



## Evaluation of functional outcome following ORIF with Distal femoral locking plate in Intraarticular fractures of the distal femur

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### ABSTRACT

Fractures of the distal femur are high-velocity injuries and are associated with factors such as fracture comminution and osteoporosis, especially in elderly individuals which are quite challenging to manage. Various implants and techniques are available for the surgical management of these fractures. This study was performed to evaluate the functional outcome of these fractures following ORIF (Open reduction and internal fixation) with the DFLP (Distal femoral locking plate). Thirty patients with distal femoral intraarticular fractures who presented between February 2013 to February 2016 were managed by ORIF with DFLP and were followed up for three years. Functional evaluation was performed using the Neers scoring system. The average age of the patients was 38.06 years ranging from 22 to 64 years. There were twenty-one males, and nine females seen in our study with the right side being more commonly affected. We achieved a 100% union rate in our series with the meantime to fracture union being 12.86 weeks. We had excellent results in 65% of patients and satisfactory results in 35% of patients with minimal complications. ORIF with the DFLP is a unique biological fixation option in intraarticular fractures of the distal femur, and it provides for reasonable rates of fracture union and an excellent functional outcome with minimal complications.

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### INTRODUCTION

Fractures of the distal femur account for 6% of all fractures and they are high-velocity injuries often associated with metaphyseal comminution. (Stewart *et al.*, 1966) Fractures in the elderly population are usually caused by minor injuries such as slip and fall due to the poor bone stock in that age group

while considerable force is required in younger individuals to bring about a fracture. These fractures are often a cause of significant morbidity and mortality, especially in the elderly age group. (Higgins, 2007; Martinet *et al.*, 2000). They are challenging to treat and pose a challenge to the treating surgeon due to the intraarticular nature of the fracture and compounding factors such as fracture comminution and osteoporosis. Conservative management is not indicated in these fractures as they result in poor functional outcomes and are only reserved for patients who are medically unfit to undergo a surgical procedure. Surgical management aims to achieve an anatomic reduction of the articular surface, provide a stable internal fixation with a rigid implant, careful soft-tissue handling to preserve the blood supply to the bone along with early and active knee mobilization to prevent knee stiffness. (Crist *et al.*, 2008; Greiwe and Archdeacon, 2007). Due to the complexity of these fractures,

complications such as nonunion, malunion and knee stiffness can be encountered, leading to a decreased functional outcome. Various implants and operative techniques are available in the management of these fractures such as intramedullary as well as surface implants. (Cantu and Koval, 2006; Zlowodzki et al., 2004). This study was performed to evaluate the functional outcome of these fractures following ORIF with the DFLP.

## MATERIALS AND METHODS

This was a prospective study of 30 patients with Intraarticular fractures of the distal femur who presented between February 2013 to February 2016 treated with ORIF with DFLP with a follow-up period of 3 years. Ethical committee approval was obtained before performing this study. Skeletally mature patients, with Intra, articular fractures of distal femur willing for the surgery and follow up were included in our study. In contrast, skeletally immature patients, extra-articular fractures, compound injuries and fractures with neurovascular compromise in the affected limb were excluded. The patients were admitted, and the limb was stabilized with a Thomas splint, and haemodynamic status of the patient was assessed. The patients were then subjected to clinical and radiological evaluation. Standard radiographs of the affected knee were taken in AP, lateral and oblique projections. CT scans were taken in comminuted fracture patterns to assess the fracture geometry and to aid in planning for surgery. All fractures were classified according to the AO classification, and the fracture type was documented in the patient case records. Figure 1.

Routine blood investigations were done, and the patients were worked up for the surgical procedure. The procedures were performed under regional anaesthesia under the IV antibiotic cover. Injection Cefazolin 1gm was given at the time of starting the surgical procedure and was given for three days postoperatively. The surgeries were performed by the same orthopaedic surgeon who was well versed with the procedure. The patient was placed in the supine position, and prepping and draping was done. A 15-20 cm incision was made in the lateral aspect of the thigh from middle third extended distally, and it was curved anteriorly up to the level of the tibial tuberosity. The fascia and the extensor retinaculum were incised in line with the skin incision, and the patella was everted to provide excellent exposure of both femoral condyles and the distal aspect of the shaft. In fractures with comminution, multiple K wires were used to fix the fracture

fragments after provisional reduction of the fracture. A suitable length plate was then applied with provision for a minimum of 5 screws proximal to the fracture site. Initially, a couple of 4.5mm cortical screws were placed proximal to the fracture site to approximate the plate to the bone followed by application of the remaining cancellous and locking screws with a minimum of six screws in the distal fragment. The fracture reduction and fixation were checked with fluoroscopic images and found to be satisfactory. The knee was then put through its range of motion to check for stability. After ensuring haemostasis and placing a drain insitu, the wound was closed in layers, and sterile dressing and compression bandage was applied. The patient's knee was actively mobilized early, and quadriceps strengthening exercises were taught to the patient. They were mobilized with non-weight bearing walking with walker support on day one. They were asked to continue strict non-weight bearing until clinical and radiological signs of fracture union.

