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A study on operative fixation of closed distal femur fractures with locking compression plate in a tertiary truma care center

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***Abstract*---**High speed vehicular accidents are responsible for distal femur fractures commonly observed in the young and middle aged. Low energy mechanisms such as fall at home may be responsible for producing fractures of distal femur in the elderly osteoporotic population especially women1. To study the functional outcome for internal fixation of closed supra- condylar femur fractures by Locking Compression Plate and to evaluate the complications of closed supracondylar fractures of femur treated with Locking Compression Plate. Hospital based Prospective observational study. Dept. of. Orthopaedics, in a tertiary care teaching college and hospital. 2 years Nov. 2019 – Nov. 2021. patients who were treated for supracondylar fractures of femur. study consisted a total of 30 patients. Simple Random sampling method. The following protocol was observed for patients with fracture lower end of femur on arrival. 1. General and systemic examination as well as local examination of the patient according to ATLS guidelines. 2. Thorough assessment of patient to rule out head/ chest/ abdominal/ spinal or pelvic injury. 3. Evaluation of patients in terms of: a) age b) Sex c) Mode of trauma d) Period between injury and arrival. The collected data were analysed with IBM.SPSS statistics software 23.0 Version. To describe about the data descriptive statistics frequency analysis, percentage analysis was used for categorical variables and the mean & S.D were used for continuous variables. Functional outcome was assessed at the

end of one year using Neer's scoring system Excellent in 19 (63%), Good in 5 (16.67%) Fair in 4 (13%) Poor in 2 (6%). In conclusion, the LCP condylar plate represents an evolutionary approach to the surgical management of supracondylar fractures of femur, but it does not completely solve the age-old problems of nonunion and mal-union. Potential reasons for implant failures include technical errors in plate placement and early weight-bearing in the presence of delayed fracture union.

***Keywords*---**distal femur fractures, supracondylar fractures, nonunion, mal- union.

Introduction

High speed vehicular accidents are responsible for distal femur fractures commonly observed in the young and middle aged. Low energy mechanisms such as fall at home may be responsible for producing fractures of distal femur in the elderly osteoporotic population especially women[1]. Fractures of the distal part of the femur are difficult to treat and present considerable challenges in management. Pain, decreased range of motion and compromised function of the knee joint is a common problem arising out of articular incongruity and improper fixation of articular fragments in such fractures[2]. The use of fixed angle devices such as the condylar blade plate and the Dynamic Condylar Screw (DCS) requires certain amount of bone stock which limits their use in comminuted fractures. This led to development of condylar buttress plate for comminuted femoral fractures. However, with standard condylar buttress plate, these fractures often have a tendency to fall into a varus collapse because of toggle at the screw- plate interface. Retrograde nails have proved to be very useful in extra-articular and partial articular distal femur fractures, but fixation of comminuted articular fractures is still a grey area with such an implant. To address these issues, locking condylar plate was designed. A locking condylar plate decreases screw-plate toggle and provides more stable fixation which is one of the key factor in the successful treatment of these fractures.These devices create a fixed angle at each screw hole where the individual screw head is secured to the plate by a locking mechanism[3-5.]

Since, the plate does not depend on the friction created at the bone-plate interface to provide stability, the plate does not have to contact the bone directly which helps in preserving the periosteal blood supply[6,7]. Locked implants are typically indicated in patients with osteoporosis, fractures with metaphyseal comminution where the medial cortex cannot be restored, or with a short articular segment[8]. Comminuted articular fractures can also be addressed more conveniently with the use of additional screws such as partially- threaded cancellous screws, herbert screws and other varieties of smaller screws. By making use of the technique of counter- sinking, the screw heads can be adjusted to seat the distal femur locking plate in a proper fashion. It also provides another useful choice for extra-articular fractures of distal femur.

Thus, the flexibility of locking condylar plate with its fixed angle properties appears to offer an effective alternative to implants like DCS, condylar buttress plate and a supra- condylar or a distal femur retrograde nail. This study was done to study the functional and radiological outcome of distal femoral fractures in skeletally mature patients treated by open reduction and internal fixation with distal femur locking plate.

Aim

To study the functional outcome for internal fixation of closed supra- condylar femur fractures by Locking Compression Plate and to evaluate the complications of closed supracondylar fractures of femur treated with Locking Compression Plate.

Material and Methods

Study Design

Hospital based Prospective observational study.

Study area

Dept. of. Orthopaedics, Government Medical College/ Government General Hospital, Mahabubnagar, Telangana.

Study Period

2 years Nov. 2019 – Nov. 2021.

Study population

Patients who were treated for supracondylar fractures of femur.

