's knee criteria.*

Conclusion: *Knee stiffness is the most common complication following these fractures. There were no cases with loss of fixation. Two cases were delayed union but shown radiological features of union in final follow up. At the final follow up 6 months after operation, 72.7% patients shown the excellent result according to Neer's knee criteria. Therefore, the distal femoral locking plate provides a stable fixation in comminuted fractures.*

Key Words: *Open Reduction; Internal Fixation; Supracondylar fractures; Femur*

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I. Introduction

The femur is the largest tubular bone in the body connecting between tibia and pelvic bone. It is surrounded by the largest mass of muscles, having three portions as proximal, middle and distal third. The distal femur (supracondylar and intercondylar) comprises the distal about 10 to 15 cm of the femur [1]. The supracondylar area is defined as the zone between the femoral condyles and femoral diaphysis [2]. Femur is almost cylindrical in most of its length and bowed with a forward convexity [3]. It is narrowest in the mid shaft, expands a little as it is traced upward and widens appreciably near the lower end of the bone [4]. Distal femoral fracture is classified as Muller's type A (extraarticular), type B (Intra articular unicondylar) and type C (both intra & extra articular). In my thesis study I included only Muller's type A fractures which is extra articular. Distal femoral fractures account for about 7% of all femoral fracture [5]. These fractures have got wide variety of fracture patterns and they are commonly associated with open wounds, ligament disruption of knee, fractures of acetabulum, femoral neck, shaft of tibia, patella etc. These serious injuries have the potential risk to produce significant long-term disability especially when they are associated with extensive articular cartilage damage, marked bone comminution and severe soft tissue injury [6]. Supracondylar fractures of femur have a catastrophic event with bimodal distribution and occur most frequently in young men after high energy trauma and in elderly women after a low-energy fall [1,4].

Several methods of treatment are now available; the choice of a particular method being determined by the type, location, degree of comminution, age of the patient, surgeon's expertise and the availability of implants and instruments. The surgical goals of treatment are anatomic reduction of the fracture, restoration of limb length and function; bone grafting is necessary for extensive bone loss and old fracture. Stable fixation allows early mobilization of knee. Metaphyseal comminution is a challenge to conventional plate fixation. Among the operative managements; locking compression plate gives one of the best clinical results especially in highly comminuted and osteoporotic fractures where intramedullary fixation cannot be applied due to very short distal fragment [7, 8, 9]. Locking compression plates allows both locking and compression screw fixation of the femur shaft. The pullout strength of locking screws is substantially higher than that of conventional screws and it is difficult for one screw to pull out or fail unless all adjacent screws do so.

This enables a better hold in osteoporotic bones. The preservation of osseous viability using indirect reduction methods has led to an increase in fracture union rates without the need for supplemental bone grafting procedures. These plates are designed to apply in minimally invasive fashion to preserve local biology and avoid problems with fracture healing and infection. These locking plates forms a fixed angle construct and enables placement of the plate with a limited contact to the bone [10, 11, 12, 13]. Despite the advances in techniques and the improvements in surgical implants, treatment of supracondylar femoral fractures remains a challenge in many situations. Thus, the purpose of this study was to evaluate the rate of union, functional outcome and complications of these fractures treated with open reduction and internal fixation with a distal femoral locking plate for closed supracondylar fracture of femur.

II. Objectives of The Study

General Objectives:

To evaluate the clinical and radiological outcome of open reduction & internal fixation with distal femoral locking plate for closed supracondylar fracture of femur.

Specific Objectives:

To assess the outcome of early knee mobilization.

To evaluate the status of fracture healing radiologically.

To assess the rate of infection.

To assess the range of motion (ROM) of the knee joint. To assess the other complications like knee stiffness.

