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DIAPHYSEAL FEMORAL FRACTURES;
OUTCOME TREATED WITH CLOSE VS OPEN

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ABSTRACT… The femur fractures usually happen with oomph forces like motor vehicle accidents. **Objectives:** To assess the mode of injury and complications of the management, in diaphyseal femoral fractures, in comparison of close versus open intramedullary interlocking nail (IMN). **Study Design:** Experimental and comparative study. **Period:** April 2013 to March 2014. **Setting:** Department of Orthopaedic Surgery, Peoples University of Medical & Health sciences, Nawabshah. **Methods:** The cases were divided into two groups A and B. Group A was treated by open nailing (n = 20) and group B by close nailing (n = 20), all the cases were operated within 48 hours of admission. All the data were recorded on well structured proforma. Serial radiographies were performed at 3, 6, 12 weeks, and 6 months; additional radiographies were performed as needed postoperatively. Knee, ankle, and hip motions were begun and protected weight bearing was started on the second day postoperatively and increased gradually to full WB depending on x-ray findings of callus formation. The patients were followed for two years. Results of open and closed I.M.N were assessed and the complications if any were observed over a mean follow-up period of two years. **Results:** The mean age in group A was 29.40 years and the mean age in group B was 30.45 years. Out of 40 cases, 32(80.0%) were males with male to female ratio 1:4. Mean ± SD hospital stay was 19.80 ± 14.60 days in group A, and 17.90 ± 5.95 days in group B (p value 0.55). Average time between injury and admission was 1.53 days (n = 40), in the group A it was 1.05 days, and in the group B it was 2.0 days (p value 0.03). The average of time between injury and operation in the group A was 8.75 days, and in the group B, it was 8.20 days, (p value 0.71). The average of time between admission and discharge in the group A was 11.0 days, and in the group B was 9.15 days, (p value 0.55). Mean ± SD union time was 11.70 ± 6.45 weeks, in group A and 11.90 ± 5.77 weeks, in group B. (p value 0.91). All the patients had full ranged of hip motion and 2 (10.0%) patients of group A had mild limitation of knee motion with a flexion ranges between 80 and 110 degrees. Final functional results based on Thoresen BO criteria[16]. Excellent results were observed in 19 (47.5%) cases, out of them 5(25.0%) were in group A and 14(70.0%) were in group B. Good results were found in 13(32.5%) patients, out of these 7(35.0%) were in group A and 6(30.0%) were in group. Fair and poor results were detected in 4(10.0%) cases of group A. **Conclusions:** Road traffic accidents by motorcycle was found the commonest (47.5%) cause of femur fracture, a few complications were observed in open interlocking nailing as compared to closed interlocking nails.

Key words: Diaphyseal Femoral Fractures, Close & Open IMN, Hospital Stay, Outcome.

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INTRODUCTION

The femur is the longest tubular bone, and also more strong & heavy among them. In lower extremity, it is the bone which bears main load[1-4]. The femur fractures usually happen with oomph forces like motor vehicle accidents[5].

In daily orthopaedic practice the most frequent fractures are of femoral shaft[6], specially in young dynamic society these injuries are more common resulting from an accident by vehicle, accidents in the industries, or plunge from height, and due to traumatic scenery of these lesions, thorough demanding surgery is always required and soft tissue damage is frequent[7,8].

The most favorite technique to treat these fractures is intramedullary nailing.[9] The greater trochanter & the fossa piriformis offered the changeable preliminary points for antegrade

nailing. Otherwise, retrograde nailing is arranged. There are various indications, advantages and disadvantages of each method. The position of the patient also plays a role and can give ease in the process and may result in malalignment. The systemic complications can be reduced by curtailing the time of the procedure. When the starting point is determined the allied co morbidities, the body physique, and related injuries should be well thought-out. The procedure establish a stable fixation by using indirect reduction technique, obtaining high union rates and low complication when strict attention is given during whole management.[9]

The goal of treatment is reliable anatomical stabilization, allowing early mobilization.