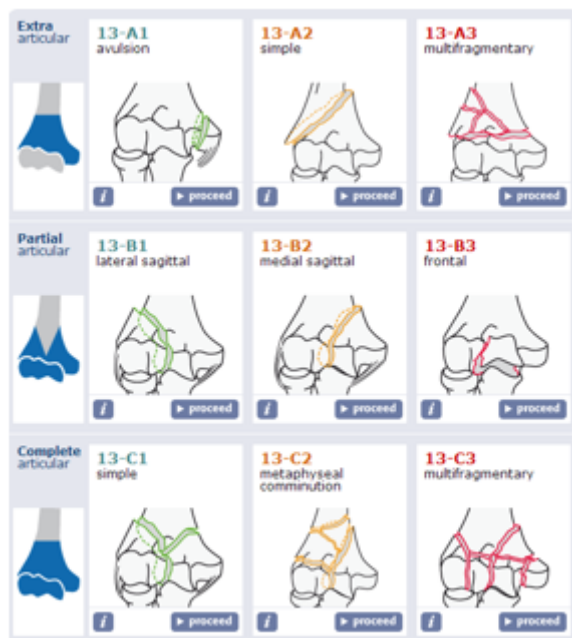
Wound inspections were done on day 3, and 5 and suture removal was done on day 12. The patients were then discharged and asked to review at prescribed intervals where serial radiographs were taken to assess for signs of fracture union. Functional assessment was done with the Neers scoring system. Fracture union was taken to be cross trabeculation across the fracture site radiologically, and absence of tenderness over the fracture site and lack of pain on weight-bearing walking clinically. All findings were documented in the case records. Data analysis was performed using IBM SPSS Version 22.0. Armonk, NY: IBM Corp software. The Chi-square test compared categorical variables. A P value of <0.05 was considered to be statistically significant.

## RESULTS AND DISCUSSION

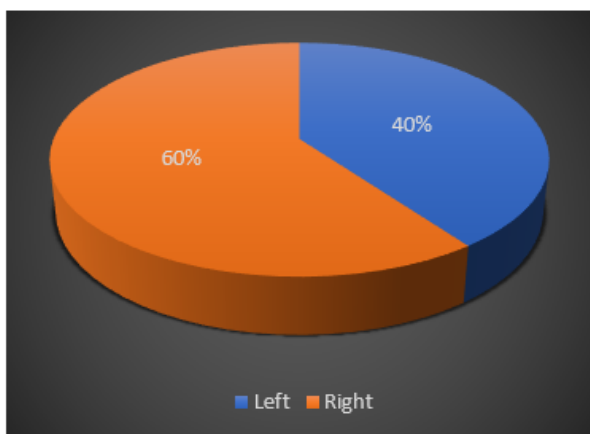
The average age of the patients was 38.06 years which ranged from 22 to 64 years. There were 21 males and nine females in our study with the right side being more commonly affected, as seen in 18 patients. Figure 2.

The most common mode of injury were road traffic accidents followed by slip and fall. Figure 3.

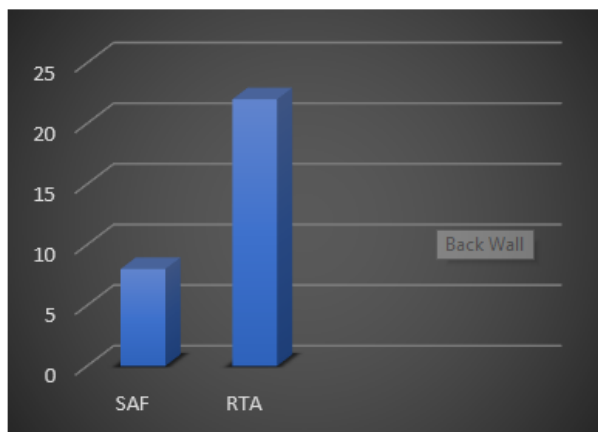
The mean time from injury to presentation to the hospital was four days, ranging from 1 to 12 days while the meantime from the presentation to the surgical procedure was five days ranging from 3 to 14 days. According to the AO classification, C1 was the most common fracture type seen followed by C2 and C3. The average surgical time was 75.4 minutes ranging from 80 to 110 minutes. The average blood



**Figure 1: AO classification**



**Figure 2: Side dominance**



**Figure 3: Mode of injury**

loss was 375.66 ml ranging from 300 to 450 ml. We were able to achieve a 100% union rate in our series with the meantime to fracture union being 12.86 weeks which ranged from 11 to 15 weeks. Table 1 Figure 4.

