

# Comparison of Functional Outcome of closed Retrograde Nailing and Mippo (Minimally Invasive Percutaneous Plate Osteosynthesis) Distal Femoral Locking Plate Fixation for Distal Femoral Fractures

MUHAMMAD IMRAN HAIDER<sup>1</sup>, KASHIF SIDDIQ<sup>2</sup>, AHMAD JAMAL<sup>3</sup>, MUHAMMAD ADEEL RAZZAQUE<sup>4</sup>, ADNAN NAZIR<sup>5</sup>, MUHAMMAD IMRAN ANJUM<sup>6</sup>

<sup>1</sup>Assistant Professor Orthopedics, Nishtar University Multan

<sup>2</sup>Assistant Professor Orthopedic surgery, BVH, Quaid-e-Azam Medical College Bahawalpur

<sup>3</sup>Senior Registrar Orthopaedics, Nishtar Hospital Multan,

<sup>4</sup>Assistant Professor, Bakhtawar Amine Hospital Multan

<sup>5</sup>Senior Registrar Orthopaedics, Bahawal Victoria Hospital Bahawalpur

<sup>6</sup>Consultant Orthopaedic Surgeon, Victoria Hospital BWP

Corresponding author: Muhammad Imran Haider, Email: [drmiqhaisrani@gmail.com](mailto:drmiqhaisrani@gmail.com), Cell: 03336100785

## ABSTRACT

**Objective:** The purpose of our study is to compare the safety and efficacy of MIPPO distal femoral locking plate versus retrograde nailing in distal locking plate fixation among patients suffering from distal femoral fractures.

**Study Design:** Quasi Experimental study

**Place and Duration:** Nishtar Hospital Multan. August 2021-May 2022

**Methods:** There were 112 patients of both genders with ages 15-48 years had distal femoral fractures and underwent for surgery were included in this study. After obtaining informed written consent, demographically detailed of enrolled cases were recorded. Causes of distal femoral fractures were assessed. Patients were equally categorized in two groups. 56 patients in group O received MIPPO DFLP and in group P 56 cases received retrograde nailing. All patients were radiographed and categorized according to the criteria established by the AO/OTA categorization system.[13] Outcomes among both groups were assessed and compared in terms of surgery duration, efficacy and complications. HSS score was used to describe effectiveness of both groups. SPSS 24.0 was used to analyze all data.

**Results:** We found that males were higher in numbers 80 (71.4%) than females (32 (28.6%). Mean age of the included patients were 29.5±9.81 years and had mean BMI 24.8±11.44 kg/m<sup>2</sup>. Most common cause of fracture was road traffic accident (RTA) in 51 (45.5%) cases, followed by falling in 35 (31.3%) cases, sports in 17 (15.2%) cases and violence in 9 (8.04%). Most common affected side was right. As per AO classification, numbers were higher in Type 43A1 classification found in 65 (58.04%) cases. Mean union time in group O was lower 2.5±4.87 months as compared to group P 3.9±6.54 significantly with p value <0.005. We found significantly higher number of excellent results in MIPPO DFLP group found in 29 (51.8%) cases as compared to retrograde nailing group in 14 (25%) cases with p value <0.003. Complications (delayed union, non-union, deformity, bone stiffness) were found higher in group P.

**Conclusion:** We concluded in this study that use of MIPPO DFLP for the treatment of distal third femoral shaft fractures is highly effective and useful as compared to retrograde nailing with p value <0.04 in terms of less unions time, higher excellent results and lower number of complications.

**Keywords:** Retrograde Nailing, Distal Femoral Fractures, MIPPO DFLP, Efficacy, Complications

## INTRODUCTION

Only 3-6% of all femur fractures are at the distal third, according to certain sources [1]. They have a bimodal distribution, with the first peak happening between the ages of 15 and 50, most commonly in males who have sustained high-energy trauma, and the second peak happening between the ages of 50 and 99, most commonly in females who have osteoporosis and have sustained low-energy trauma due to their advanced age [2]. The problems with the traditional open reduction and internal plate fixation of distal femoral fractures are well known. They have been linked to extensive fracture site exposures [3]. Common among runners and the military, femoral shaft fractures are defined as breaks in the diaphysis that occur between 5 centimetres (cm) distal to the lesser trochanter and 5 centimetres (cm) proximal to the adductor tubercle.