If the alignment is not done properly, there are various short and long term effects of femoral fracture on hip and knee joints. These problems are can be reduced by interlocking intramedullay nailing.[11]

There are others options for treatment of fracture shaft of femur, including skin traction, which mostly applied at field in emergency in order to ovoid further damage to soft tissues and alleviate the patient problems. In young children and adults skeleton traction is applied on interim, but it has many negative aspects including infection in the pin tract, pulmonary insufficiency can develop, nursing care is difficult, the control is not satisfactory on alignment and length of fracture bone, supine position of patient results in joint stiffness, rehabilitation is limited, and the quadriceps muscle can be tethered. Skin and skeletal traction, casting & cast brace are nonsurgical options for the treatment which are infrequently used outside of young pediatric patients. Spica casting is also used in children having weight under 80lb. Most of the closed & some open injuries are managed by internal fixation as the treatment of choice, as there are less complications, morbidity is low, control of alignment is better, union rate is high and hospital stay is less[12-14].

Closed interlocking nailing required appropriate pre-operative management, pre-operative planning, preventive antibiotics together with excellent operative techniques and skills decrease the intra-operative and post-operative complications[15].

Keeping these facts in view we conduct the current study to determine to asses and to compare the hospital stay, union time, and functional outcome of the closed and open intramedullary interlocking nailing in our setup.

MATERIALS AND METHODS

This experimental, comparative study was arranged in the Department of Orthopaedic, Peoples University of Medical & Health Sciences, Nawabshah, from April 2013 to March 2014.
40 cases of femoral fractures were included in the study.

Inclusion criteria

1. Closed diaphyseal fracture femur in patients of 18-65 years of age.
2. Gustilo I, II. Open femoral diaphyseal fracture.
3. Non infective delayed union of femoral diaphyseal fracture for more than four months duration.
4. Non-infective non-union of femoral diaphyseal fracture for more than nine months duration.
5. Non-infected Implant failure (plate & screw) after surgical procedure in the treatment of femoral diaphyseal fracture.

Exclusion criteria

1. Infected non union of femoral diaphyseal fracture
2. Pathological femoral diaphyseal fracture.
3. Malunited femoral diaphyseal fracture.
4. Gustilo III open femoral diaphyseal fracture.
5. Diaphyseal femoral fracture with associated major neurological, chest, abdomen or pelvic injuries
6. Diaphyseal femoral fracture in patients under 18 years and over 65 years of age.

All the patients fulfilling the criteria were admitted through either emergency or OPD of PUMHS

Hospital. Informed consent of the patients was obtained for the procedure. All the data were recorded on well structured proforma. The base line investigations were done and the fracture was classified depending on the X-ray findings, site, comminution and the character of wound. The cases were divided into two groups A and B. Group A was open nailing (n = 20) and group B was close nailing (n = 20).

The operation was performed in all cases during 48 hours of admission. Nailing was performed in supine position with help of traction table, using as close method intramedullary interlocking nail femur, the lateral position was preferred exclusive of fracture table by physical traction on the flexed hip & knee when were using as open method of intramedullaruy interlocking nail femur.

The supine position was used for patients having multiple injuries and in patients with bilateral fractures. Open reduction was favored by a minimum incision and suturing prior to reaming if achievable.

After 3, 6, 12 weeks, and 6 months, radiographies were obtained in serial & additional X-rays were also obtained postoperatively if necessary. On the 2nd postoperative day the movements of knee, hip & ankle were begun and the protected weight bearing was increased progressively to full weight bearing depending on callus formation detected on X-ray. The follow up of all the cases was done and complications were noted during this period.

DATA ANALYSIS

The SPSS 16.0 was used for data analysis., the qualitative data (Frequency & percentage) like gender, mode of injury, wound condition at the time of arrival, Gustilo classification (GI & GII), range of movement (knee and ankle joints) and complications are shown as n(%), the Chi-square test was used in the comparison of proportions. Numerical data like age (in years), time between injury and arrival procedure (hour), time between arrival & primary procedure (hour), time between primary procedure & fixation, time of full weight bearing, time of dynamization, time of union and hospital stay (in days) shown as mean ± standard deviation, the student *t* test (2 tailed) was used while comparing the means in the both groups. Calculation of the data was done on 95% confidence interval and the p value $\leq$ 0.05 was considered as statistically significant.

