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Comparative study on femoral shaft fracture treated by plate and screws versus intramedullary interlocking nails. A clinical study

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Abstract

Background and objective: Diaphyseal femoral fracture is injury that need reduction and fixation. The aim is to compare between treatment of diaphyseal femoral fracture by open and closed technique in primary outcome measures as union and malalignment; and secondary outcome measures as nerve injury, blood loss, exposure to fluoroscopy and infection.

Methods: This cross-sectional study compares two groups of sixty-three patients, with DFF; group A (27patients) were treated by closed reduction by intramedullary interlocking nail and group B (36 patients) by open reduction and internal fixation by plate and screws. Both groups were followed up by union, malalignment, blood loss, nerve injury, infection, exposure to radiation and implant failure. Following surgery, both groups were evaluated at four weeks, six weeks, three months, six months, and one year.

Results: there was significant association between type of operation and gender 88.9% of male patients were treated by group A technique while 63.9% of male patients treated by group B technique (P = 0.024), callus formation after 4 weeks 81.5% of group A cases callus formed after 4 weeks (P <0.001), union at 6 months 92.83% of group A united (P = 0.007),intra operative exposure to radiation 100% patients of group A exposed to fluoroscopy (P <0.001), blood transfusion 66.7% of group B cases transfused blood (P <0.001), nerve injury 100% of cases in group B did not have nerve injury (P = 0.029) and range of knee flexion at 6 months 88.9% of group A cases range of knee flexion was 0- ≥ 120 degrees (P = 0.004).

Conclusion: This study found that closed reduction by intramedullary interlocking nail better than open reduction and internal fixation by plate and screws in callus formation after four weeks, union at six months, blood loss and range of knee flexion; while the open reduction and internal fixation by plate and screws was better than closed reduction by intramedullary interlocking nail in nerve injury and exposure to radiation.

Keywords: Diaphyseal femoral fracture; Intramedullary interlocking nail; Plate and screws fixation; Callus formation; Union.

Introduction

Diaphyseal femoral fractures were the most prevalent type of injury managed by orthopedic surgeons, these types of fractures were often accompanied by multiple trauma and can be life threatening and failure of perfect treatment of diaphyseal femoral fractures that resulted from high energy trauma like motor vehicle accidents lead to limb length discrepancy in the affected side.[1] Femoral diaphyseal fractures predominantly happen in a bimodal distribution, high-energy trauma in the young population, and lower energy trauma in the elderly population.[2]

Diaphyseal femoral fractures (DFF) were often associated with multiple injuries that necessity advanced trauma life support

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and multidisciplinary team care. The functional recovery and early weight bearing was the main purpose for operation. The new method of fixation of diaphyseal fracture of femur records perfect result.[3]

Presentations of patients with this type of injury varies from simple alone fracture to a complicated associated multiple organ injury. Multidisciplinary advanced teams that need cooperation between emergency services, surgical teams, critical care providers, internists, nurses, therapists, social workers, and case managers were essential for steps starting from the operation till complete weight bearing and return to work.[4]

Globally the prevalence of femoral shaft fractures ranges between 10 and 21 per 100,000 per year. Two percent of diaphyseal femur fractures were open fractures.[5] Male patients were more probably suffer from these type of fractures at earlier ages between 15-35 mostly from automobile accidents and other high energy injuries that's more prominent in younger age groups; in comparison to female patients were frequently started at the age of 60 and more; mostly from fallen on the grounds that's more popular in elderly people which is attributed to osteoporosis.[5,6] In operative procedures by close reduction and internal fixation by intramedullary interlocking nail (IMN); patient should be prepared after history taking, physical and radiological examination then send for preoperative investigations as needed; lie the patient down on the operative table and should receive prophylactic antibiotic with the induction of anesthesia either by general anesthesia or by spinal anesthesia in some of cases spinal anesthesia, with orthopedic table and under fluoroscopy; reduction maneuver should be done for DFF then fixed by IMN.[7]

