Prospective Study
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Short Term Analysis of the Functional and Radiological Outcome of Distal Femoral Fractures Fixed with Locking Compression Plate by Minimally Invasive Plate Osteosynthesis (MIPO) Technique

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Abstract

Background: Fractures of distal femur are very complex injuries and there is significant difficulty to manage. These injuries are severe and have a potential to produce long term disability. These fractures often are unstable and comminuted and tend to occur in elderly or multiply-injured patients.

The fractures of distal femur account for 7% of all femoral fractures. If Hip fractures are excluded, 31% of fractures involve the distal femur. The fractures involving distal 15 cm of femur including distal femoral metaphysis (supracondylar) and articular surface (intercondylar) are classified as distal femur fractures [1].

Distal femur fractures exhibits bimodal age distribution. In young adults it occurs due to high velocity trauma like road traffic accidents. These patients often sustain multiple and compound injuries. Older patients sustain distal femur fractures mostly due to trivial fall occurring in elderly osteoporotic bone.

In 1960's most of these fractures were treated conservatively and documented better outcome than operative treatment. But with the advent of newer implants and modern techniques, these fractures are best treated with surgical stabilization. The newer modalities of treatment include minimally invasive plate osteosynthesis (MIPO) and Less invasive skeletal stabilization (LISS).

Aim of this study: To evaluate twenty cases of distal femur fractures fixed with locking compression plate by minimally invasive plate osteosynthesis (MIPO) technique in the Department of Orthopaedic Surgery at SCB Medical College and Hospital, Odisha between July 2018 to November 2020.

To prospectively analyse the clinical and radiological outcome of the above procedure.

Keywords: Minimally Invasive Plate Osteosynthesis (MIPO), Distal Femoral Fractures, Radiological Outcome, Locking Compression Plate

Background

Fractures of distal femur are very complex injuries and there is significant difficulty to manage. These injuries are severe and have a potential to produce long term disability. These fractures often are unstable and comminuted and tend to occur in elderly or multiply-injured patients.

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To prospectively analyse the clinical and radiological outcome of the above procedure.

Materials & Methods

Study topic: A short term analysis of the functional and radiological outcome Of distal femoral fractures fixed with locking compression plate by minimally invasive plate osteosynthesis (MIPO) technique.

Study Design: Prospective study

Study Venue: Department of Orthopaedics, SCB Medical College & Hospital, Cuttack, Odisha 753007.

Study center: SCB Medical College & Hospital, Cuttack between

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July 2018 - November 2020.

Inclusion criteria

- Patients in the age group of above 18 years
- Distal femoral fractures – Müllers type A, C1 and C2
- < 2 weeks of injury
- Fractures reducible by indirect methods
- Grade I and II compound injuries (Gustillo Anderson)

Exclusion Criteria

- Fractures with grade III compound injuries
- Active infection
- Muller type B & C3 fractures
- Skeletal immaturity
- > 2 weeks of injury (fracture may not reducible by indirect methods)
- Periprosthetic fractures
- Comatosed patients
- Patients with risk of infections like on immune suppressants drugs
- Pathological fractures

Results

Criteria for clinical fracture union:

1. No pain/tenderness on weight bearing
2. No pain/tenderness on palpation/examination
3. Ability to walk/perform activities of daily living with no pain.

Criteria for radiological union: [32]

Table V: Radiological assessment of fracture healing. Hammer et al

Grade	Callus Formation	Fracture line	Stage of union
1	Homogeneous bone structure	Obliterated	Achieved
2	Massive .Bone trabeculae crossing fracture line	Barely discernible	Achieved
3	Apparent. Bridging of fracture line	Discernible	Uncertain
4	Trace. No bridging of fracture line	Distinct	Not achieved
5	No callus formation	Distinct	Not achieved

Knee society score: [34]

The outcome analysis done using American knee society scoring system. The total score is 200 comprises of

- Knee score 100
- Function score 100

Outcome	Knee score (100)	Function score (100)	Total score (200)
Excellent	80-100	80-100	160-200
Good	70-79	70-79	140-159
Fair	60-69	60-69	120-139
Poor	< 60	< 60	< 120

Table VI: Outcomes

Observation and Results

The results were analysed prospectively both clinically and radiologically. The follow up period ranged from 6 months to 18 months (mean = 12 month). The results of our study are elucidated

Table I: Age Distribution

s. no	Age (in years)	No. of patients	Percentage
1	11-20	1	5
2	21-30	4	20
3	31-40	4	20
4	41-50	1	5
5	51-60	3	15
6	61-70	6	30
7	71-80	1	5

