ORIGINAL ARTICLE

Functional Outcome of Diaphyseal Fracture of Femur Managed by Locked Intra-Medullary Nailing in Adults

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ABSTRACT

Objective: The purpose of our study was to determine the outcome of diaphyseal fracture of femur managed by locked intramedullary nailing in adults and to compare these results with other available published studies.

Study Design: Descriptive case series study.

Place and Duration of study: Institute of orthopaedic and surgery Karachi from April 2010 to March 2012.

Patients and Methods: A total of 54 femoral shaft fractures in 53 patients were analyzed. Average age of patient was 30.6. Out of these, 49 were males and 4 were females. 39 were closed fractures while 14 were open fracture Gustilo Anderson Type I. More than 50% were of complex pattern regarding fracture geometry. RTA was the most common mode of injury followed by firearm. Average operative time was 119 minutes. Average hospital stay was 8 days. 39 (72%) healed uneventfully, 6 (11.11%) showed delayed healing treated by dynamization but 3 needed bone grafting also. We also faced 3 (5.55%) mal-union, 2 (3.7%) cases of infection, 2 (3.7%) of implant failure and 2 (3.7%) had shortening of limb.

Results: At the time of most recent follow-up (minimum of 6 months) according to modified Klaus &Klemm criteria. There were 61% rated as excellent, 22% as good, 11.11% as fair and 5.5% as poor.

Conclusion: The results of aforementioned studies and our analysis suggest that intra-medullary interlocking nailing is an excellent technique to treat femoral shaft fractures in adults especially complex pattern regarding good healing, minimum complications, shorter hospital stay and early functional rehabilitation and most importantly early return to work and pre-fracture state.

Key Words: Femoral shaft fracture, intramedullary nailing

INTRODUCTION

The spectrum of femoral shaft injuries has widened due to prevalence of high energy trauma in our environment. Since the femur is the largest bone of the body and one of the principal load bearing bone in the lower extremity, fracture can cause prolonged morbidity and extensive disability unless treatment is appropriate. The review of literature helped to understand this problem in a better way, on the basis of this, treatment goals were established including reliable anatomic fixations permitting rapid progress out of supine position, early return of extremity function and subsequent restitution of hip and knee motion and strength. Various modalities were reviewed, out of which, closed intramedullary nailing was the only method that closely achieved this goal[2-5].

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Hence the current study has been undertaken to determine the functional outcome of diaphyseal fracture of femur managed by locked intra-medullary nailing in adults and to compare these results with other available published studies.

Methodology

This is a prospective case series study conducted at Institute of Orthopaedic Surgery, Karachi from April 2010 to March 2012. In this study, a total of 54 femoral shaft fractures in 53 patients were selected for assessment of outcome.

Criteria for inclusion of cases were age ranging from 16 years to 65 years irrespective of sex and race, either unilateral or bilateral, Located between 2.5 cm distal to the lesser trochanter and 10 cm proximal to the knee joint, Closed or Gustilo Anderson[2] type I open diaphyseal fracture of femur and follow-up of atleast 6 months unless fracture healing was documented to have occurred earlier.While patients with pathological fractures were excluded from this study.

After a careful history and examination of injured limb, AP and Lateral radiographs were

taken; closed reduction and Thomas's splint immobilization were done in all cases. The operative procedures and its advantages were explained in detail to each patient and informed consent was obtained.

All patients were operated using nail insertion technique described by Kempf et al (1985)[6]. All fractures were fixed with standard AO femoral intramedullary interlocking nail using closed technique in a supine positionon on traction table under image intensifier.

Closed reduction and intramedullary nailing was performed in 51 femoral shaft fractures. The fracture site was opened in 3 cases because closed reduction was unsuccessful as all these were old fractures.

All patients were encouraged to do static quadriceps exercises and straight leg raise from first post-operative day with active and passive knee exercises within 48 hours or as tolerated by patient. Partial weight bearing was started for all cases with the help of crutches or walker frame once the acute pain had subsided. Full weight bearing was allowed when callus was visible on the radiograph.

At the time of most recent follow-up (minimum of 6 months post-op), all patients were reviewed to document clinical and radiological union of the fracture and to assess the hip and knee range of motion.

We considered a fracture to be united, if there was no pain on palpation or attempted motion, no discomfort on full weight bearing and serial radiographs demonstrated bony trabeculae across the fracture site. Examination of knee and hip was done at 6 weeks and upon union.

Results of the treatment were evaluated using modified Klaus &Klemm criteria[7].