III. Review of Literature

Controversy still exists regarding the surgical treatment method of distal femoral fractures. Internal fixation procedures are dependent on fracture type and the surgeon's preference. While intramedullary nails have comparable advantages than locking plates. Its benefits are percutaneous placement, indirect fracture reduction, soft tissue protection and high healing rates. It shows success in osteoporotic bone [14]. Locking plates become the most commonly used method to stabilize fractures of the distal femur [15]. Techniques are improved for distal femoral fixation with locking plates compared to blade plate. Retrograde nailing is not suitable for osteoporotic bone [16]. Although locking plates have provided a valuable additional option for treatment of distal femoral fractures, it has some complications like nonunion, delayed union, infection, knee stiffness and implant failure. Earlier studies have shown reduced nonunion rates with locking plates for distal femoral fractures compared to non-locking plates [17]. But more recent studies found nonunion rates is up to 20% [18, 19]. Multiple reasons influence union rates. Higher stiffness of knee with locking plate is related with prolonged immobilization, adhesion of tendones, soft tissue injury and callus formation [20]. But in a systematic review comparing traditional plating, intramedullary nails and locking plates; no differences were found between implants regarding the rate of nonunion, infection, fixation failure and revision surgery [14]. Titanium has been noted to have superior biocompatibility with an elasticity modulus more similar to bone than stainless steel [21]. Therefore, stiffer stainless-steel implants are related to higher nonunion rate [22]. Though, this was based on unpublished data. On the contrary, biomechanical testing demonstrated only a significantly greater stiffness of the knee in stainless steel plates (LISS- Less Invasive Stabilization System) [21]. A different study by Henderson found no significant difference between non-union rates for stainless steel and titanium ($p = 0.71$) [18]. Supracondylar fractures of femur are notoriously difficult to treat because they are highly unstable and comminuted and tend to occur usually in elderly and multiply injured patients. Because of strong muscular attachment it is difficult to maintain it in proper alignment without fixation. Also because of their proximity to knee, regaining full knee motion is usually more difficult.

Classification

The Muller AO classification [23] is the most widely used system to categorise distal femoral fractures (Fig. 1). [24, 25, 26] have proposed classification systems as well, but these did not prevail. Moreover, the AO classification unanimously has gained acceptance for distal femoral fractures. According to the common principles of the AO classification, type A fractures are extra-articular and type B fractures are intraarticular (unicondylar). Type C fractures are both intra and extraarticular fractures. The fracture types are further subdivided describing the degree of fragmentation and other characteristics. Further subdivision of type A fractures are A1 (simple transverse/oblique), A2 (comminuted with butterfly fragment) and A3 (extremely comminuted). Type B fractures include B1 (sagittal, lateral condyle), B2 (sagittal, medial condyle) and B3 (coronal, Hoffa type). Fracture type C is divided in C1 (articular simple, metaphyseal simple), C2 (articular simple, metaphyseal multifragmentary) and C3 (multifragmentary both articular and metaphyseal).

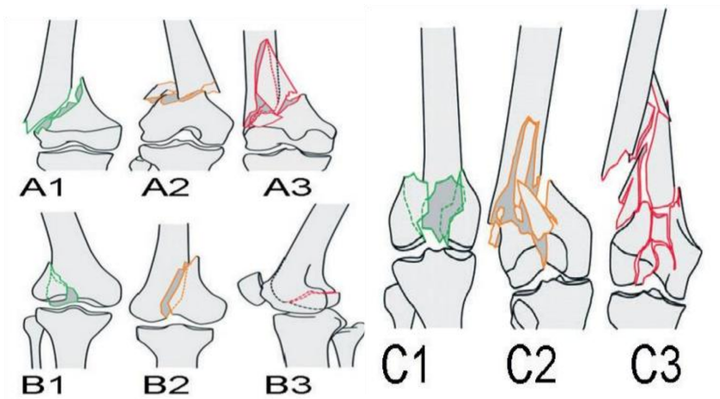


Fig. 1. Müller AO classification for distal femoral fractures (region 33) from www.aofoundation.org.

Surgical anatomy of distal femur

The femur is the largest tubular bone in the body connecting between tibia and pelvic bone. It is surrounded by the largest mass of muscles, having three portions as proximal, middle and distal third. The distal femur (supracondylar and intercondylar) comprises the distal about 10 to 15 cm of the femur [1]. The supracondylar area is defined as the zone between the femoral condyles and femoral diaphysis [2]. Femur is almost cylindrical in most of its length and bowed with a forward convexity [3]. It is narrowest in the mid shaft, expands a little as it is traced upward and widens appreciably near the lower end of the bone [4].

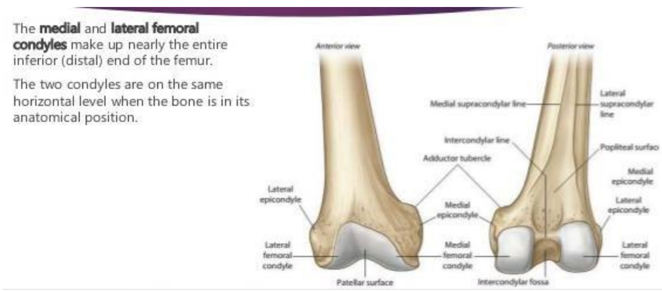


Fig: Anatomy of distal femur

Surgical Approach

The choice of surgical approach mainly depends on the type of fracture and implant. The supine position of the patient is preferred. Typically, the knee is slightly flexed 30° by supporting it with paddings, which releases traction of the gastrocnemius muscle and prevents extension of the distal fragment. Draping free of both legs allows for intraoperative comparison of length, axes and rotation in relation to the well leg. The lateral approach to the distal femur allows for visualization of reduction and fixation of most of the fractures. (Fig. 2).