Minimally invasive plate osteosynthesis (MIPO) was developed to enhance fracture healing and reduce complications by reducing the need for direct exposure to the fracture site [4,5]. The use of MIPO procedures shortens the duration of anaesthesia and the amount of blood lost [6].

Synthes plate™ (Synthes, West Chester, PA, USA), a less invasive stabilisation system (LISS), was developed to facilitate indirect reduction techniques and minimally invasive procedures [7]. The locking plate elevates the fracture away from the bone, functioning like a "internal" fixator, protecting the periosteum from crushing and, in theory, the blood supply [8].

The anatomical/subcutaneous position, poor blood supply, and limited muscular anterior cover of extra-articular distal femur fractures make them among the most challenging fractures for

Orthopaedic surgeons to treat. Orthopaedic surgeons often report that a significant complication rate, including things like delayed bone union, non-union, wound infections, and wound dehiscence, is their worst concern. When it comes to treating distal femur fractures, one of the most popular, reliable methods is minimally invasive percutaneous plate osteosynthesis (MIPPO). [9] The goal of MIPPO is to preserve the osteogenic fracture haematoma while minimising iatrogenic damage to the surrounding soft tissues and bone's vascularity. It has been documented that the MIPPO procedure, which involves the implantation of a larger lever arm plate, aids in early and full union and great functionality of the knee. Therefore, we intended to carry out this research to gather proof for the local populace. [10]

Failure of fixation in osteoporotic bone should be decreased with the use of an intramedullary device due to the former's ability to preserve the anatomical axis and the latter's reduced bending movement. Preserving fracture hematoma, reducing blood loss, performing little soft-tissue dissection, shortening operational time, and decreasing the risk of infection are all additional benefits of a retrograde intramedullary supracondylar nail. The anatomically pre-contoured design of the LCP makes it effective as an internal external fixator and lessens the risk of soft-tissue complications. As the screw locks into place on the plate during an LCP procedure, there is also a reduced risk of the plate coming loose and requiring another surgery. As an added bonus, the minimally invasive plate osteosynthesis approach utilized in conjunction with closed reduction results in little soft-tissue injury. [8-10]

This will enhance our practice and provide us with local magnitude that we can utilize in the future to adopt the MIPPO

method for preventing complications and achieving good to exceptional results as quickly as possible.

**MATERIAL AND METHODS**

This Quasi Experimental study was conducted at Nishtar Hospital, Multan from August 2021 to May 2022 and comprised of 112 patients. After obtaining informed written consent, demographically detailed of enrolled cases were recorded. Patients <15 years of age, patients with severe medical illness, allergic to medicines and those did not provide any written consent were excluded from this study.

Included patients had age 15-48 years. All patients were radiographed and categorized according on the criteria established by the AO/OTA categorization system. The classification is commonly used to classify distal femur fractures into extra-articular (type A), partial articular (type B), and complete articular (type C). [13] Included patients had region distal 5-7 cm of femur fracture. During the preoperative evaluation, standard anteroposterior and lateral x-ray views of the distal femur and knee joint were taken for all patients. Axial computed tomography with frontal and sagittal plane reconstruction was performed to aid in surgical planning for difficult multiplanar fractures. Patients were equally categorized in two groups. 56 patients in group O received MIPPO DFLP and in group P 56 cases received retrograde nailing. The Sanders et al. functional evaluation scale for distal femoral fractures was used to evaluate all patients clinically and radiographically after 4 months of follow-up. T-tests, Chi-square analyses, and Fisher's exact test were used to determine how patient and fracture characteristics influenced functional recovery. HSS score was used to present results in terms of excellent, good, fair and poor.

**RESULTS**

Among 112 cases, males were higher in numbers 80 (71.4%) than females (32 (28.6%)).(figure 1)