Table II: Sex Distribution

S. no	Sex	No. of patients	Percentage
1	Male	13	65
2	Female	7	35

Table III: Radiological Assessment of Union

S. no	Hammer et al Grade	No. of patients	Percentage
1	I	12	60
2	II	8	40

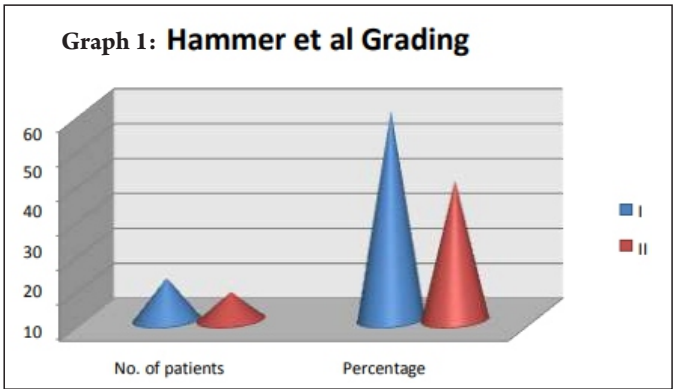

Table IV: Knee Extension

S. no	KNEE EXTENSION	No. of patients	Percentage
1	Full	17	85
2	Extensor lag	3	15

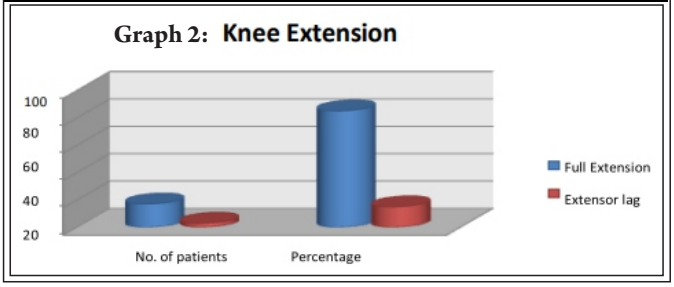

Table VII: Knee Flexion (Degrees)

Follow up	Minimum flexion	Maximum flexion	Mean flexion
1month	10	90	56.5
3 month	20	105	70.25
6 month	20	120	84.25
Final	30	125	91.75

Graph 3: knee flexion in degrees

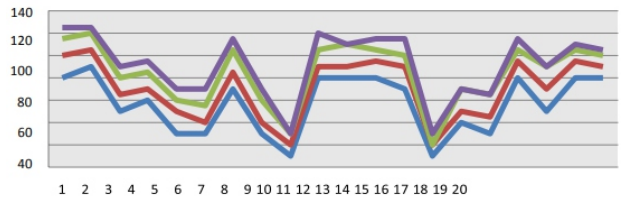

Table VIII: Knee Society Score (Total score 200)

Follow up	Minimum score	Maximum score	Mean score
1month	32	78	57
3 month	56	146	111
6 month	68	166	133
Final	81	188	153

Graph 4: Knee society score

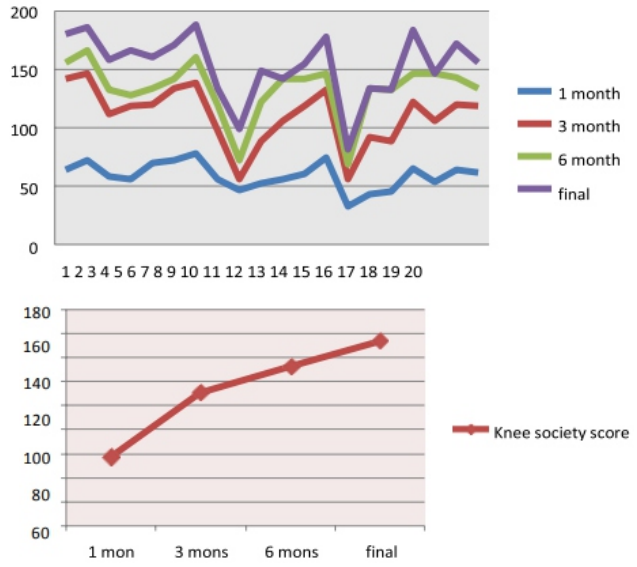

Table IX: Comparison of results of fractures of distal femur treated with MIPO & LISS

Author	No.of cases	F/up months mean	Mean Time to union(wks)	Knee Flexion deg	complications			scoring system & mean score	excellent and good results %
					Infection %	Revision/ Failure %	Malalign %		
Kregor et al	66	9	11	103	3	1.5	4.5	-	-
Kanabar et al	17	12	17	93	-	11.7	6	-	-
Schutz et al	99	13.7	-	107	7	6	1	-	-
Markmiller et al	20	12	13.8	110	-	10	15	Lysholm	87.5
Schandelmaier et al	54	6	14.3	104	1.4	7.9	13	Neer	-
Yeap & Deepak et al	11	9.7	18	107	-	9	9	schatzker	72.7
our study	20	12	15	92	5	5	-	Kss Mean-153	75

in the tables presented below. Table I, II, III, IV, V, VI, VII, VIII, IX and graphs 1, 2 & 3.