RESULTS

A total 40 cases having femoral fracture were analyzed in current study based on inclusion criteria. The patients were divided into two groups of method, 20 patients in group A (open interlocking nails) and 20 in group B (close interlocking nails).

The mean age in group A was 29.40 years and the mean age in group B was 30.45 years. Out of 40 cases, 32(80.0%) were males with male to female ratio 1:4.

Mean ± SD hospital stay was 19.80 ± 14.60 days, median was 16.0 days and mode was 12 days in group A (OPEN, n = 20) and Mean ± SD hospital stay was 17.90 ± 5.95 days, median was 17.0 days and mode was 17 days in group B (CLOSED, n = 20) (p value 0.55). (Table No.I)

Hospital Stay (In Days)	A: Open Nailing N = 20	B: Close Nailing N = 20
Mean	19.80	17.90
Standard Deviation	14.76	5.95
Mode	12.0	17.0
Median	16.0	17.0

Table-I. Hospital Stay (in days) in Both Groups (n = 40)

P value = 0.55, calculated by student t test (2 tailed)

Average of time in getting injury and having admission was 1.53 days (n = 40). The average of time between injury and admission in the group A (OPEN, n = 20) was 1.05 days, standard deviation was 0.22, median 1.0 and mode 1.0 days and average of time between injury and admission in the group B (CLOSED, n = 20) was 2.0 days, standard deviation was 1.97, median was 1.0 and mode was 1.0 days (p value 0.03).(Table No.II)

Duration between injury & Admission (days)	A: Open Nailing n = 20	B: Close Nailing n = 20
Mean	1.05	2.0
Standard Deviation	0.22	1.97
Mode	1.0	1.0
Median	1.0	1.0

Table-II. The duration between Injury & admission (Days) in Both Groups (n = 40)

P value = 0.03, calculated by student t test (2 tailed)

The average of time between injury and operation in the group A (OPEN, n = 20) was 8.75 days, standard deviation was 4.94, median 7.0 and mode 7.0 days and average of time between injury and operation in the group B (CLOSED, n = 20) was 8.20 days, standard deviation was 4.46, median was 7.0 and mode was 5.0 days (p value 0.71).

The average of time between admission and discharge in the group A (OPEN, n = 20) was 11.0 days, standard deviation was 3.24, median 6.50 and mode 12.0 days and average of time between admission and discharge in the group B (CLOSED, n = 20) was 9.15 days, standard deviation was 4.63, median was 8.50 and mode was 17.0 days (p value 0.55). (Table No. III)

Time between admission and discharge (in days)	A: Open Nailing n = 20	B: Close Nailing N = 20
Mean	11.0	9.15
Standard Deviation	3.24	4.63
Mode	12.0	17.0
Median	6.50	8.50

Table-III. Time Between Admission and Discharge (in days) in Both Groups (n = 40)

P value = 0.55, calculated by student t test (2 tailed)

Mean ± SD union time was 11.70 ± 6.45 weeks, mode was 4.0, and median was 12.0 in group A and Mean ± SD was 11.90 ± 5.77 weeks, mode 13.0 and median was 12.50 in group B. (p value 0.91) (Table No.IV).

Time of union (in weeks)	A: Open Nailing n = 20	B: Close Nailing n = 20
Mean	11.70	11.90
Standard Deviation	6.45	5.77
Mode	4.0	13.0
Median	12.0	12.50

Table-IV. Time of Union (in weeks) in Both Groups (n = 40)

P value = 0.91, calculated by student t test (2 tailed)

All the patients had full ranged of hip motion and 2 (10.0%) patients of group A had mild limitation of knee motion with a flexion ranges between 80 and 110 degrees.