Fig. 2. Position of patient.

The approach relies on an atraumatic elevation of the vastus lateralis from the lateral aspect of the distal femur, and a lateral arthrotomy for joint access. Articular reduction and lateral plate application can both be achieved with the same approach. In addition, the approach may be extended proximally to display the entire length of the femoral shaft. Fractures of the medial femoral condyle and more complex fractures are better exposed with a lateral or rarely medial para-patellar approach that provides good view of the articular surface of the distal femur (Fig. 3).

Fig. 3. Lateral approach for distal femur and Position of plate along the axis of bone.

To gain full exposure to the knee Joint, the patella has to be dislocated medially or laterally respectively through marginal longitudinal incision of the quadriceps tendon and extensor mechanism. The lateral minimally invasive approach for plate osteosynthesis (MIPO) consists of a short lateral approach overriding the lateral condyle to the distal femur as well as a short lateral approach to the midshaft or proximal femur depending on plate length, and small stab incisions for direct reduction and percutaneous screw placement A medial approach to the distal femur may be used to expose a medial distal femoral or Hoffa-type fractures. A small transligamentous approach through the patellar tendon serves for insertion of a retrograde nail. Two anatomical structures are at risk using this approach. The common peroneal nerve and the popliteal vessels are mostly injured during dissection and inadvertent retraction with bone lever. The posterior cruciate ligament is also most important structure one should take care for. Furthermore, cartilage in the weightbearing zone may be damaged.

Non-operative: Result is not satisfactory due to displacement of fracture site. Where operation is high risk, patient refused operation; skeletal traction is applied for 6 to 8 weeks followed by rehabilitation is recommended.

IV. Materials And Methods

It was a descriptive observational study. This study was carried out at the Department of Orthopaedic Surgery, Faridpur Medical College Hospital, Faridpur, Bangladesh from 01st June 2017 to 31st July 2018. Study period was 14 months from June 2017 to July 2018. The patients who have closed supracondylar fracture of femur admitted during the study period at the Department of Orthopaedic Surgery, Faridpur Medical College

Hospital, Faridpur, Bangladesh. An arbitrary sample of 22 patients were enrolled for the present study and applied Purposive sampling. Supracondylar fracture of femur patients who were admitted at the Department Orthopedic surgery, Faridpur Medical College Hospital, Faridpur, Bangladesh were selected for the study. Maintaining selection criteria data were collected through face to face interview from the patient in a pre-designed and pre-tested questionnaire. Informed consent form describing the purpose of the study was provided. Detailed history was taken as age, sex, socioeconomic status, history of complications and investigations were evaluated from history sheet, discharge paper and documented investigation result sheet.

Collected data was sorted and screened for any discrepancy and edited for finalized result. After editing and coding, the coded data were analyzed by SPSS®22. Data analysis After collection all the data were checked and edited. Then data were entered into the computer with the help of software SPSS for windows programmed version 22.0. After frequency run, data were cleaned and frequencies were checked. An analysis plan was developed keeping in view with the objectives of the study. A descriptive statistical analysis was carried out in the present study. Results on continuous measurements were presented on mean ± SD (minmax) and results on categorical measurements were presented in number (%). Significance was assessed at 5 % level of significance. Data were presented in the form of figures, tables and graphs. Descriptive statistics were presented with frequency table. Computer program used for data analysis: SPSS® 22. Statistical significance levels set: A "P" value <0.05 was considered as significant.

V. Results

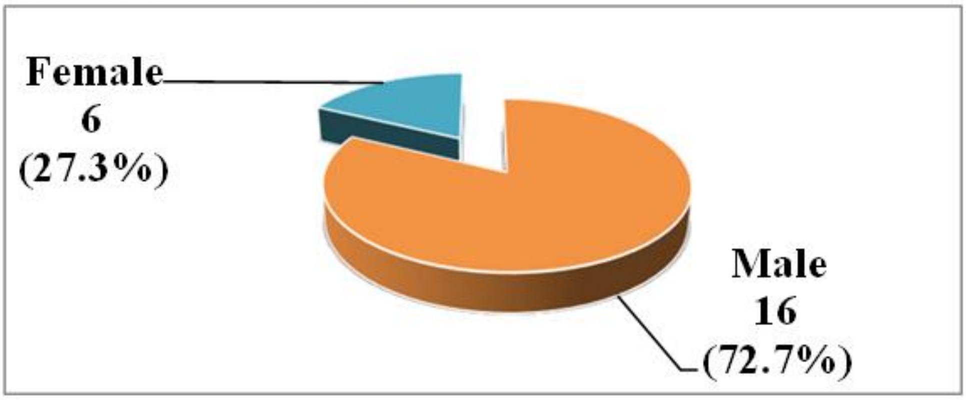
The results are shown in following tables and figures:

Table-1: Age distribution of the patients

Age	Number	Percentage	Mean±SD
Years	9	40.9	42.7±11.4
Years	10	45.5	
Above 60 years	3	13.6	
Total	22	100.0	

The table shows that 9 (40.9%) patients were belonging to the age group 18-39 years, 10 (45.5%) patients were belonging to the age group 40-60 years and only 3 (13.6%) patients were belonging to above 60 years age group. The mean age of the patients was 42.7±11.4 years. So, 5th and 6th decades are the most vulnerable age group of this study.

Figure -1: Sex distribution of the patients



The figure shows that most of the patients 16 (72.7%) were male and 6 (27.3%) patients were female.

Table-2: Soft tissue injury during fracture: According to Tscherne grading system.

Soft tissue injury	Number	Percentage (%)
grade 0	3	13.6
grade 1	8	36.4
grade 2	11	50.0
grade 3	0	00.0
Total	22	100.0

The table shows the grade of soft tissue injury during fracture. Highest 11 (50.0%) patients had grade 2 soft tissue injury, 8 (36.4%) patients had grade 1 soft tissue injury and 3 (13.6%) patients had grade 0 soft tissue injury.

Table-3: Radiological type of the fractures

Radiological classification	Number	Percentage (%)
Transverse (A1)	7	31.8
Oblique with butterfly(A2)	6	27.3
Comminuted (A3)	9	40.9
Total	22	100.0

The table shows that 9 (40.9%) patients radiological type of fracture was comminuted fracture (A_3), transverse fracture (A_1) 7 (31.8%) and oblique fracture with butterfly fragment (A_2) were 6 (27.3%) patients.

Table-4: Comorbidities of the patients (n=7)

Comorbidities	Number	Percentage (%)
DM	4	18.2
HTN	3	13.6
Total	7	31.8

The table shows that out of total 22 (100.0%) patients only 7 (31.8%) patients had comorbidities. Out of these 7 (31.8%) patients, 4 (18.2%) patients had Diabetes Mellitus and 3 (13.6%) patients had Hypertension. All these patients were well controlled medical disease by drugs during surgery.

Table-5: Duration (weeks) of post-operative plaster immobilization

Duration of post-operative plaster (week)	Number	Percentage (%)
1 week	5	22.7
2 weeks	13	59.1
3 weeks	4	18.2
Total	22	100.0

The table shows that 13 (59.1%) patients plaster duration were 2 weeks, 5 (22.7%) patients was 1 week and 4 (18.2%) patients were 3 weeks due to AO-33 A_3 and osteoporotic bone. Postoperative duration of immobilization of knee was depended on soft tissue injury, quality of fixation, quality of bone and fracture pattern.

Table-6: Passive knee movement allowed after (days)

Knee movement allowed after	Number	Percentage (%)
7 days	6	27.3
14 days	12	54.5
23 days	4	18.2
Total	22	100.0

The table shows that 12 (54.5%) patient's passive knee movement were allowed after 14 days and 6 (27.3%) patients were after 7 days and 4 (18.2%) patients were 23 days after operation. Passive assisted knee movement was allowed on the basis of fracture type, soft tissue condition, bone quality and quality of fixation.

Table-7: Range of motion (flexion) of the patients

Range of motion (flexion)	1st Follow up (7 d)	2nd Follow up (14d)	3rd Follow up(6w)	4th Follow up (3m)	5th Follow up (6m)
<60□	16	0	0	0	0
60□-89□	3	12	2	0	0
90□-110□	3	7	11	6	3
>110□	0	3	9	16	19

The table shows that in the 1^{st} follow up highest 16 patients range of motion (flexion) were <60□, 3 patients
60□-89□ and 3 patients 90□-110□. In the 2^{nd} follow up maximum 12 patient's rom flexion were 60□-89□, 7 patients were 90-110□ and 3 patients were patients > 110□. In 3^{rd} follow up 2 patients rom flexion were 60□89□, 11 patients were 90-110□ and 9 patients were > 110□. In 4^{th} follow up highest 16 patient's ROM flexion were >110□ and 6 patients were 90□-110□.In final follow up at 6^{th} months, the ROM of knee was $>110^0$ in 19 patients and only 3 patients had within $90\text{-}110^0$.