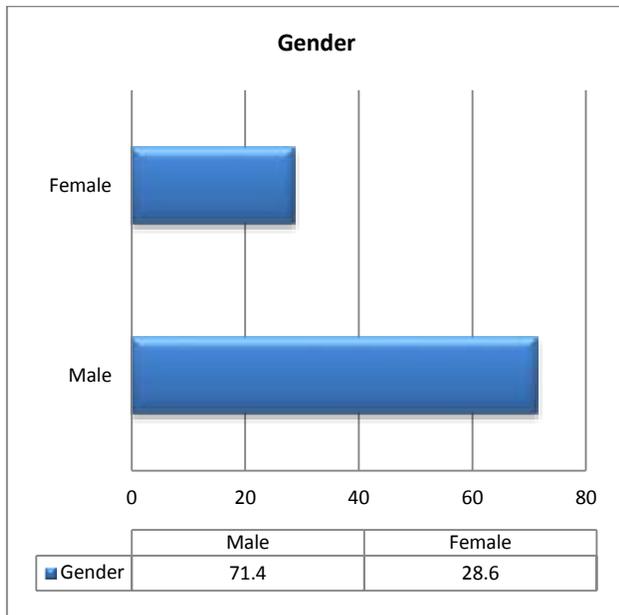


Figure-1: Included patients with gender distribution

Mean age of the included patients were 29.5±9.81 years and had mean BMI 24.8±11.44 kg/m<sup>2</sup>. Most common cause of fracture was road traffic accident (RTA) in 51 (45.5%) cases, followed by falling in 35 (31.3%) cases, sports in 17 (15.2%) cases and violence in 9 (8.04%). Most common affected side was right. Majority of the cases had poor socio economic status.(table 1)

Table-1: Included patients with detailed demographics

Variables	Frequency	Percentage
Mean age (years)	29.5±9.81	
Mean BMI (kg/m <sup>2</sup> )	24.8±11.44	
Affected Side		
Left	39	34.8
Right	73	65.2
Causes of Fractures		
RTA	51	45.5
Falling	35	31.3
Sports	17	15.2
Violence	9	8.04
Socio-economic status		
Poor	55	49.1
Middle	36	32.1
Upper	19	16.9

As per AO-OTA classification, numbers were higher in A1 classification found in 65 (58.04%) cases, 34 (30.4%) patients had A2 and A3 found in 13 (11.6%) cases. In group O mean surgery time was 38.6±4.87 minutes and in group P mean time was 47.5±8.37 minutes. Mean union time in group O was lower 2.5±4.87 months as compared to group P 3.9±6.54 significantly with p value <0.005.(table 2)

Table-2: Surgery and union time of femur fracture among both groups

Variables	MIPPO DFLP	RN
AO-Classification		
A1	65	58.04
A2	34	30.4
A3	13	11.6
Mean Surgery Time (minutes)	38.6±4.87	47.5±8.37
Mean Union Time (months)	2.5±4.87	3.9±6.54

We found significantly higher number of excellent results by using HSS score in MIPPO DFLP group found in 29 (51.8%) cases as compared to retrograde nailing group in 14 (25%) cases with p value <0.003. Frequency of poor results in group P was higher 12 (21.4%) as compared to group O 3 (5.4%) with p value <0.004.(table 3)

Table-2: Comparison of functional outcomes among both groups by using HSS score

Variables	MIPPO DFLP	RN
HSS		
Excellent	29 (51.8%)	14 (25%)
Good	15 (26.8%)	20 (35.7)
Fair	9 (16.1%)	10 (17.9%)
Poor	3 (5.4%)	12 (21.4%)
Total	56 (100%)	56 (100%)

Post-operative, complications (delayed union, non-union, deformity, bone stiffness) were found higher in group P as compared to group O.(figure 2)

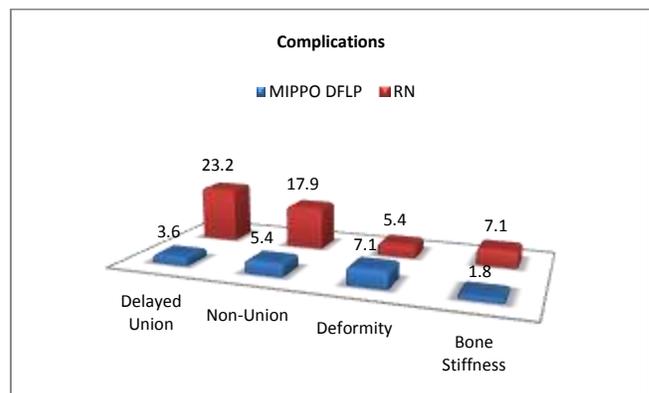


Figure-2: Comparison of complications among both groups

## DISCUSSION

There are two main ways of getting a fracture in the distal femur. High-energy trauma, such as those sustained in car accidents, can cause open wounds with significant comminution of the condyles and metaphyseal ends, while low-energy trauma, common among the elderly and associated with severe osteoporosis, can be made more complicated by the presence of a total knee prosthesis as per prosthetic fractures [11].