Final functional results based on Thoresen BO criteria[16]. Excellent results were observed in 19 (47.5%) cases, out of them 5(25.0%) were in group A and 14(70.0%) were in group B. Good results were found in 13(32.5%) patients, out of these 7(35.0%) were in group A and 6(30.0%) were in group. Fair and poor results were detected in 4(10.0%) cases of group A (Table-V).

DISCUSSION

In the present study, most of the patients were male. Shafi MK. and Basumallick MN et al. reported the same results in their studies[17,18].

The time for union is a very controversial topic. It is not possible to assess healing of fracture by usual orthopaedic criteria. Since after operation,

Functional outcome	Groups				Total
	Open Nailing (n = 20)	n(%)	Close Nailing (N = 20)	n(%)	
Excellent	5	25.0%	14	70.0%	19(47.5%)
Good	7	35.0%	06	30.0%	13(32.5%)
Fair	4	20.0%	0	0	4(10.0%)
Poor	4	20.0%	0	0	4(10.0%)

Table-V. Functional Outcome According to Thoresen B et al. Classification[16] (n = 40)

Pearson's chi square value = 12.34, df = 3, p value = 0.006

stability is obtained immediately and patient becomes pain free in the ensuring 3-4 weeks. Time to healing could not be assessed accurately either clinically or radio logically since such large intramedullary nails were used[19]. Clawson et al have reported an average time for appearance of bridging callus at 6 weeks with partial obliteration of fracture site as the time of union[20]. Rockaen et al have used the time elapsing between the accident and ability to walk without stick and return to work as the criteria for the progress of fracture healing[21]. In this study nature of bridging callus with partial obliteration of fracture site has been used as time for union. Assessment on return to work cannot be taken as a sign for progress of fracture healing since the majority of patients involved in the present series are usually heavy manual laborer who require solid union before they can go back to work in contrast to the western countries where patients usually have sedentary jobs and hence can be put to work earlier as compared to a manual laborer.

In the present study, the mean time of Union + SD, 11.70 + 6.45 (ranging 4 to 20 weeks) in group A and 11.90 + 5.77 (ranging 3 to 21 weeks) in Groups B, whereas Botchu R et al.[22] reported the average time of fracture healing was 16 weeks both methods (open vs close). Basumallick MN et al.[18] reported union between 13 to 28 weeks (average 19.2 weeks) weeks in open intramedullary nailing in his study of 50 cases. While in a local study conducted by Umer M et al.[23] reported the same figure of mean time of union was 11.5 weeks in his study on close method. In another study described by Arpacioğlu MO et al.[24] who reported 16.5 weeks average time of union in his study on femoral shaft fractures by interlocking intramedullary nailing in adults whereas Eldeen MA et al,[25] described that the average time of clinical healing was 12 weeks, these results are similar to this series.

In this study, the commonest cause of femur fractures was road traffic accidents by motorcycle noted in 47.5% fractures. In the local study described by Mahmood T et al.[27] showed the most common causes of the femoral shaft fracture being road traffic accident (RTA). There were 18 (45%) cases of fractures of femur by road traffic accident.[27] The same observations was also observed in the study of Umer M et al. who reported that Road Traffic Accidents (RTA) was common cause of femur fracture in his study.[23] while Iqbal MJ et al. also described the same results in his study.[28]

The rate of non union in this study was 5.0% in the group A, associated with deep and superficial infection. Bhandari has reported 7% nonunion rate in a systemic review[29] while Gharehdaghi M et al.[26] revealed 5% nonunion cases in his study of 126 cases, 4% rate of non union by Umer M et al.[23] whereas Gharehdaghi M et al.[26] showed 4.41% rate of non union in his study, these results are similar to this study.

In this series 1(5.0%, n = 20) patient had delayed union in group A, while Umer M et al.[23] observed 7.8% delayed union in his study of 89 cases and Shafi MK et al.[30] showed 4.0% of delayed union. While in another study conducted by Yilmaz E et al[31] revealed 6.6% delayed union in their study, these results are comparable to this study.

