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A Prospective Study on the Functional and Radiological Outcome of Double Plating in AO Type "A" and "C" Fractures of Distal end of Femur

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ABSTRACT

Fractures of distal` end of the femur include those occurring within approximately 15 cm of the distal articular surface of the femur. High-energy mechanism supracondylar femur fractures are often associated with severe soft tissue injury, extensive articular and metaphyseal comminution and occasionally segmental bone loss. These factors are a set-up for prolonged healing time. Previous generations of implants used in isolation to treat these fractures were associated with fixation failure, varus collapse and non-union. Supplemental medial fixation has been advocated to improve stability. To analyse the functional and radiological outcome of double plating of AO type A and C fractures of distal end of the femur in terms of scores according to Neer's criteria. Patients of either sex diagnosed with distal femoral fractures, type A and C who are admitted in Hospitals attached to Mysore Medical College and Research Institute, Mysore. Where managed with ORIF with double plating i.e. both medial and lateral plate using swasch bucklers approach. A total of 16 patients were followed up of which 12 were male, 4 were female. The age range was between 18 and 69 years with a mean age of 45.36±13.72 years. The fracture incidence was more common in the age groups between 41-50 years, which was 36.3% and >50 years, which was 31.8%. Final analysis of the Neer's score showed 56.3% (9 patients) were excellent, 25% (4 patients) were satisfactory, 12% (2 patients) were unsatisfactory, and in one patient there was failure. Patients who underwent double plating for AO type A and C fractures of distal end of the femur showed statistically significant functional and radiological outcomes at 6 months follow-up. We conclude by stating that the double plating technique is a viable option for the management of distal femur fractures especially in those with medial cortex comminution, articular involvement and osteoporotic fractures. The double plate technique gave a sturdy and stable construct preventing varus collapse as the patient underwent rehabilitation and thus aiding bony union and early weight bearing. Time taken to return to work and overall quality of life improved following the procedure.

INTRODUCTION

Fractures of the distal femur account for up to 6% of femur fractures and its incidence have only increased due to rapid industrialization and an increase in the number of road traffic accidents. These fractures present a considerable challenge in management. The mechanism of injury for most supracondylar fractures is thought to be axial loading with varus, valgus, or rotational forces[2]. These fractures often are unstable and comminuted and tend to have a bimodal distribution-the 1st group is made up of young adults sustaining high energy trauma due to road traffic accidents and the 2nd group comprising of elderly osteoporotic females who fall at home[2]. In the past three decades there has emerged another injury group coming out of periprosthetic fractures. This group in addition to the already existing problems of distal femoral fractures brings in the dimension of a prosthesis which might be loose.

These serious injuries have the potential to produce significant long-term disability especially when they are associated with osteoporosis, extensive articular damage, marked bone comminution, short distal femoral block in which it is difficult to insert fixation, open wounds, internal derangement of knee including ligament and meniscal injuries and possible extensor mechanism injuries and severe soft tissue injury. Complications are significant and include infection, knee stiffness, need for bone grafting, non-union and malunion.

Over the years, many different strategies have been used with varying success. There has been an evolution in treatment of distal femoral fractures with non-operative methods being mainstay in treatment during the early part of the century based on the work of Watson Jones[17] and John Charnley[18] which consisted of application of skeletal traction, fracture reduction through manipulation, application of cast and cast bracing. Shortening of limb, knee stiffness, malunion, deformity, angulation, non-union, incongruity of joint, wasting of quadriceps muscle, instability of knee joint and secondary osteoarthritis were frequently observed complications.

The management of distal femoral fractures has seen a paradigm shift from non-operative measures to biological fixation and evolution of modern implants as well as specific techniques in current times. Anatomic reduction of the articular surface, restoration of limb alignment and early mobilization have been shown to be effective ways of managing most distal femoral fractures[2]. Options for operative treatment include blade plate, dynamic compression screw, non-locking condylar plate, external fixation systems, antegrade and retrograde nailing systems and sub-muscular locked internal fixation systems.