- **Excellent**
  - Normal radiographic alignment
  - Full hip and knee motion
  - No muscle atrophy
- **Good**
  - Angular deformity <5˚
  - Slight loss of hip and knee motion
  - Muscle atrophy <2cm
  - Shortening <2cm
- **Fair**
  - Angular deformity 5˚ - 10˚
  - Moderate (25%) loss of hip and knee motion
  - Muscle atrophy >2cm
  - Shortening >2cm
- **Poor**
  - Angular deformity >10˚
  - Marked loss of hip and knee motion
  - Marked muscle atrophy
  - Marked Shortening

RESULTS

Out of the 53 patients, 49(92.4%) were male and 4(7.5%) were female, 34 (62.9%) patients had right, 18 (33.96%) had left and 1 (1.8%) had bilateral femur involvement. 40 (74.1%) femur shaft fractures were closed and 14 (24.9%) were open Gastilo Anderson Type I. The fracture was located in proximal 3rd in 12 patients, the middle 3rd in 31 patients and in distal 3rd in 11 patients. The fracture pattern was transverse in 18, oblique in 7, spiral in 4 and comminuted in 25. According to Winquist classification; there were 2 Type I, 5 Type II, 6 Type III, and 12 Type IV fractures. Injury was caused by a variety of mechanisms: automobile accident (56.6%), motor cycle accident (13.2%), automobile-pedestrian accident (3.7%), firearm related femoral fracture (18.8%), fall from height (5.5%) and in 1 (1.8%) patient femoral fracture occurred due to fall of an iron gate directly on his lower extremity. Average time from injury to definitive surgery was 15 days. Mean age at the time of operation was 30.6 years (range 16 – 56 years), all patients were treated for femur shaft fracture with intramedullary inter-locking nail. Closed reduction and intramedullary nailing was performed in 51 femur shaft fracture, the fracture site was opened in 3 because closed reduction was not possible, as all these cases were old. All the patients were discharged from hospital on average 8 days (range 6 to 15) after surgery. In 94.4% cases, union was achieved in 3 – 9 months. The median time to union defined by the presence of adequate radiographic callus was 14 weeks (range 10 – 28). There was no non-union. Post-operatively, majority of patients achieved at least 130^0 of knee flexion. Three patients had only 110^0 of flexion while in one patient flexion was limited to 90^0. Extension lag of 15^0 remained in 1patient. Despite closed nailing technique, timely and careful management of open fractures, 2 (3.7%) patients developed wound infection, one had superficial surgical site infection and the other had deep infection but both responded well to treatment with antibiotics without the need for removal of the intramedullary nail. There were 6 (11.11%) cases of delayed union. In all of them there were no signs of clinical or radiographic

healing at the end of 3 months. All these nails were statically locked. 4 cases showed callus formation after dynamization and progressive weight bearing. While in other 2, bone grafting was performed as there was no healing evident even after dynamization. All these cases ultimately healed within 8 to 14 months. Shortening of more than 2 cm occurred in 2 (3.7%) patients. The maximum shortening was 3 cm in a patient who had a longitudinal split of 2/3 of his femur. In other patients the shortening of 2.5 cm occurred who had type-IV comminuted fracture in distal 3rd of femur. Both of these patients were given heel elevation which eliminated their apparent limp. 2 (3.7%) cases of Implant failure were recorded in our series. One patient, a young boy of 17 years, with fracture of distal 3rd of femur, was statically locked using AO femur intra-medullary nail. There was formation of adequate callus but the nail broke through proximal of the two distal locking holes which in our opinion occurred due to premature lifting of a heavy object. The other case of implant failure was a young, heavy built person, who did not turn-up for follow-up but presented with implant failure after one year. Radiographically there was poor callus. . Exchange nailing was done in both these cases. Angular mal-alignment was noted in 3 (5.5%) cases (Valgus angulation between 5^0-10^0 in two cases and Varus angulation of 7^0 in one). All three had comminuted type IV fractures in distal 3rd of the femur. Rotation was not measured routinely during follow-up of the patients who had a femur fracture. However, no clinically significant rotational deformity was noted. No case of fat embolism syndrome or adult respiration distress syndrome was observed in the series. No patient died during the study. At the time of most recent follow-up (minimum of 6 months), the patients were evaluated both clinically and radiologically by using modified Klaus &Klemm criteria. Out of 54 femoral shaft fractures 61% were rated as excellent, 22% as good, 11.11% as fair and 5.5% as poor.

Table 1: Comparison of union rate and complications

Study	No.	Union	Delayed union	Nonunion	Mal-union		Infection		Implant failure	Shortening
					Angular	Torsional	Superficial	Deep		
MK Deepak (2012)	30	96.6 %	2	-	-	-	5	-	1	4
Karadimas EJ (2009)	415	97.8 %	14	9		4	1	1	28	6
Fadero PE (2008)	19	100 %	-	-	-	-	2	-	-	-
Wolinsky PR (1999)	551	98%	26	6	-	-	6	-	1	-
Christie J (1988)	120	98.3	2	2	1		1		2	2
Zuckerman JD (1987)	64	98.4 %	2	1	1		-	-	-	2
Wiss DA (1986)	112	98%	2	-	-	8	-	-	-	2
Winquist RA (1984)	520	99.1 %	-	-	12		4			10
Rothwel AG (1982)	32	93.7 %	2		4					2
Present Study	54	94.4 %	6	-	3		1	1	2	2