Tabe-8: Surgical site infection of the patients: According to Southampton classification

Surgical site infection(No)	1st Follow up (7 d)	2nd Follow up (14 d)	3rd Follow up (6w)	4th Follow up (3 m)	5th follow up (6m)
Grade 0 infection	18	19	20	20	21
Grade I infection	4	3	0	0	0
Grade II infection	0	0	2	0	0
Grade III infection	0	0	0	2	0
Grade IV infection	0	0	0	0	1

The table shows that in the 1^{st} follow up grade 0 infection was found 18 patients, grade I infection 4 patients, and no patient was found of grade II or grade III infection. In 2^{nd} follow up grade 0 infection was found 19 patients, grade I infection was 3 patients, grade II, III or grade IV infection was 0 patients. In 3rd follow up, grade 0 infection was found in 20 patients, grade I infection was 0 patients, grade II infection was in 2 patients and no patient were found of grade III and grade IV infection. In 4th follow up, grade 0 infection was found 20 patients, grade III infections were found in 2 patients, no patient was found in grade I, II and grade IV infections. In 5^{th} follow up, only one patient had grade IV infection and other 21 patients had no infection. The patients with superficial surgical site infection were under antibiotic coverage after culture and sensitivity study of pus, regular dressing and nutritional support.

Table-9: Weight bearing status of the patients

Weight bearing status	1st Follow up (7 d)	2nd Follow up (14 d)	3rd Follow up (6 w)	4th Follow up (3 m)	5th follow up (6 m)
No weight bear	22	22	6	0	0
Partial weight	0	0	16	4	0
Full weight	0	0	0	18	22

The table shows that in 1^{st} and 2^{nd} follow up no patient was permitted to bear weight. In 3^{rd} follow up 16 patients were advised to bear partial weight bearing. In 4^{th} follow up, 18 patients could bear their full weight and 4 patients were continuing partial weight bearing. In final follow up at 6 months, all 22 patients could bear full weight.

Table-10: Pain after operation (Visual Analogue Scale)

Pain status	1st Follow up (7d)	2nd Follow up (14d)	3rd Follow up (6 w)	4th Follow up (3m)	5th Follow up (6m)
No pain	0	0	4	14	18
Mild	0	5	14	8	4
Moderate	22	17	4	0	0

The table shows that in 1^{st} follow up, all patients had moderate pain. In 2^{nd} follow up, 5 patients felt mild pain and 17 patients felt moderate pain. In 3^{rd} follow up, 4 patients felt no pain, 14 patients felt mild pain and 4 patients felt moderate pain. In 4^{th} follow up, 14 patients felt no pain, 8 patients felt mild pain and no patients felt moderate pain. In 5^{th} follow up, 18 patients had no pain and 4 patients had mild pain during extreme ROM of knee. No patient was suffering from severe or excruciating pain after operation. All patients were relieving pain gradually during in postoperative follow up.

Table-11: Reduction status of the fractures (Radiologically)

Reduction status	1^{st} Follow up (7d)	2^{nd} Follow up (14 d)	3^{rd} Follow up (6 w)	4^{th} Follow up (3 m)	5^{th} Follow up (6 m)
Good position	18	18	17	16	16
Mild displacement <5 mm, < 10^0	4	4	4	4	4
Displaced >5 mm, > 10^0	0	0	1	2	2

The table shows that while 1^{st} follow in up, during the postoperative radiological evaluation; 4 patients were mildly displaced because there were not possible to anatomical reduction of fracture due to severe comminution. But others shown good anatomical reduction. In 2^{nd} follow up, 4 patients' fracture were found mild displacement (<5 mm & less than 10^0 angulations). In 3^{rd} follow up, 17 patients' fracture were found in good position; 4 patients' fracture were found mild displacement (<5 mm & less than 10^0 angulations) and 1 patients' fracture were found displaced (>5 mm more than 10^0 angulations). In 4^{th} follow up and 5^{th} follow up, 16 patients' fracture were found in good position; but 4 patients' fracture was found mild displacement (<5 mm & less than 10^0 angulations) and 2 patients' fracture were found displaced (>5 mm and more than 10^0 angulations). Reduction status had gradually detoriated in two patients during allowing passive and active movement of knee and partial weight bearing.

Table-12: Healing status of the surgical wound

Healing status	1^{st} Follow up (7 d)	nd Follow up (14 d)	3^{rd} Follow up (6 w)	4^{th} Follow up (3 m)	5^{th} Follow up (6m)
Well healed	Not Assessed	19	20	20	21
Not healed	Not Assessed	3	2	2	1

The table shows that in 1^{st} follow up (7 days) time was not enough to heal the surgical wound. In 2^{nd} follow up, 19 patients' surgical wound were well healed and 3 patients were not healed. In 3^{rd} follow up and 4^{th} follow up, surgical wound was well healed in 20 patients. Two patient's wounds were infected. In final follow up in 6 months, only one patient's wound was not healed due to infection. **Table -13:** Healing status of bone (Radiologically).