The problems which are commonly observed during treatment of these fractures are:

- Adequate exposure of articular surface, particularly of medial femoral condyle and coronal plane fractures are challenging.
- Standard implants used for other types of distal femoral fractures like condylar blade plate and supracondylar nails are not helpful in articular surface reduction and fixation.
- In setting of medial comminution and short distal segment, there is high incidence of loss of fixation and varus collapse.
- Laterally based locking implants showed improved union rates, but these were not without their failures. Those that failed tended to be those high energy fractures with compromised soft tissues, severe comminution, or bone loss[19].
- An option to improve bicolumnar stability is the addition of a medially based plate in conjunction with a laterally based, locking plate[6]. Double plating has advantages such as precise exposure, easy manipulation, anatomical reduction and stable fixation.
- The indications for double plating include AO type C2 and C3 fractures, low transcondylar intercondylar fractures and supracondylar-intercondylar fractures with extensive medial metaphyseal comminution or bone loss[20].

Method of Study:

- **Study Design:** Prospective observational/ interventional study.
- **Study Period:** Aug 2022 to Sep 2023.
- **Sample Size:** It is a hospital-based study of 16 patients who fulfilled the inclusion criteria.
- **Place of Study:** K R Hospital Mysore.

Inclusion Criteria:

- Patients who are medically fit for surgery and have given written consent for surgery
- Patients who are diagnosed with distal femur fractures with
- Medial supracondylar bone loss.
- Low transcondylar fractures.
- Medial Hoffa fractures.
- Peri-prosthetic distal femur fractures.
- Non-union after failed fixation with single lateral plate.

Exclusion Criteria:

- Type 2 and type 3 open fractures
- Associated co-morbiditie patient unfit for surgery.
- Paediatric fractures.
- Patients unwilling for surgery.
- Patients who underwent alternate fixation methods.

MATERIALS AND METHODS

We studied prospectively 16 patients, with distal femur fractures (AO classification A, C) who were treated with

double plating at the Department of Orthopaedics, KR hospital, MMCRI, Mysore from August 2022 to Sept 2023. The study sample was 16 patients and all were included with predefined inclusion and exclusion criteria in this study.

After initial resuscitation in the emergency, closed fractures were splinted and operated at the earliest. In case of open fractures, swabs were taken from the wound for culture and sensitivity and gram staining, and wound irrigation and debridement done. Broad spectrum intravenous antibiotics were started according to local hospital guidelines and later changed to specific antibiotics based on culture and gram staining report. Preference was given for management of life-threatening emergencies i.e., head injury, blunt trauma abdomen, blunt trauma chest and patients were taken up for orthopaedic surgery once patient was out of danger, till then fractures were managed with slab application and limb elevation.

- Detailed history of the patient was recorded including mode of injury.
- After informing the patient about diagnosis, treatment options, possible complications and obtaining prior written consent, the patient was subjected to relevant investigations and interventions as indicated for treatment.
- Radiological evaluation included anteroposterior and lateral X-rays of the femur with knee, along with a pelvic X-ray to rule out proximal femur fractures. Computed tomography (CT) scans with three-dimensional reconstruction were done. AO-ASIF classification criteria was used to classify fracture based on radiographic study. Preoperative templating of the radiograph was done to assess the length and position of the plate and screws.
- All the patients underwent surgical fixation of fracture with double plating technique using DFLCP and a medial locking plate.

Steps of the Procedure:

- Intravenous antibiotics is given half an hour prior to surgery.
- After the patient is anaesthetised, the patient is placed in a supine position over a radiolucent table.
- A sandbag is placed under the ipsilateral hip and a bolster is placed under the knee joint.
- The Limb is painted and draped free up to the level of iliac crest proximally and below the level of knee joint distally.
- Midline anterior skin incision over the knee joint taken which curves laterally proximally (Swashbuckler approach).
- The incision is carried down to the fascia overlying the quadriceps muscles. This fascia is split in line with the skin incision and lifted off the underlying vastus lateralis muscle belly.
- The iliotibial band is retracted laterally, away from the underlying muscle.
- The lateral parapatellar retinaculum is incised to separate it from the vastus lateralis muscle belly, and a lateral parapatellar arthrotomy is performed.