Sample size

Study consisted a total of 30 patients.

Sampling method

Simple Random sampling method.

Inclusion Criteria

- Age more than 18 years
- Both sexes are included
- Fresh supracondylar femur fractures which are of closed type.
- Cases will also include all supracondylar with intercondylar extension of distal femoral fractures.
- Patients presenting with supracondylar femur fractures with or without osteoporotic changes were included in the study.

Exclusion Criteria

- Age less than 18 years.
- Compound injuries.
- Medically co-morbid patients.
- Patients lost in follow – up.

Study tools and Data collection procedure

The following protocol was observed for patients with fracture lower end of femur on arrival.

- General and systemic examination as well as local examination of the patient according to ATLS guidelines.
- Thorough assessment of patient to rule out head/ chest/ abdominal/
- Spinal or pelvic injury.
- Evaluation of patients in terms of:
  - age b) Sex
  - Mode of trauma
  - Period between injury and arrival.
- Musculo-skeletal examination of patient to rule out associated fractures.
- Stabilization of patient with intravenous fluids, oxygen and blood transfusion as and when required.
- Careful assessment of injured limb as regards to neurovascular status.
- Primary immobilization of involved limb in Thomas splint with a cotton pad below the distal fragment and transport of patient to the Department of Radiodiagnosis in the same.
- Radiological assessment: Anteroposterior and true lateral views of injured limb including complete knee joint and distal femur/proximal leg.

Fractures were classified with the help of radiographs according to the AO-ASIF classification. Preoperative calculation was done on radiographs to ascertain the size of the plate, accurate size of locking, cortical and cancellous screws after subtraction of the magnification factor. The limb to be operated was prepared. One gm. of third generation cephalosporin was injected 10 min before surgery.

Statistical Analysis

The collected data were analysed with IBM.SPSS statistics software 23.0 Version. To describe about the data descriptive statistics frequency analysis, percentage analysis was used for categorical variables and the mean & S.D were used for continuous variables.

Observations and Results

Table 1
Age distribution

AGE IN YRS	NUMBER	PERCENTAGE
18-30	6	20
31-40	7	23
41-50	9	30
51-60	6	20
>60	2	7
TOTAL	30	100

The patients' ages ranged from 18 to 74 years with a mean age of 43 years.

Table 2
Sex distribution

SEX	NUMBER	PERCENTAGE
MALE	21	70
FEMALE	9	30

21 patients were males and 9 were females.

Table 3
Type of fracture

TYPE	NUMBER	PERCENTAGE
A1	2	6.67
A2	4	13.3
A3	0	0
B1	1	3.3
B2	1	3.3
B3	0	0
C1	8	26.6
C2	9	30
C3	5	16.6
TOTAL	30	100

According to Muller's classification of distal femur two were Muller's type A1;four were type A2;one type B1;one type B2;eight Muller's type C1; nine Muller's type C2; and five Muller's type C3.

Table 4
Duration of surgery

DURATION(MIN)	NUMBER	PERCENTAGE
0-90	12	40
90-120	10	33.3
>120	8	26.6

Table 5
Radiological union

UNION IN WEEKS	NUMBER	PERCENTAGE
<16	6	20
16-18	19	63.4
19-20	3	10
DELAYED UNION	1	3.33
NON UNION	1	3.33

Of 30 patients, 28 Patients (93.33%) showed radiological union within 20 weeks. Average time for union was 16 weeks. One patient had delayed union at 13 months. And one patient had nonunion.

Table 6
Time at which full weight bearing achieved

TIME IN MONTHS	NUMBER	PERCENTAGE
2-3	5	16.7
4-5	22	73.4
>6	3	10

Table 7
Limb length discrepancy

SHORTENING(cms)	NUMBER	PERCENTAGE
0	23	76.7
0.5-1	5	16.7
1-2	1	3.33
>2	1	3.33
TOTAL	30	100

Table 8
Functional results

GRADE(NEER SCORE)	NUMBER	PERCENTAGE
EXCELLENT(>85)	19	63.4
GOOD(75-84)	5	16.67
FAIR(55-69)	4	13.3
POOR(<55)	2	6.67

Functional outcome was assessed at the end of one year using Neer's scoring system Excellent in 19 (63%), Good in 5 (16.67%) Fair in 4 (13%) Poor in 2 (6%).

Table 9
Complications

COMPLICATION	NUMBER	PERCENTAGE
SUPERFICIAL INFECTIONS	0	0
DELAYED UNION	1	3.33
DEEP INFECTION	1	3.33
PLATE BACKOUT	0	0
NON UNION	1	3.3
VARUS MALALIGNMENT	0	0
VALGUS MALALIGNMENT	0	0

Complications
Non-union

One out of 30 patients (3.33%) had non-union. He was managed with implant removal, freshening of edges, Ilizarov external fixator application & bone grafting was done.