While in open reduction and internal fixation (ORIF) by plate and screws method of fixation starting operation through lateral approach going to reflecting the Vastas lateralis muscle or by cutting through longitudinal dissection of the muscle, the fracture site explored to perform open reduction perfectly and hold proximal and distal fracture fragments by bone holders; Placing a convenient plate is the aim of operation then fixing by screws.[8]

The aim of the study was to compare the treatment of DFF between two method of fixation; group A close reduction and internal fixation by IMN and group B ORIF by plate and screws in primary outcome measure as union rate including callus formation and malalignment that include malrotation as external or internal rotation, shortening, recurvatum or procurvatum and varus or valgus deformity; and in secondary outcome measures as immediate, delay and late complications including nerve injury, blood loss, intraoperative exposure to radiation (flouroscopy), infection, functional levels of knee joint and implant failure.

Methods

This study was a prospective comparative clinical study designed to compare the incidence of outcome measures after surgical treatment of DFF in adult by close reduction and internal fixation by IMN (group A) versus ORIF by plate and screws (group B); the decision of the type of operation was chosen according to patients condition, surgeons decision and availability of instruments in the operation theatre and operations done by different surgeons that were on call in hospital at that time that conducted in Hawler teaching Hospital, Rozhawa Emergency Hospital and Rozhhallat Emergency Hospital. This study was carried out from January 2021 until June 2022 and one year follow up for each case. This study carried out on 63 adult patients from 18 and above (as before age of 18 trochanteric apophysis may not present) that have DFF. Sampling method for this study was purposive in two separate groups of patients; sample size was 63. The patients were taken in hospitals as needed in the study; only

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those cases were taken that underwent operation divided into two groups; group A (27 cases) and those by group B (36 cases). Data collection was done by using specially designed finding protocols obtained by the author on each patients; variables were obtained from preoperative, intraoperative and postoperative information mainly including radiographs according to AO classification types of DFF then collected and entered into a computer via an Excel worksheet using Microsoft Excel version 2010. The data was analyzed statistically using SPSS version 28.

After the data of all 63 patients were filled up, the standard deviation and *P* value of different variables were calculated. Chi square and unpaired t-test used for association between types of surgery and primary and secondary outcome measures. A p value of less<0.05 was considered statistically significant. Adult from 18 and above who gave consent about including in the study; males and females both were included in the study, patients that had closed DFF AO/OTA classification 32 A, B, C types and subtypes, cases that operated by IMN fixation and with plate and screw fixation and those cases that had no pre fracture complication in the femoral shaft cases where included in the study. The following patients were excluded in this study: previous traumatic deformity and malalignment problem, open DFF, cases which were unwilling to participate in the study and patients who had DFF with ipsilateral femoral neck or intertrochanteric fracture. Patients in each group was followed up for about one year starting from intra operative complications, postoperative, after 4 weeks, after 6 weeks, after 3 months, 6 months and final assessment atone year according to research protocol. All of data collected in a sheet at each visit. Protection of human subjects through the application of appropriate ethical principles was important in my research. Ethical approval obtained from the Hawler Medical University/Post graduate Department-General Surgery department. Permission to carry out the research granted by the East Emergency Hospital management and the Department of Orthopedic and informed patient assent obtained.[9]

Results

Among 63 participants enrolled in the current study starting from age 18 and above and age range was 68; most (74.6%) of them were male and nearly quarter (25.4%) of subjects were female, more than half (57.1%) got open reduction surgery while 42.9% of them underwent closed reduction, 57.1% of them exposed to radiation, 42.9% of patients needed blood transfusion. In table 1, there was significant association between type of operation and gender (*P* = 0.024) 88.9% of male, 11.1% of female patients treated by group A. While 63.9% of male, 36.1% of female patients treated by group B.