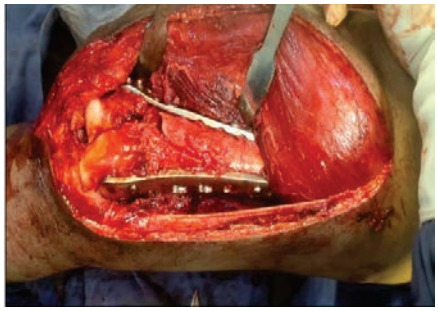

Fig 1: Intra Op Image

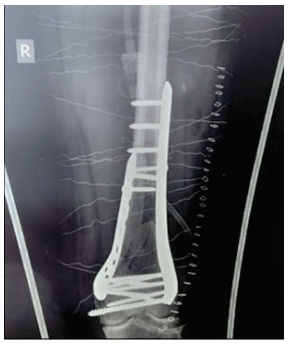

Fig 2: Post Op X-ray

Fig 3: Knee Flexion Immediately After Ot

Fig 4: Knee Flexion At 6 Month Follow-Up

Table 1:Functional and anatomical unit

Functional (70 Units)		Anatomical (30 Units)	
Pain (20 Units)	**Unit value**	**Gross anatomy (15 Units)**	**Unit value**
5 No pain	20	5Thickening only.	15
4 Intermittent or badweather	16	45 degrees angulation or 0.5 Centimetres short.	12
3 With fatigue	12	310 degrees angulation or 2.0 Centimetres short.	9
2 Restrict function	8	215 degrees angulation or 3.0 Centimetres short.	6
1-0 Constant or at night	4-0	1Union but with great deformity.	3
		0Non-union or chronic infection.	0

Table 2: Function and radiograph

Function (20 Units)		Radiograph (15 Units)	
5As before injury	20	5Near normal	15
4Mild restriction	16	45 degrees angulation or 0.5 centimeters displacement	12
3Restricted; stairs sideways	12	310 degrees angulation or 1.0 centimeters displacement	9
2Cane or severe restriction	8	215 degrees angulation or 2.0 centimeters displacement	6
1-0 Crutches or brace	4-0	1Union but with greater deformity; spreading of condyles; osteoarthritis	3
		0Non-union or chronic infection	0
Motion (20 Units)		Interpreting Neer's scoring system:	
5Normal or 135 degrees	20	**Outcome: Total score:**	
4100 degrees	16	Excellent ->85	
380 degrees	12	Satisfactory -70-85	
260 degrees	8	Unsatisfactory -55-69	
140 degrees	4	Failure - <55	
020 degrees or less	0		
Work (10 Units)			
5As before injury	10		
4Regular but with handicap	8		
3Alter work	6		
2Light work	4		
1-0 No work	0		

Master Chart

SL. No.	Name	Age (Y)	Sex	Side	Moi	A0 Type	Union Rate	ROM	Neer Score	Outcome
1.	Siddraju	58	M	L	FALL	A3	2OW	115°	85	Excellent
2.	Dayawathi	38	F	L	RTA	C2	22W	120°	82	Excellent
3.	Daddaswamy	55	M	L	RTA	C3	24W	90°	65	Unsatisfaction
4.	Praveen Kumar	28	M	R	RTA	C3	15W	120°	85	Excellent
5.	Jagadisha M	40	M	R	RTA	C3	14W	95°	70	Unsatisfaction
6.	Shiva Kumar L	36	M	R	RTA	C3	14W	100°	75	Satisfactory
7.	Somanayaka	49	M	R	RTA	C3	24W	115°	85	Excellent
8.	Vishwanath	29	M	L	RTA	C2	13W	120°	88	Excellent
9.	Siddaiah	45	M	L	RTA	C3	20W	80°	60	Failure
10.	Somanayaka	42	M	R	RTA	C3	20W	120°	90	Excellent
11.	Kupamma	38	F	R	RTA	C3	22W	110°	80	Excellent
12.	AppaSomachari	48	M	L	RTA	C3	22W	115°	85	Excellent
13.	Siddesha	52	M	L	RTA	C2	23W	105°	78	Satisfactory
14.	Siddarayashetty	56	M	R	FALL	A3	24W	110°	80	Satisfactory
15.	Jayamma	52	F	R	RTA	C3	24W	120°	82	Excellent
16.	Mangala	44	F	R	RTA	C2	24W	110°	80	Satisfactory

- The fracture site is exposed and haematoma is drained. The ends of the fracture fragments are cleaned.
- The medial and lateral femoral condyles are reduced and held together with the help of the patella clamp making sure there is anatomical reduction of articular fragments and consequently joint congruity.
- The condyles are provisionally fixed with K-wires.
- Later, partially threaded 6.5mm cannulated cancellous screws are applied to fix the condyles.
- Next the articular block is reduced to the femoral shaft and fixed with a laterally based DFLCP of appropriate length, following which a medial plate is applied.

Physical rehabilitation included static quadriceps exercises and hamstring strengthening exercises which were started on first post-operative day. Later active and active assisted range of motion exercises of the knee were initiated and non-weight bearing assisted ambulation advised.