Figure 4 shows Preop AP. B. Preop lateral view. C. Immediate postop AP view. D. 6 weeks AP. E. 3rd month follow up. F. 6th month follow up showing good union at the fracture site.

The range of motion achieved was  $125^0 \pm 5^0$ . According to the Neers scoring system, we had excellent scores in 65% of patients and satisfactory in 35% of patients with no unsatisfactory or failure results. We had minor complications such as superficial skin infections in 3 patients, skin necrosis in one patient. In comparison, two patients had an extensor lag of 10 and 15 degrees which did not affect the functional outcome. We had no significant complications such as nonunion, malunion, implant failure or arthrofibrosis seen in our study. We did not lose any of our patients to follow up.

Fractures of the distal femur account for 6% of all fractures and they are high-velocity injuries often associated with metaphyseal comminution. Conservative management is not indicated in these fractures as they result in poor functional outcomes and are only reserved for patients who are medically unfit to undergo a surgical procedure. Surgical management aims to achieve an anatomic reduction of the articular surface, provide a stable internal fixation with a rigid implant, precise soft-tissue han-

**Table 1: Patient demographics and data**

S.No	Age	Sex	Side	Mode of injury	AO type	Surgical time (mins)	Blood loss (ml)	Time to union (weeks)
1	25	M	R	SAF	C3	80	410	11
2	27	M	R	RTA	C1	94	375	11
3	41	F	R	RTA	C1	90	350	12
4	56	M	L	SAF	C1	110	310	14
5	59	M	R	RTA	C2	100	340	13
6	64	F	L	RTA	C3	82	440	15
7	58	M	R	RTA	C1	94	410	11
8	61	F	R	RTA	C1	98	350	15
9	32	F	L	RTA	C2	100	450	14
10	41	M	R	RTA	C3	87	400	15
11	49	M	L	RTA	C3	94	375	11
12	33	M	R	SAF	C1	93	320	12
13	36	F	L	SAF	C2	90	300	13
14	41	M	R	RTA	C1	89	310	13
15	45	M	R	RTA	C1	86	300	13
16	46	M	L	RTA	C2	80	340	11
17	54	F	R	SAF	C1	110	350	12
18	60	F	L	RTA	C3	104	400	13
19	38	M	R	RTA	C1	100	450	13
20	29	M	R	RTA	C1	98	410	11
21	26	M	L	RTA	C1	99	330	12
22	31	M	R	SAF	C2	89	375	15
23	43	F	R	RTA	C1	81	380	14
24	44	M	R	RTA	C1	84	410	13
25	58	M	L	SAF	C2	92	320	14
26	40	M	R	SAF	C1	96	410	14
27	29	M	L	RTA	C1	100	400	11
28	36	F	L	RTA	C2	90	350	13
29	39	M	R	RTA	C1	84	360	14
30	44	M	L	RTA	C1	80	420	13



**Figure 4: Illustrative case**

dling to preserve the blood supply to the bone along with early and active knee mobilization to prevent knee stiffness. The various implants available for the fixation of these fractures are DCS (Dynamic condylar screw) condylar buttress plates, retrograde nails, LISS (Less invasive skeletal stabilization) and the DFLP. DCS used to be done quite commonly in the past but is not so much in vogue now and has shown to produce poor functional outcomes in fractures with osteoporosis and metaphyseal comminution. The condylar buttress plate can be used in fractures with metaphyseal comminution. Still, it has shown to be associated with complications as varus collapse due to toggle, which occurs at the interface between the screw and plate. Retrograde nails produce good results but have a steep learning curve. In fractures with comminution and intraarticular extension they are associated with variable outcomes with malreduction of the proximal fragment and it may fail during axial loading due to loss of distal fixation and can cause penetration of the nail into the knee joint and can be associated with knee stiffness. (Schmidt *et al.*, 2013; Vallier and Immler, 2012). LISS is associated with a decreased incidence of metal loosening, promotes early mobilization of the joint with good healing rates along with reduced blood loss with decreased rates of infection. The DFLP acts on the internal fixator principle. It provides a stable fixation construct and is a good option in fractures with metaphyseal comminution where it can be used to bridge the fracture site. It provides fixation option for fixed angle locking screws which enable a good purchase in osteoporotic bone. It resists varus collapse at the fracture site and reduces the toggle at the interface between the screw and the bone. The screw heads lock on the plate, and there is no displacement of the fracture when the screws are tightened. It facilitates decreased soft tissue stripping and aids in the preservation of the blood supply to the bone resulting in increased rates of bony union. (Bolhofner *et al.*, 1996; Fankhauser *et al.*, 2004) ; (Fankhauser *et al.*, 2004). In Toro *et al.* study of 10 patients with distal femur fractures, they reported a male preponderance and achieved union in all patients. They had two cases of nonunion with one patient having a delayed union after the first year. (Toro *et al.*, 2015). Galal *et al.* studied 20 patients and reported a 100% union rate in their study. The mean time to fracture union was 13.4 weeks ranging from 8 to 24 weeks, and they reported delayed union in two patients. All but one of the fractures, united in an anatomic position. No other complications were reported. Galal (2017). In Ziran *et al.* study of thirty-five patients, there was also a male preponderance