Table 1 Association between type of operation and gender

		Type of surgery			
		Group A (closed method) No.(%)	**Group B (open method) No.(%)**	**Total No. (%)**	***P*-Value**
Gender	Male	24 (88.9)	23 (63.9)	47 (74.6)	
	Female	3 (11.1)	13 (36.1)	16 (25.4)	
Total		27 (100.0)	36 (100.0)	63 (100.0)	0.024

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Results of Table 2 reveals that, there was association between type of surgery and callus formation after 4 weeks the majority (81.5%) of group A cases callus formed after 4 weeks in reverse no case (0.0%) group B. There was significant statistical association between type of surgery and union at 6 months, most 92.83% of group A united and 7.17% didn't united while (71.42%) of group B united and (28.57%) didn't unite; Chi square test was significant and *P*-values were 0.007 and became good at one year.

Table 2 Association between type of surgery and primary outcome measures

Variable	Categories	Type of surgery		*P*-value
		Group A (closed method) No.(%)	Group B (open method) No.(%)	
Callus formation after 4 weeks	No	5 (18.5)	36 (100.0)	<0.001
	Yes	22 (81.5)	0 (0.0)	
Callus formation after 6 weeks	No	1 (3.7)	7 (19.4)	0.123
	Yes	26 (96.3)	29 (80.6)	
Union at 6 months	Yes	26 (92.8)	25 (71.42)	
	No	2 (7.1)	10 (28.57)	0.007
Malalignment	No	22 (81.5)	33 (91.7)	0.480
	malrotation / internal rotation	3 (11.1)	2 (5.6)	
	external rotation	2 (7.4)	1 (2.8)	
Shortening ≤2 cm at 6 months		6 (100.0)	6 (100.0)	0.897
Total		100.0	100.0	

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Outcomes of Table 3 show that, there was significant statistical association between type of surgery and intra operative exposure to radiation. All (100.0%) patients of group A exposed to radiation while three quarters (75%) of group B patients did not have intra operative exposure to fluoroscopy, there was significant statistical association between types of surgery and blood transfusion, most (66.7%) of group B participants had blood transfusion while only (11.1%) of group A transfused blood *P*-value was <0.001.There was statistically significant association between type of surgery and nerve injury, all (100.0%) of cases in group B did not complain of nerve injury while 14.8% of group A patients experienced such injury. Chi square test was done and *P*-value was 0.029. There was statistically significant association between type of surgery and range of motion at 6 months, the majority (88.9%) of group A cases range of knee flexion was 0->120 degrees while 44.4% of group B had 0-< 120 degrees range of knee flexion at 6 months and became good at one year. Chi square test was done and *P*-value was 0.004.

Findings of Table 4 show that there was a significant statistical difference between group A and group B regarding to duration of surgery, the mean time of group A was 2.18 hours while group B spent 3.08 hours, and *P*-value was <0.001. There was a significant statistical difference between type of surgery and hospital stay, group B cases stayed for 2.22 days while 1.22 day was amount of group A patients stayed at hospital, t-test was done and *P*-value was 0.009.

Table 3 Association between type of surgery and secondary outcome measures

Variable	Categories	Type of surgery		*P*-value
		Group A (closed method) No. (%)	Group B (open method) No. (%)	
Intra operative exposure to radiation	No	0 (0.0)	27 (75.0)	<0.001
	Yes	27(100.0)	9 (25.0)	
Blood transfusion	No	24 (88.9)	12 (33.3)	<0.001
	Yes	3 (11.1)	24 (66.7)	
Infection	No	27 (100.0)	34 (94.4)	0.502
	Early	0 (0.0)	2 (5.6)	
Nerve injury	No	23 (85.2)	36 (100.0)	0.029
	Yes (Early temporary)	4 (14.8)	0 (0.0)	
Range of knee flexion at 6 months	0-< 120 degrees	3 (11.1)	16 (44.4)	0.004
	0-> 120 degrees	24 (88.9)	20 (55.6)	
Total		100.0	100.0	

Table 4 Difference time of surgery, hospital stay and range of motion between the two types of surgery

Variables	Type of surgery	N	Mean	Std. Deviation	*P*-value
Duration of surgery (hours)	Group A	27	2.18	1.02	<0.001
	Group B	36	3.08	0.69	
Hospital stay (days)	Group A	27	1.22	0.57	0.009
	Group B	36	2.22	2.08	

P value <0.05 is significant and *P* value< 0.005 is highly significant.