- Patients were discharged after suture removal once wound was healed completely All patients were followed up at 2nd week, 4th week, 6th week, 3 months and 6 months.
- The functional and anatomical outcome was assessed at the end of 6 months follow up using Neer's criteria with parameters being pain (20 points), walking capacity.
- (20 points), movements-flexion (20 points), and work capacity (10 points), gross anatomy (15 points), radiograph (15 points). The scores were classified as Excellent (>85), Satisfactory (70-85), Unsatisfactory (55-69) and Failure (<55). The final outcome was compared with the results available from the latest literature.

RESULTS AND DISCUSSIONS

A total of 16 patients were followed up of which 12 were male, 4 were female. The age range was between 18 and 69 years with a mean age of 45.36±13.72 years. The fracture incidence was more common in the age

groups between 41-50 years, which was 36.3% and >50 years, which was 31.8%. Most common mode of injury was road traffic accidents (87.5%) whereas incidence of self-fall as mode of injury was 12.5%. The study included 10 cases of AO type C3(62.5%), 4 cases of AO type C2
(25%) and 2 cases of AO type A3 (12.5%). The average time to union was around 4 months (18.4 weeks) with a range of 3-6 months (14-24 weeks) with standard deviation of 4.04. The mean range of flexion at knee obtained postoperatively was 109.680(range of 750-1200). The Neer's score ranged from 60-90 and the mean Neer's score was 79.38 and the standard deviation was 8.24. Final analysis of the Neer's score showed 56.3% (9 patients) were excellent, 25% (4 patients) were satisfactory, 12% (2 patients) were unsatisfactory and in one patient there was failure.

CONCLUSION

Patients who underwent double plating for AO type A and C fractures of distal end of the femur showed statistically significant functional and radiological outcomes at 6 months follow-up. We conclude by stating that the double plating technique is a viable option for the management of distal femur fractures especially in those with medial cortex comminution, articular involvement, and osteoporotic fractures. The double plate technique gave a sturdy and stable construct preventing varus collapse as the patient underwent rehabilitation and thus aiding bony union and early weight bearing. Time taken to return to work and overall quality of life improved following the procedure.

REFERENCES

1. Bruce, D.B., J. Jesse, K. Christian and A.A. Paul, 2019. Browner: Skeletal Trauma-Basic Science, Management, and Reconstruction. 6th Edn., Saunders, alkland Islands, ISBN-13: 9780323611145, Pages: 2626.
2. Robert, W., J.D. Bucholz and Heckman, et al., 2010. Rockwood and Green's Fracture in Adults. 7th Edn., Lippincott Williams and Wilkins, U.S.A., ISBN-14: 978-1496386519, Pages: 2800.
3. Jon, C. and M.D. Thompson, 2015. Netter's Concise Atlas of Orthopaedic Anatomy. 2nd Edn., Elsevier, Amsterdam, Netherlands, ISBN-14: 978-0323429702, Pages: 416.
4. Terry, C.S., 2021. Canale and Beaty: Campbell's Operative Orthopaedics. 13th Edn., Elsevier, Amsterdam, Netherlands, ISBN-13: 9780323672177, Pages: 4535.
5. Gray's Anatomy, 2005. The Anatomical Basis of Clinical Practice. AJNR Am J Neur., 26: 2703-2704.
6. Dugan, T.R., M.G. Hubert, P.A. Siska, H.C. Pape and I.S. Tarkin, 2013. Open supracondylar femur fractures with bone loss in the polytraumatized patient-timing is everything!. Injury, 44: 1826-1831.
7. Button, G., P. Wolinsky and D. Hak, 2004. Failure of less invasive stabilization system plates in the distal femur. J. Orthop. Trauma, 18: 565-570.
8. Davison, B.L., 2003. Varus collapse of comminuted distal femur fractures after open uction and internal fixation with a lateral condylar buttress plate. Am J Orthop., 32: 27-30.
9. Bolhofner, B.R., B. Carmen and P. Clifford, 1996. The results of open reduction and internal fixation of distal femur fractures using a biologic (indirect) reduction technique. J. Orthop. Trauma, 10: 372-377.
10. Ostrum, R.F. and C. Geel, 1995. Indirect reduction and internal fixation of supracondylar femur fractures without bone graft. J. Orthop. Trauma, 9: 278-284.