Healing status	1st Follow up (7 day)	2nd Follow up (14 days)	3rd Follow up (6 weeks)	4th Follow up (3 months)	5th Follow up (6 months)
Sign of union	Not assessed	0	13	20	22
No sign of union	Not assessed	22	9	2	0

During the 1^{st} follow up, radiological sigh of healing is not assessed. But the 2^{nd} follow up (14^{th} POD), no patients had features of healing radiologically. In 3^{rd} follow up, 13 cases had radiological features of bone healing. In 4^{th} follow up, 20 patients had features of bone healing radiologically but 2 patients' had no features of bone healing. In final follow up at 6 months, all patients had radiological features of bone healing. So, the bone healing rate of this study is 100%. But two patients had features of delayed union.

VI. Discussion

The present study was tried to evaluate the clinical and radiological outcome of open reduction & internal fixation with distal femoral locking plate for closed supracondylar fracture of femur. According to the inclusion and exclusion criteria and due to unavailable of patient with time constrain, we included 22 cases in our study. Historically supracondylar fracture of femur has been difficult to treat. These fractures often are unstable and comminuted and have a potential for long term disability. Because of strong muscular attachment it is difficult to maintain it in proper alignment without fixation and also because of their proximity to knee, regaining full knee motion is usually more difficult. The review of literature showed the application of various different implants and techniques in the management of these fractures, the uses of these devices requires a certain amount of bone stock present, which limits their uses in some fracture types. The present study shows that among shows that 9 (40.9%) patients were belonging to the age group 18-39 years, 10 (45.5%) patients were belonging to the age group 40-60 years and only 3 (13.6%) patients were belonging to above 60 years age group. The mean age of the patients was 42.7±11.4 years and age range were 18 to 68 years. Most of the patients 16 (72.7%) were male and 6 (27.3%) were female. Almost similar observation was reported by [27, 28].

The present study shows that the highest 11 (50.0%) patients had grade II soft tissue injury, 8 (36.4%) patients had grade I soft tissue injury and 3 (13.6%) patients had grade 0 soft tissue injury. Maximum 9 (40.9%) patients' radiological type of fracture was comminuted (A_3), 7(31.8%) patients were transverse (A_1) and oblique fracture with butterfly fragment (A_2) were 6 (27.3%) patients. Out of total 22 patient; only 7 (31.8%) patients had comorbidities. Out of these 7 (31.8%) patients, 4 (18.2%) patients had Diabetes Mellitus and 3 (13.6%) patients had Hypertension. All these patients were well controlled medical disease by medicine during surgery. The plaster duration of 13 (59.1%) patients were 2 weeks, 5 (22.7%) patients were 1 week and 4 (18.2%) patients were 3 weeks. Postoperative immobilization of knee was depended on soft tissue injury, quality of fixation, quality of bone and fracture pattern. The assisted passive knee movement of 12 (54.5%) patients were allowed after 14 days followed by 6 (27.3%) patients were after 7 days and 4 (18.2%) patients were 23 days after surgery. Assisted passive knee movement was allowed on the basis of fracture type, soft tissue condition, bone quality and quality of fixation. The study shows that after the final follow up in six months, highest 19 patient's ROM (flexion) were >110□ and 3 patients were 90□-110□. There was statistical significance found among the range of motion flexion (p=0.001). After the final follow up, only 1 (4.54 %) patient had deep surgical site grade IV infection. And other 21 patients had no infection. This patient was under antibiotic coverage after culture and sensitivity test of pus, regular wound care, improve nutritional status and rehabilitation.

In the present study after the final follow up, all patients could bear weight. Out of the total patients, 18 (81.8%) patients felt no pain, 4 (18.2%) patients felt mild pain. Soft tissue of all patients were well healed after 5th follow up except 1 patients having SSI grade IV. Maximum 18 patient's reduction status in postoperatively were good and 4 patients were not reduced during operation. At the final follow up, 16 patients' reduction status were satisfactory. Four patients' reduction status were mild displaced. And 2 patients' fracture were found displaced (>5 mm and more than 10^0 angulations. In the study documented after the final follow up, knee stiffness were the common complications which had 7 (31.8%) patients. Knee swelling was of 5 (22.7%) patient and ankle swelling was of I (4.5%) patients respectively. One patient developed foot drop after operation but after 3 months it recovered spontaneously. In the present study the average length of hospitalization was 15 days with a range of 10 to 25 days. Similar observation was reported by various other researchers that the average length of hospitalization was 13 days with a range of 10 to 30 days. The mean duration of hospitalization for all patients was 18.77 days (range, 14 – 29 days) [29]. The average number of days from injury to surgery was 9 days with a range of 5 to 14 days in this study. Majority 19 (87.50%) patients were operated in 8–14 days following injury. Similar findings also reported by [30, 31]. Clinical union was seen at a mean time of 12 weeks (6-24 weeks) in all cases. Almost similar observation was made by [19] that clinical union mean time was 12 weeks (8-26 weeks) and [32] reported mean time to union was 14.3 weeks. The average post-operative active range of motion as reported by [25] was 91 degrees. The average range of motion in our series is 113^0 with range of 90 to 130 degrees. There was statistical significance found among the range of motion flexion (p=0.001). We had 4 (18.2%) cases of Grade-I superficial infection which was managed by antibiotics after testing culture and sensitivity of pus, local wound dressing and nutritional support. [24] Has reported 20% infection rate. There was highly statistical significance found among the surgical site infection (p=0.001).