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Discussion

Femur, is the longest and strongest bone in the human body. Often, fracturing the femur needs a lot of force because of its strength. For example, vehicle accidents are the most common cause of femur fractures. This type of fractured limb almost often needs surgery to recover. In our study 63 cases were involved in which 74.6% male and 25.4% female; because of males are more prone to high energy trauma.

Regarding demoghraphic data there was significant association between type of operation and gender (*P* = 0.024) 88.9% of male, 11.1% of female patients treated by group Awhile 63.9% of male, 36.1% of female patients treated by group B.[10] The increase in ratio of females to be treated by plan B might be surgeon's decision and experience. Regarding age starting from 18 years old and above with the age range was 68that was statistically not significant in association with both groups A and B. In the current study there was highly significant association between type of surgery and callus formation after 4 weeks; the majority (81.5%) of group A cases callus formed after 4 weeks in reverse no case in group B (*P* <0.001); hardly seen group A callus formation sooner than group B because of secondary bone healing in group A in reverse to primary bone healing in group B. Also there was highly significant statistical association between type of surgery and union at 6 months, most 92.83% of group A united and 7.17% didn't unite while (71.42%) of group Bunited and (28.57%) didn't unite (*P* = 0.007) and became good at one year. These results were similar to the study published by Ertuğrul K, Kemal D, Muhammed B, Abdullah K, Sarp B; this is due to group A method require less soft tissue dissection preserves the initial hematoma and blood supply to bone fragments, resulting in undisturbed blood supply and rapid callus bone healing.[11] Regarding exposure to radiation highly significant statistical association between types of surgery and intra operative exposure to fluoroscopy (*P* <0.001). All (100.0%) patients of group A exposed to radiation while quarters of group B had intra operative exposure to fluoroscopy.[12] There was significant statistical association between type of surgery and blood transfusion, most (66.7%) of group B participants had blood transfusion while only (11.1%) of group A transfused blood . (*P* <0.001), There was a significant statistical difference between group A and group B regarding duration of operation, the mean time of group A was 2.18 hours while group B spent of 3.08 hours (*P* <0.001). There was a significant statistical difference between group A and B regarding hospital stay group B cases stayed for 2.22 days while group A patients 1.22 days stayed at hospital. (*P* = 0.009) similar to the study conducted by Ertuğrul K, Kemal D, Muhammed B, Abdullah K, Sarp B.[11] There was statistically significant association between type of surgery and nerve injury, (100.0%) of cases in group B did not have nerve injury while 14.8% of group B patients experienced such injury (*P* = 0.029); 6.3% of cases were presented as perineal paresthesia and numbness in group A, traction by orthopedic table might be the cause as they fortunately recovered after 6 weeks.[13]

There was statistically significant association between type of surgery and range of motion at 6 months, the majority (88.9%) of group A participants range of knee flexion was 0-> 120 degrees while 44.4% of group B had 0-< 120 degrees range of knee flexion at 6 months (*P* = 0.004) and became good at one year. The outcome of our study in terms of the range of motion was comparable to the study conducted by Andrzejewski K, Panasiuk M, Grzegorzewski A, Synder M.[14]

Conclusion

This study found that intramedullary interlocking nail (IMN) better than ORIF by plate and screws in callus formation after

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two weeks, union at six months, blood loss, and range of flexion of the knee joint that was excellent outcome in IMN in comparison to ORIF by plate and Screws; while the ORIF by plate and screws was better than IMN in nerve injury and exposure to radiation.

We recommend larger sample size, extend the follow up time for long term complication assessment, earlier management of patients in order to reduce the amount of blood loss, availability of instruments especially IMN and experienced medical staffs and availability of more centers for physiotherapy.