seen and the meantime to fracture union was 16 weeks. The mean arc of motion was 5 to 100°. They had three cases of nonunion and one patients with arthrofibrosis of the knee. (Ziran *et al.*, 2002) In our study, we were able to achieve a 100% union rate in our series with the meantime to fracture union being 12.86 weeks ranging from 11 to 15 weeks. The range of motion achieved was 125°±5. According to the Neers scoring system, we had excellent scores in 65% of patients and satisfactory in 35% of patients with no unsatisfactory or failure results. We had minor complications such as superficial skin infections in three patients, skin necrosis in one patient. In comparison, two patients had an extensor lag of 10 and 15 degrees which did not affect the functional outcome.

## CONCLUSION

ORIF with the DFLP is an excellent biological fixation option in intraarticular fractures of the distal femur. It provides a stable fixation construct and is a good option in fractures with metaphyseal comminution where it can be used to bridge the fracture site. It provides fixation option for fixed angle locking screws which enable a good purchase in osteoporotic bone. It resists varus collapse at the fracture site and reduces the toggle at the interface between the screw and the bone. The DFLP provides for excellent rates of fracture union and good functional outcome with minimal complications.

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The authors declare that they have no funding support for this study.

## Conflict of Interest

The authors declare that they have no conflict of interest for this study.

## REFERENCES

- Bolhofner, B. R., Carmen, B., Clifford, P. 1996. The Results of Open Reduction and Internal Fixation of Distal Femur Fractures Using a Biologic (Indirect) Reduction Technique. *Journal of Orthopaedic Trauma*, 10(6):372–377.
- Cantu, R. V., Koval, K. J. 2006. The Use of Locking Plates in Fracture Care. *Journal of the American Academy of Orthopaedic Surgeons*, 14(3):183–190.
- Crist, B. D., Rocca, G. J. D., Murtha, Y. M. 2008. Treatment of Acute Distal Femur Fractures. *Orthopedics*, 31(7):681–690.
- Fankhauser, F., Gruber, G., Schippinger, G., Boldin, C., Hofer, H. P., Grechenig, W., Szyszkowitz, R. 2004.

- Galal, S. 2017. Dynamic locked plating for fixation of distal femur fractures using near-cortical over-drilling: Preliminary results of a prospective observational study. *Journal of Clinical Orthopaedics and Trauma*, 8(3):215-219.
- Greiwe, R. M., Archdeacon, M. T. 2007. Locking plate technology: current concepts. *J Knee Surg*, 20:50-55.
- Higgins, T. F. 2007. Distal femoral fractures. *J Knee Surg*, 20:56-66.
- Martinet, O., Cordey, J., Harder, Y., Maier, A., Bühler, M., Barraud, G. E. 2000. The epidemiology of fractures of the distal femur. *Injury*, 31:62-94.
- Schmidt, U., Penzkofer, R., Bachmaier, S., Augat, P. 2013. Implant Material and Design Alter Construct Stiffness in Distal Femur Locking Plate Fixation: A Pilot Study. *Clinical Orthopaedics and Related Research*, 471(9):2808-2814.
- Stewart, M. J., Sisk, T. D., Wallace, S. L. 1966. Fractures of the Distal Third of the Femur. *The Journal of Bone & Joint Surgery*, 48(4):784-807.
- Toro, G., Calabrò, G., Toro, A., Sire, A. D., Iolascon, G. 2015.
- Vallier, H. A., Immler, W. 2012. Comparison of the 95-Degree Angled Blade Plate and the Locking Condylar Plate for the Treatment of Distal Femoral Fractures. *Journal of Orthopaedic Trauma*, 26(6):327-332.
- Ziran, B., & Rohde, R., Wharton, A. 2002.
- Zlowodzki, M., Williamson, S., Cole, P. A., Zardiackas, L. D., Kregor, P. J. 2004. Biomechanical Evaluation of the Less Invasive Stabilization System, Angled Blade Plate, and Retrograde Intramedullary Nail for the Internal Fixation of Distal Femur Fractures. *Journal of Orthopaedic Trauma*, 18(8):494-502.