Restoring bone length, aligning and rotating the articular surface, early mobilizing of the related joints, promoting fracture union, and minimizing sequelae are all targets of care for distal femur fractures [12]. There are a variety of fixation techniques that have been described. There are three main types of fixation: retrograde intramedullary nailing, bridge plating, and open anatomical reduction with plates and screws [13].

In current study 112 patients of both genders had distal femur fractures were included. Among 112 cases, males were higher in numbers 80 (71.4%) than females (32 (28.6%)). Mean age of the included patients were 29.5±9.81 years and had mean BMI 24.8±11.44 kg/m<sup>2</sup>. Most common cause of fracture was road traffic accident (RTA) in 51 (45.5%) cases, followed by falling in 35 (31.3%) cases, sports in 17 (15.2%) cases and violence in 9 (8.04%). These presented results were comparable to the previous some studies, in which majority of the trauma caused in males due to RTA and had age 20-35 years.[14.15] In our study right side was the most common affected side. As per AO-OTA classification, most of the patients were had A1. These results showed same results to the prior study.[16]

In our study mean surgery time was 38.6±4.87 minutes in MIPPO group and in group P mean time was 47.5±8.37 minutes. Mean union time in group O was lower 2.5±4.87 months as compared to group P 3.9±6.54 significantly with p value <0.005. Twenty-two patients with distal femoral fractures were treated with the DFLP plating and then re-examined an average of 4 months later. The average time it took for a fracture to heal without additional surgery was 13 weeks (range 7-16 weeks). Failure to stabilize, implant fracture, or infection did not occur [17]. Patients treated by Fankhauser et al. for 30 distal femoral fractures (types A and C) with the MIPPO plating were followed for a mean of 20 months. According to their data, the average time to union was 12 weeks (range: 8-23 weeks), while the duration to complete weight bearing was anything from 6-18 weeks [13].

Diverse methods of treating distal third femur fractures have been published in the literature. [18] However, for distal femur fractures, MIPPO and intramedullary interlock nail are the two most successful and proposed techniques. Fractures of the distal femur fractures are difficult to treat with intramedullary nailing and require careful attention to placement. Deformity and failure to heal can result from improperly handling bone fragments at the ends of bones. [19,20] We found significantly higher number of excellent results by using HSS score in MIPPO DFLP group found in 29 (51.8%) cases as compared to retrograde nailing group in 14 (25%) cases with p value <0.003. Frequency of poor results in group P was higher 12 (21.4%) as compared to group O 3 (5.4%) with p value <0.004. Recent biomechanical research [21] suggests that the MIPPO fixation method is superior to conventional implants like condylar buttress plates and dynamic condylar screws in terms of load resistance and stability of fixation. Nailing was shown to be more laborious intraoperatively due to increased operating time and blood loss and subsequent anterior knee pain prompting implant removal in a study comparing intramedullary nails versus MIPPO DFLP in the therapy of extra-articular supracondylar femur fractures [22].

Post-operative, we found that complications (delayed union, non-union, deformity, bone stiffness) were found higher in RN as compared to MIPPO DFLP group. As a result, MIPPO has a great

chance of success in obtaining good to exceptional results in the greatest possible number of patients presenting with a distal tibia fracture. As a result, this method will be the standard for treating similar fractures in the future.[23] More extensive follow-up studies are required to compare this therapy approach with other important outcomes.

## CONCLUSION

We concluded in this study that use of MIPPO DFLP for the treatment of distal third femoral shaft fractures is highly effective and useful as compared to retrograde nailing with p value <0.04 in terms of less unions time, higher excellent results and lower number of complications.