Competing interests

The authors declare that they have no competing interests.

References

1. Medda S, Unger T, Halvorson J. Diaphyseal Femur Fracture. Stat Pearls. 2022. Available from: https://www.ncbi.nlm.nih.gov/books/NBK493169/
2. Denisiuk M, Afsari A. Femoral Shaft Fractures. Stat Pearls. 2022. Available from: https://www.ncbi.nlm.nih.gov/books/NBK556057/
3. Deepak MK, Jain K, Rajamanya KA, Gandhi PR, Rupakumar CS, Ravishankar R. Functional outcome of diaphyseal fractures of femur managed by closed intramedullary interlocking nailing in adults. Ann Afr Med. 2012; 11(1):52-7. doi: 10.4103/1596-3519.91025. PMID: 22199051.
4. Han Y, Peng G, Liu L, Xie X. Multidisciplinary cooperative first aid model for the treatment of patients with pelvic and multiple fractures. Pak J Med Sci. 2022; 38(3Part-I):560-4. doi: 10.12669/pjms.38.3.5014 PMCID: PMC9002415
5. Saita Y, Ishijima M, Kaneko K. Atypical femoral fractures and bisphosphonate use: current evidence and clinical implications. Ther Adv Chronic Dis. 2015; 6(4):185-93. doi: 10.1177/2040622315584114. PMCID: PMC4480549
6. Enninghorst N, McDougall D, Evans J, Sisák K, Balogh Z. Population-based epidemiology of femur shaft fractures. J Trauma Acute Care Surg. 2013; 74(6):1516-20. doi: 10.1097/TA.0b013e31828c3dc9
7. El-Menyar A, Muneer M, Samson D, Al-Thani H, Alobaidi A, Mussleman P, et al. Early versus late intramedullary nailing for traumatic femur fracture management: meta-analysis. J Orthop Surg Res. 2018; 13(1):160. doi: 10.1186/s13018-018-0856-4
8. Hernigou P, Pariat J. History of internal fixation with plates (part 2): new developments after World War II; compressing plates and locked plates. SICOT. 2017; 41:1489–500. doi: 10.1007/s00264-016-3379-9
9. Jeanes E. Are we ethical? Approaches to ethics in management and organization research. Organization. 2017; 24:174-97. doi: 10.1177/1350508416656930
10. von Heideken J, Svensson T, Iversen M, Blomqvist P, Haglund-Åkerlind Y, Janarv PM. Sociodemographic factors influence the risk for femur shaft fractures in children: a Swedish case-control study, 1997-2005. Acta Paediatr. 2013; 102(4):431-7. doi: 10.1111/apa.12150
11. Ertuğrul K, Kemal D, Muhammed B, Abdullah K, Sarp B. Comparison Of Two Biological Internal Fixation Techniques In The Treatment Of Adult Femur Shaft Fractures (Plate - Screws and Locked Intramedullar Nail). TJTES. 2011; 17:159-65. doi: 10.5505/tjtes.2011.24892
12. Jiang W, Lin Y, Kotian RN, Xie WQ, Li YS, Li GH, et al. A novel reduction device for the minimally invasive treatment of femoral shaft fractures. Am J Transl Res. 2020; 12(7):3917-25. PMID: 32774745; PMCID: PMC7407717
13. Polyzois I, Tsitskaris K, Oussedik S. Pudendal nerve palsy in trauma and elective orthopaedic surgery. Injury. 2013; 44(12):1721-4. doi: 10.1016/j.injury.2013.09.001
14. Andrzejewski K, Panasiuk M, Grzegorzewski A, Synder M. Comparison of knee function in patients with a healed fracture of the femoral shaft fixed with retrograde and antegrade intramedullary nailing. Ortop Traumatol Rehabil. 2013; 15(5):395-405. doi:10.12659/MSM.935438. PCMID: PMC8594116