DISCUSSION

Femur is the largest and strongest bone of the body. Its fracture affects ambulation and the upright posture. Its healing in proper alignment and without shortening prevents the person from early post-traumatic arthritis and limp respectively. The perfect method of fracture treatment is one that

can safely fix the fracture so that soft tissue and joint could be mobilized early and continuously during healing and which also allows early weight bearing. Compared to other methods of internal fixation, intramedullary interlocking nail is the method that fits this criteria. Intra-medullary nail, with its location close to center of femur can tolerate bending and torsional loads better and locking mechanism provides less tensile and shear stress than plate fixation.[4] Closed nailing technique is preferred because it prevents damage to the periosteum and surrounding soft tissue so that the biological environment around the fracture is minimally disturbed. Another important benefit of closed intramedullary interlocking nail is commencement of early ambulation of the patient which itself reduces the complications of prolonged bed confinement.

Comparison of union and complications are presented in Table-I.

MK Deepak & Karun Jain (2012)[4] performed locked intramedullary nailing in 30 femoral shaft fractures. They reported 96.6% union rate, 6.6% patients had delayed union, 16.6% patients had superficial infection, 4 13.3% had limb shortening and there was 3.3% case of re-fracture with implant failure. The study concluded that closed intramedullary interlocking nail is the current treatment of choice for closed diaphyseal fractures of femur in adults with an acceptable rate of complications.

Efthimios J. Karadimas (2009)[8] studied 415 femur fractures treated with antigrade reamed intramedullary nailing and reported 97.8% union rate. The complications noted were; 2.16% non-union, 3.37% delayed union,0.9% torsional malunion, 1.4% shortening, 0.4% infection and in 6.7% locking bolts broke. The study concluded that antegrade reamed inramedullary nailing was a preferred treatment for closed and open femoral fractures.

Fadero PE &Alabi S (2008)[9] treated 19 femoral shaft fracture with locked intramedullary nailing. They reported 100% union rate. There were 2 cases of superficial wound infection. Although rotational mal-alignment and limb length discrepancy were not assessed. The author mentioned that dynamization of statically locked nail is not always necessary for healing of fractures.

Wolinsky and Philip R (1999)[10] performed reamed intramedullary nailing in 551 femoral shaft fractures. They reported 98% union rate, while in 4.7% cases union was delayed; only 1% fractures did not heal. There was1% infection and0.18% nail and 2.3% locking bolt failures, and all fractures healed with <10 degree of angulation in either plane. They concluded that reamed intramedullary nailing was a marvellous procedure that results in low rate of nonunion, mal-union, infection and hardware failure.

J. chiristle&C.Court Brown (1988)[5] analyzed 120 femoral shaft fractures.They reported 98.3% union rate. 0.83% superficial infection, 1.6% delayed union, 1.6% implant failure 1.6% shortening of > 2 cm and 0.83% rotation deformity. Authors concluded that early closed nailing with locking screws to enhance stabilization was the method of choice.

Zuckerman JD &Veith RG (1987)[11] analyzed 64 unstable femoral shaft fractures treated with closed interlocking intramedullary nailing. He reported 98.4% union rate; 2 had Delayed union, 1 had non-union, 2 had shortening of limb and 1 had mal-union with angulation > 10^0.

Wiss DA & Fleming CH (1986)[12] treated 112 comminuted or rotationally unstable fractures of the femur with an interlocking nail. They reported 98% union rate; there were 2 non-unions, 2 had shortening of limb. 8 had external rotation deformity; there were no deep wound infection and angular deformity in any plane > 10^0. Their study showed that interlocking nail was the treatment of choice for complex fracture of femur with minimal complications.

Winquist& Hansen (1985)[13] performed closed intramedullary nailing in 520 femoral shaft fractures. They reported 99.1% union rate and minimal complications.

Alastair G. Rothwell (1982)[3] reviewed 32 cases of more severely comminuted femoral fractures. He reported 93.7% union rate also.So according to this author, when proper equipment and expertise are available, closed nailing is the treatment of choice for severely comminuted fractures of femoral shaft.

In our study, we performed locked intramedullary nail in 54 femoral shaft fractures. We obtained 94.4% clinical and radiological union rate. There was no case of non-union, while delayed unions were noted in 11.11% cases. We reported infection in 3.7% and shortening of limb in 3.7%cases.

Although we have limited follow-up our results are comparable with many studies reported in the literature[4,5,8,11,13].

CONCLUSION

The results of aforementioned studies and our analysis suggest that intramedullary interlocking nail is an excellent technique to treat femoral shaft fractures in adults especially in complex pattern fractures; ensuring good healing, minimum complications, shorter hospital stay and early functional rehabilitation and most importantly early return to work and pre-fracture state.

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