Limitation of the study: Although optimum care had been tried by the researcher in every step of this study, still some limitations. The study was conducted in selected area. So, the study population might not represent the whole community. Probability sampling technique could not be employed to recruit the study unit; they were selected purposively due to time constraints. As a result, there might be some selection bias. In spite of maximum effort by the researcher due to time and resource limitation, the sample size was small; a larger sample size would have given a better result.

VII. Conclusion And Recommendation

Locking compression plate acts as an extra-medullary loadbearing device, stabilizing fracture fragments and ensuring early bony union. Based on the study finding, distal femoral locking compression plate can be recommended for distal femoral fracture in an attempt to achieve a satisfactory function of knee. Knee stiffness is the common complication following these fractures. The rate of union is comparable to similar series whereas the average duration for union is high. There were two cases with secondary loss of reduction and 2 cases were delayed union. Therefore, the distal femoral locking plate provides a stable fixation in comminuted fractures of distal femur. Further wider study involving more number of cases and a longer follow up need to fully defined the clinical and radiological outcome of open reduction & internal fixation with distal femoral locking plate for closed supracondylar fracture of femur. This hospital based cross sectional study provides demographic information, frequency and clinical and radiological outcome of open reduction & internal fixation with distal femoral locking plate for closed supracondylar fracture of femur. The random sampling technique rather than the convenient would be chosen in further in order to enabling the power of generalization the results. The duration of the study was short, so in future wider time would be taken for conducting the study. Investigator use only 22 participants as the sample of this study, in future the sample size would be more.

References:

[1]. Koval KJ, Zuckerman JD. (2006). Handbook of fractures. 3rd ed. Philadelphia: Lippincott Williams & Wilkins. Chapter 20. Page no 304-313.

[2]. Mahesh D V, Gunnaiah, Vishwanath. (2014). Management of Distal Femur Fracture by Locking Compression Plate. International Journal of Health Sciences & Research. (www.ijhsr.org); 4(5):235-240.

[3]. Dalley AF II. Frank H Netter (1996). Atlas of human anatomy. 2nd ed. East Hanover: Novartis.

[4]. Bucholz RW, Jones A. (1991). Current Concepts Review: Fractures of the Shaft of the Femur. J Bone Joint Surg Am. 73:1561-66.

[5]. Hoffmann MF, Jones CB, Sietsema DL. (2013). Clinical outcomes of locked plating of distal femoral fractures in a retrospective cohort. Journal of orthopedic surgery and research. 8:43.

[6]. Walling A, Seradge H, Spiegel. (1982). Injuries to the knee ligaments with fractures of the femur. The Journal of Bone & Joint Surgery. 64:1324-1327.

[7]. Greiwe RM, Archdeacon MT. (2007). Locking plate technology: current concepts. J Knee Surg. 20(1):50-5.