Discussion

The evolution of management of distal femoral fractures has come a long way from totally conservative management in the 1960's to definitive surgical treatment at present. There is increasing incidence of comminuted distal femur fractures due high velocity motor vehicle accidents in younger population and increased life expectancy resulting in fractures following trivial fall due to osteoporotic bone. In both the groups our aim is to restore the function and near normal anatomy similar to the pre injury status.

There are many surgical alternatives for distal femur fractures, each with its own pearls and pitfalls. Many studies were conducted using different implants and techniques resulted in varying outcome and complications. After the introduction of locking compression plate (LCP) by AO in 2000, the trend is shifting towards it due its added advantages like,

- Providing both angular and axial stability
- Applied in both locking and compression mode
- Better hold in osteoporotic bone

Due to the changing concepts towards relative stability and biological fixation from absolute stability and rigid fixation, minimally invasive plate osteosynthesis (MIPO) technique evolved. Many studies proved better outcome with lesser morbidity than the conventional technique.

In our study involving 20 patients with 13 males and 7 females with mean age of 47 and the mean follow up period ranges between 6 month to 18 month (mean 12 months). 15 patients had type A fracture and 5 patients had type C fracture and 25% of patients had open injuries.

The mean operating time was 100 minutes compared to 119 minutes by Yeap and Deepak et al [35]. The mean time to radiological fracture union was 15 weeks (range 12 -20 weeks) Which was comparable to 11 weeks by Kregor et al [30], 14.3 weeks by Schandelmaier et al [28], 12 weeks by Fankhauser et al [34] and 18 weeks by Yeap and Deepak et al [35].

The average knee flexion achieved was 92 degrees comparable to that of 103° by Kregor et al [30], 104° by Schandelmaier et al [28], 107° by schutz et al [29], 101° by Fankhauser et al [34] and 93° by Kanabar et al [36].

The scoring system used was knee society scoring and the mean score was 153 compared to the score of 131 by Fankhauser et al . With this system 45% patient is having an excellent outcome, 30% good, 15% fair and 10% with poor outcome.

The percentage of patients with good and excellent outcome was 75% comparable to 87.5% by Markmiller et al, 72.7% by Yeap and Deepak et al.

The complications encountered are deep seated infection (n=1), post-operative loss of reduction which requires a revision surgery (n=1), deep vein thrombosis (n=1), Knee stiffness (n=3), varus malalignment (n=2), reactive synovitis (n=1).

The incidence of loss of reduction requiring a revision surgery was 5% comparable to 10 % by Markmiller et al, 9 % by Yeap and Deepak et al 7.9 % by Schandelmaier et al and 6 % by Schutz et al.

The infection rate in our study was 5 % comparable to 7 % by Schutz

et al [29] and 3 % by Kregor et al [30].

We had two cases of varus malalignment (< 5°) but within acceptable limits in contrast to 15% by Markmiller et al and 13% by Schandelmaier et al, both having significant malalignment (> 10°). These patients may require a long term follow up to evaluate the development of arthritis.

There was an incidence of 15 % knee stiffness (n =2) < 30° and (n=1) 70° and failed to show any improvement even after aggressive continuous motion therapy.

We had a complication of post op DVT and reactive synovitis, which settled uneventfully with symptomatic therapy. Union was achieved in all cases and bone grafting was not required in any of our cases.

Conclusion

• In our study, Minimally Invasive Plate Osteosynthesis (MIPO) technique using Locking Compression Plate (LCP) shows good to excellent results in terms of union and functional outcome.

• When operated within two weeks of injury, it was easier to achieve closed reduction. This decreases the operating time, blood loss and intra-operative morbidity.

• MIPO technique could results in satisfactory union and eliminates the need for bone grafting.

• The incidence of infection and post- operative morbidity was less compared to conventional open technique.

• LCP has a better hold in osteoporotic bone with less chances of failure.

• Inadequate fixation leads to loss of reduction, resulting in an open reduction and revision fixation.

• Long term follow up is necessary to study the development of arthritis in patients with varus/valgus malalignment.

• From our study, we conclude that the Minimally Invasive Plate Osteosynthesis (MIPO) technique using Locking Compression Plate (LCP) will results in early post- operative rehabilitation, satisfactory union and good functional outcome. The chances of infection and implant failure are less. Proper patient selection and meticulous surgical techniques will give the best results.

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Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his/her consent for his/her images and other clinical information to be reported in the Journal. The patient understands that his/her name and initials will not be published, and due efforts will be made to conceal his/her identity, but anonymity cannot be guaranteed.

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