Infection rate in this study was found 10.0% in group A. Similarly, Mahmood T et al.[27] found the rate of infections in his study, 10.0% for intramedullary interlocaking nailing. Naeem-Ur-Razaq M showed 12.0% rate of infection in his study.[32] Ali MA et al.[33] described 10.3% rate of infection, Iqbal MJ et al. also described the same results in his study.[28] these results correlates well to the present study, while Whittle et al. showed 4% infection rate.[34]

CONCLUSIONS

Few complications were observed in open interlocking nailing as compared to closed interlocking nails.

REFERENCES

1. Moore, KL, Agur, AM. **Clinically Oriented Anatomy,** 3rd ed, Williams and Wilkins, Baltimore 1992.

2. Bucholz, R, Brumback, R. **Fractures of the shaft of the**

femur. In: Rockwood and Green's Fractures in Adults, 4th ed, Rockwood, C, Green, D, Bucholz, R, et al. (Eds), Lippincott-Raven, Philadelphia 1996. p.1827.

3. Platzer, W. **Color Atlas of Human Anatomy,** Vol. 1: Locomotor System, 5th ed, Thieme Medical Publishers, Stuttgart 2003.

4. Whittle, AP, Wood, GW II. **Fractures of the lower extremity.** In: Campbell's Operative Orthopedics, 10th ed, Vol 3, Canale, ST (Ed), Mosby, St. Louis 2003. p.2825.

5. Bucholz RW, Jones A. **Fractures of the shaft of the femur.** J Bone Joint Surg Am 1991; 73:1561.

6. Whittle AP, Wood GW II. **Fractures of the lower extremity.** In: Canale ST, editor. Campbell's operative orthopedics. Vol.3. 10th.ed. Newyork: Mosby; 2003;2725-872.

7. Blustrode CJK, Kinninmonth A. **Lower limb trauma.** In: Russell RCG, Williams NS, Bulstrode CJK, editors. Bailey & Love's short practice of surgery. 24th ed. London: Arnold; 2004; 397-405.

8. Hafeez UR, Ghulam MKK, Haq NU, et al: **Interlocked intramedullary nailing in open femoral shaft fracture:** JPOA 2010;22:82-86.

9. Deepak MK, Karun J, Kumardev A, et al. **Functional outcome of diaphyseal fractures of femur managed by closed intramedullary interlocking nails in adults.** Annals of African Medicine 2012;11(1):52-7.

10. Bucholz, R, Brumback, R. **Fractures of the shaft of the femur.** In: Rockwood and Green's Fractures in Adults, 4th ed, Rockwood, C, Green, D, Bucholz, R, et al. (Eds), Lippincott-Raven, Philadelphia 1996. p.1827.

11. Fadero PE, Alabi S, Asebule GT, Osungi OO. **Locking intramedullary nailing for the treatment of femoral shaft fractures:** niger J Med, 2009 Apr-Jun;17(2):169-72.

12. Kanlic E, Cruz M. **Current concepts in pediatric femur fracture treatment.** *Orthopedics*. Dec 2007;30(12):1015-9.

13. Poolman RW, Kocher MS, Bhandari M. **Pediatric femoral fractures: a systematic review of 2422 cases.** *J Orthop Trauma*. Oct 2006;20(9):648-54.

14. Lee SH, Baek JR, Han SB, Park SW. **Stress fractures of the femoral diaphysis in children: a report of 5 cases and review of literature.** *J Pediatr Orthop*. Nov-Dec 2005;25(6):734-8. [Medline]

15. Ricci WM, Gallagher B, Haidukewych GJ. **Intramedullary nailing of femoral shaft fractures: current concepts.** J Am Am Acad Orthop Surg.2009 may:17(5):296-305.

16. Thoresen BO, Alho A, Ekeland A, Stromse K, Folleras G, Haukebo A. **Interlocking intramedullary nailing in femoral shaft fractures.** J Bone Joint Surg 1985;67:1313–20.

17. Shafi MK, Ahmed N, Khan AH, Aziz A. **Results of fracture union in closed reamed interlocking nail in fractures of femur.** Pak J Med Sci 2008;24(5):698-701.