## REFERENCES

- Epidemiology of adult fractures: a review. Court-Brown CM, Caesar B. *Injury*. 2006;37:691-697.
- The epidemiology of fractures of the distal femur. Martinet O, Cordey J, Harder Y, Maier A, Bühler M, Barraud GE. *Injury*. 2000;31:62-63.
- Jha AK, Bhattacharyya A, Kumar S, Ghosh TK. Evaluation of results of minimally invasive plate osteosynthesis (MIPO) of distal tibia fractures in adults. *Journal of the Indian Medical Association* 2012;110(11):823-4.
- Less invasive stabilization system plating for distal femoral fractures. Kanabar P, Kumar V, Owen PJ, Rushton N. *J Orthop Surg*. 2007;15:299-302.
- Ronga M, Longo UG, Maffulli N. Minimally invasive locked plating of distal tibia fractures is safe and effective. *Clin Orthop Relat Res* 2010;468(4):975-82.
- Treatment of distal femur fractures using the less invasive stabilization system: surgical experience and early clinical results in 103 fractures. Kregor PJ, Stannard JA, Zlowodzki M, Cole PA. *J Orthop Trauma*. 2004;18:509-520.
- The development of the distal femur less invasive stabilization system (LISS) Frigg R, Appenzeller A, Christensen R, Frenk A, Gilbert S, Schavan R. *Injury*. 2001;32:24-31.
- Distal femoral fractures: a review of fixation methods. Forster MC, Komarsamy B, Davison JN. *Injury*. 2006;37:97-108.
- Kolb, W, Guhlmann, H, Windisch, C, Marx, F, Kolb, K, Koller, H. Fixation of distal femoral fractures with the Less Invasive Stabilization System: A minimally invasive treatment with locked fixed-angle screws. *J Trauma* 2008;65:1425-34.
- Sommer, Ch, Gautier, E. Relevance and advantages of new angular stable screw-plate systems for diaphyseal fractures (locking compression plate versus intramedullary nail) [in German]. *Ther Umsch* 2003;60:751-6.
- Double-plating of comminuted, unstable fractures of the distal part of the femur. Sanders R, Swionkowski M, Rosen H, Helfet D. *J Bone Joint Surg Am*. 1991;73:341-346.
- Christodoulou, A, Terzidis, I, Ploumis, A, Metsovitis, S, Koukoulidis, A, Toptsis, C. Supracondylar femoral fractures in elderly patients treated with the dynamic condylar screw and the retrograde intramedullary nail: A comparative study of the two methods. *Arch Orthop Trauma Surg* 2005;125:73-9.
- Minimal-invasive treatment of distal femoral fractures with the LISS (less invasive stabilization system): a prospective study of 30 fractures with a follow up of 20 months. Fankhauser F, Gruber G, Schippinger G, Boldin C, Hofer HP, Grechenig W, Szyszkowitz R. *Acta Orthop Scand*. 2004;75:56-60.
- Abdelmonem AH, Saber AY, El Sagheir M, El-Malky A. Evaluation of the Results of Minimally Invasive Plate Osteosynthesis Using a Locking Plate in the Treatment of Distal Femur Fractures. *Cureus*. 2022 Mar 29;14(3):e23617
- Kao FC, Tu YK, Su JY, Hsu KY, Wu CH, Chou MC. Treatment of distal femoral fracture by minimally invasive percutaneous plate osteosynthesis: comparison between the dynamic condylar screw and the less invasive stabilization system. *J Trauma*. 2009 Oct;67(4):719-26.
- Nayak RM, Koichade RM, Umre AN, Ingle MV. Minimally Invasive Plate Osteosynthesis Using a Locking Compression Plate for Distal Femoral Fractures. *Journal of Orthopaedic Surgery*. August 2011;185-190
- Early results of the less invasive stabilization system for mechanically unstable fractures of the distal femur (AO/OTA types A2, A3, C2, and C3) Weight M, Collinge C. *J Orthop Trauma*. 2004;18:503-508.
- Gorczyca JT, McKale J, Pugh K, Pienkowski D. Modified tibial nails for treating distal tibia fractures. *Journal of orthopaedic trauma* 2002;16(1):18-22
- Konrath G, Moed BR, Watson JT, Kaneshiro S, Karges DE, Cramer KE. Intramedullary nailing of unstable diaphyseal fractures of the tibia with distal intraarticular involvement. *Journal of orthopaedic trauma* 1997;11(3):200-5.
- Tornetta III P, Casey D, Creevy W. Nailing proximal and distal tibia fractures. Rosemont. IL: Orthopaedic Trauma Association Final Program & Membership Directory 2000:131-2
- Kim JW, Oh CW, Kyung HS, Min WK, Yoon SH. Factors affecting the results of distal femoral fractures treated by retrograde intramedullary nailing. *Zhongguo Xiu Fu Chong Jian Wai Ke Za Zhi* 2009;23:1311-5.
- Bahari S, Lenehan B, Khan H, McElwain JP. Minimally invasive percutaneous plate fixation of distal tibia fractures. *Acta Orthop Belg* 2007;73:635-40
- Sitnik A, Beletsky A, Scheikun S. Intra-articular fractures of the distal tibia. *EFORT Open Reviews* 2017;2(8):352-61