Superficial infection

No patients had superficial infection.

Deep infection

One patient (3.33%) developed deep infection for which thorough wound debridement, freshening of edges, wash, implant removal, Ilizarov external fixator application and bone grafting was done.

Shortening

Out of 30 patients three patients had shortening.
< 1 cm – five patient -16.6%
1 to 2 cm- one patient-3.33%
More than 2 cm shortening was seen in 1 patient -3.33%.

Discussion

Fractures of the distal femur are challenging injuries. These require an extensive surgical approach to visualize and reduce the articular fragments, particularly in complex fractures. The insult to the periarticular soft tissues caused both by the initial trauma and subsequent surgical approach, causes difficulty in early postoperative rehabilitation predisposing to knee stiffness. Hence, the outcome of intraarticular fractures of the distal femur remains unpredictable, and these are fraught with complications such as malunion, nonunion, stiffness, and secondary osteoarthritis. Current fracture patterns veer towards complex comminuted types due to the prevalence of high speed vehicles. Improved healthcare results in a longer lifespan and subsequently presents us with more osteoporotic fractures which were previously treated using conservative methods.

The LCP is a single beam construct where the strength of its fixation is equal to the sum of all screw-bone interfaces rather than a single screw's axial stiffness and pullout resistance in unlocked plates. Its unique biomechanical function is based on splinting rather than compression resulting in flexible stabilisation, avoidance of stress shielding and induction of callus formation. When applied via a minimally invasive technique, it allows for prompt healing, lower rates of infection and reduced bone resorption as blood supply is preserved. Our study included 30 patients who sustained supracondylar femur fracture treated with locking compression plate. Overall final outcome was assessed in terms of regaining the lost knee function using NEER'S Score. The majority of fractures occur between the age of 18-65 yrs with mean age of 43 years.

Age distribution compared with other study

Author	Age yrs
KREGOR *et al*	49
SCHANDELMAIER et al	50
SCHUTZ *et al*	54
FANKHAUSER et	57
MARKMILLER et al	57
WEIGHT et al[10]	44
WONG *et al*	75
YEAP et al[11]	44
OUR STUDY	43.1

Complications compared with other study

	Deep nf %	Implant Fail %	Malalignment
KREGOR *et al*	3	1.5	4.5
SCHANDELMAIER	1.9	7.4	13
SCHUTZ *et al*	7	6	1
FANKHAUSER et	-	10	-
KREGOR *et a*l	3	5	6
MARKMILLER et al	-	10	15
WEIGHT et al		13.6	
SCHUTZ *et al*	3	4.5	37
WONG *et al*		12.5	
YEAP et al	9		9
OUR STUDY	3	-	-

Distal femur comparison studies

Author	No	Open # %	Age yrs	F/up mon	ROM	Union weeks	Bone Graft %	Deep inf %	Implant Fail %	Malal-ignment
KREGOR *et al*	66	N/A	49	9	2-103	11	5	3	1.5	4.5
SCHANDELMAIER	54	18.5	N/A	6	104	14.3	-	1.9	7.4	13

SCHUTZ *et al*	99	29	54	13.7	0-107	N/A	6	7	6	1
FANKHAUSER et	30	46.7	57	20	4-113	12	-	-	10	-
KREGOR *et a*l	103	34	52	14	1-109	12	7	3	5	6
MARKMILLER et al	20	N/A	57	12	0-110	13.8	-	-	10	15
WEIGHT et al	22	27	44	18	5-114	13			13.6	
SCHUTZ *et al*	66	32	52	12	112	N/A	9	3	4.5	37
WONG *et al*	16		75	23	N/A	30			12.5	
YEAP et al	11	36	44	9.7	1-107	18	18.2	9		9
OUR STUDY	30	-	43	12	0-112	16	0	3	-	-

Functional outcome

We have applied Neers scoring system, to assess the functional outcome in our study population .we are able to achieve 63.3% excellent result 16.67% good results (overall 80% acceptable results) with the standard surgical care using Neer's score. In addition we have 13.3% fair and 6.6% poor results in terms of functional outcome. Average range of motion at the knee being 112^0 to 120°. These results are comparable and on par with other documented standard studies.

Conclusion

In conclusion, the LCP condylar plate represents an evolutionary approach to the surgical management of supracondylar fractures of femur, but it does not completely solve the age-old problems of nonunion and mal- union. Potential reasons for implant failures include technical errors in plate placement and early weight-bearing in the presence of delayed fracture union.

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