18. Basumallick MN, Bandopadhyay A. **Effect of dynamization in open interlocking nailing of tive randomized comparative study of 50cases with a 2-year follow-up.** Acta Orthop Belg. 2002 Feb;68(1):42-8.

19. Winquist RA, Hansen ST Jr, Clawson DK. **Closed interamedullary nailing of femoral fractures.** *J Bone Joint* Surg (Am).1984; 66: 529-539

20. Clawson DK, Smith RF, Hansen ST. **Closed intramedullary nailing of the femur.** *J Bone Joint* Surg (Am). 1971; 50:681-692.

21. Rokamen P, Slatis P, Vankka E. **Closed or open intramedullary nailing of femoral shaft fractures. A comparison with conservatively treated cases.** *J Bone Joint* Surg (Br). 1969; 51: 313-323.

22. Botchu R, Umanath H, Reddy BVS, Raju SD. **Management of fracture of shaft of femur by intramedullary nailing in a developing county: A clinical study.** The Internet Journal of Orthopedic Surgery 2006;3(1):240-7

23. Umer M, Niazi A K, Hussain D, Ahmad M. **Treatment of acute fractures of the Femoral Shaft with reamed Intramedullary Interlocking AO Nails.** J Pak Med Assoc Aug 2004;54(8):423-7.

24. Arpacioğlu MO, Akmaz I, Mahiroğullari M, Kiral A, Rodop O. **Treatment of femoral shaft fractures by interlocking intramedullary nailing in adults.** Acta Orthop Traumatol Turc. 2003;37(3):203-12.

25. Eldeen MA, Shiha A. **Early weitgh – Bearing after statically locked intramedullary nailing of femoral shaft fractures.** Pan Arab J. Orth. Trauma 2002;6(2):173-9.

26. Gharehdaghi M, Rahimi H, Bahari M, Afzali J. **A prospective study of closed and open reamed intramedullary nailing of 136 femoral shaft fractures in adults.** JRMS 2007; 12(1): 16-20.

27. Mahmood T, Yasin A, Cheema AA, *Chaudhary RC.* **Comminuted fractures of shaft of femur; Bridge plate versus interlocking nail in low velocity gun shot injuries.** Professional Med J Sep 2009; 16(3): 351-6.

28. Iqbal MJ, Yaseen A, Rasool S, Chaudhary RA. **Comparison of Solid versus Cannulated Interlocking Nail in Fracture of Shaft of Femur in Adults.** A.P.M.C 2010;4(2):155-8.

29. Bhandari M, Guyatt GH, Tong D, Adili A, Shaughnessy SG. **Reamed versus nonreamed intramedullary nailing of lower extremity long bone fractures: a systematic overview and meta-analysis.** J Orthop Trauma 2000;14(1):2-9.

30. Shafi MK, Ahmed N, Khan AH, Aziz A. **Results of fracture union in closed reamed interlocking nail in fractures of femur.** Pak J Med Sci Oct - Dec 2008;24(4):698-701.

31. Yilmaz E, KARAKURT L, BULUT M, BELHAN O, SERIN E. **Treatment of femoral shaft fractures with interlocking intramedullary nailing.** Acta Orthop Traumatol Turc 2005;39(1):7-15.

32. Naeem-Ur-Razaq M, Qasim M, Khan MA, Sahibzada AS, Sultan S. **Management outcome of closed femoral shaft fractures by open SurgicalImplant Generation Network (SIGN) interlocking nails.** J Ayub Med Coll Abbottabad. 2009 Jan-Mar;21(1):21-4.

33. Ali MA, Hussain SA, Khan MS. **Evaluation of results of interlocking nails in femur fractures due to highvelocity gunshot injuries.** J Ayub Med Coll Abbottabad. 2008 Jan-Mar;20(1):16-9.

34. Whittle AP, Wood II GW: **Fractures of lower extremity.** In: Canale TS (ed.): Campbell's Operative Orthopaedics. 10th ed. Vol. 3. pp.2825-2872, Mosby, St Louis London Philadelphia Sydney Toronto 2003.

"It is during our darkest moments that we must focus to see the light."

Aristotle Onassis

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