[8]. Yeap EJ, Deepak AS. (2007). Distal Femoral Locking Compression Plate Fixation in Distal Femoral Fractures: Early Results. Malaysian Orthopaedic Journal. 1(1):12-17.
[9]. Eric J Strauss, Ran Schwarzkopf, Frederick Kummer, Kenneth A. Egol. (2008). The Current Status of Locked Plating: The Good, the Bad, and the Ugly. J Orthop Trauma. 22(7):479-86.
[10]. Charles M. Court-Brown, James D. Heckman, Margaret M. McQueen (2012), Rockwood and Green's Fractures in adults/Philadelphia, USA/Wolter Klowar Phublication/8th edition/vol2/section four lower extremity/chap 53/page no 22292268.
[11]. Schatzker J, Lambert DC. (1979). Supracondylar Fractures of the Femur. Clin Orthop; 138:77-83.
[12]. Parker DA, Lautenschlager EP, Caravelli ML, Flanigan DC, Merk BR. (2005). A Biomechanical Comparison of Distal Femoral Fracture Fixation: The Dynamic Condylar Screw, Distal Femoral Nail, Locking Condylar Plate, and Less Invasive Stabilization System. OTA.
[13]. Wagner M, Frenk A, Frigg R. (2004). New concepts for bone fracture treatment and the Locking Compression Plate. Surg TechnolInt; 12:271-7.
[14]. Markmiller M, Konrad G, Sudkamp N (2004): Femur-LISS and distal femoral nail for fixation of distal femoral fractures: are there differences in outcome and complications? Clin Orthop Relat Res, 426:252–257.
[15]. Henderson CE, Lujan T, Bottlang M, Fitzpatrick DC, Madey SM, Marsh JL (2010): Stabilization of distal femur fractures with intramedullary nails and locking plates: differences in callus formation. Iowa Orthop J, 30:61–68.
[16]. Kubiak EN, Fulkerson E, Strauss E, Egol KA (2006): The evolution of locked plates. J Bone Joint Surg Am, 88(Suppl 4):189–200.
[17]. Zlowodzki M, Williamson S, Cole PA, Zardiackas LD, Kregor PJ (2004): Biomechanical evaluation of the less invasive stabilization system, angled blade plate, and retrograde intramedullary nail for the internal fixation of distal femur fractures. J Orthop Trauma, 18:494–502.
[18]. Henderson CE, Kuhl LL, Fitzpatrick DC, Marsh JL (2011): Locking plates for distal femur fractures: is there a problem with fracture healing? J Orthop Trauma, 25(Suppl 1): S8–S14.
[19]. Weight M, Collinge C (2004): Early results of the less invasive stabilization system for mechanically unstable fractures of the distal femur (AO/OTA types A2, A3, C2, and C3). J Orthop Trauma, 18:503–508.
[20]. Lujan TJ, Henderson CE, Madey SM, Fitzpatrick DC, Marsh JL, Bottlang M (2010): Locked plating of distal femur fractures leads to inconsistent and asymmetric callus formation. J Orthop Trauma, 24:156–162.
[21]. Beingessner D, Moon E, Barei D, Morshed S (2011): Biomechanical analysis of the less invasive stabilization system for mechanically unstable fractures of the distal femur: comparison of titanium versus stainless steel and bicortical versus unicortical fixation. J Trauma, 71(3):620–4.
[22]. Gaines RJ, Sanders R, Sagi HC, Haidukewych GJ (2008): Titanium versus stainless steel locked plates for distal femur fractures: is there any difference? In OTA, Annual Meeting. Denver. Paper no. 55.
[23]. Muller, M. E., Nazarian, S., Koch, P., Schatzker, J. (1990): The Comprehensive Classification of Fractures of Long Bones. New York. Springer-Verlag. Page no 138-139.
[24]. Neer CS, Grantham SA, Shelton ML. (1967). Supracondylar fracture of the adult femur. J Bone Joint Surg Am.; 49:591-613.
[25]. Seinsheimer F. (1980). Fractures of the distal femur. Clin Orthop Relat Res. 153:169-79.
[26]. Egund, N., Kolmert, L. (1982): Deformities, gonarthrosis and function after distal femoral fractures. Acta Orthop. Scand., 53: 963–974.
[27]. Arneson TJ, Melton LJ, Lewallen DG. (1988). Epidemiology of diaphyseal and distal femoral fractures in Rochester, Minnesota, 1965–1984. Clin Orthop. 23(41):88-94.
[28]. Shriharsha RV, Sapna M. (2015). Utility and outcomes of locking compression plates in distal femoral fractures. Int J Res Ortho.; 1:15-21.
[29]. Tapi Nalo, Amit Agrahari, Snehasish Datta, Vinil Paul S, Nongthon Singh, Roel Langshong. (2015). Treatment of Supracondylar Fracture of Distal Femur with Condylar Locking Compression Plating, IJSR, 4(2):1468-1470.
[30]. Bipul Borthakur, Birseek Hanse, Russel Haque, Saurabh Jindal, Manabjyoti Talukdar. (2016). Results of Locking Compression Plate fixation in Distal Femur Fractures: A Prospective Study, Journal of medical thesis. 4(1):31-36.
[31]. Rajaiah D, Ramana Y, Srinivas K. (2016). A study of surgical management of distal femoral fractures by distal femoral locking compression plate osteosynthesis. J Evid. Based Med. Healthc; 3(66):3584-3587.
[32]. Bae SH, Cha SH, Suh JT. (2010). Treatment of Femur Supracondylar Fracture with Locking Compression Plate. Jn Korean Fract Soc., 23(3):282-88.

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