Original Article

Functional Outcome of Diaphyseal Tibial Fractures Treated by Intramedullary Interlocking Nail, LUMHS Experience

Diaphyseal Tibial Fractures Treated by Interlocking Nail

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ABSTRACT

Objective: To evaluate the functional outcome of Diaphyseal Tibial Fractures treated by Intramedullary interlocking nail by looking at the rate of infection, time of union and knee range of motions.

Study Design: Non randomized controlled trial.

Place and Duration of Study: This study was conducted at the Orthopedic Department of Liaquat University of Medical and health Science Jamshoro from January 2016 July 2016.

Materials and Methods: Fourty patients with diaphyseal tibia fractures (the fractures 7cm below the articular surface of knee and 4 cm above the ankle joint) were included in this study. Diagnosis was made on clinical grounds & radiological examination. Closed intramedullary nail were performed in all skeletally mature (the patients whose epiphysis has been united) patients with diaphysial tibial fracture. Intramedullary interlocking nail were performed in static method in all closed as well as open tibial fractures upto Gustillo Anderson type III-b. Skeletally immature patients, patients who showed signs and symptoms of infection at the site to be operated or elsewhere in the body, pathological fractures, having any medical illness which effect the bone healing, any previous knee or ankle disease and Gustilo Anderson open fractures with neuro-vascular injuries (Gustilo III-C) were excluded from the study.

Results: In our study there were 34 (85%) male, 6 (15%) female patients with mean age of 42 yrs.27 (67.5%) patients presented with close fractures, while 13 (23.5%) patients had open fractures. 10 (25%) patients were operated within six hours and remaining 30 (75%) were operated within 24hours. No patient had any infection either deep or superficial, at the end of our study. Wounds of all of the patients became clean at the end of 12th week. Full weight bearing was allowed to 39(9756%) patients at the end of 24th wks. At the end of our study most of our patient's 40(100%) got knee range of motion from 0 – 135 degree. Fracture union was observed in 39 (97.5%) patints, while one (2.5%) patients did not show any sign of union at the end of study. The overall results were excellent in both close as well as open fractures.

Conclusion: Intramedullary interlocking nail is the treatment of choice in all diaphyseal tibial fractures. Both open and closed fractures can be managed effectively by this method of treatment. It provides early mobilization of the patient and decreases hospital stay. Early rehabilitation and early return to work makes it economical for the patients.

Key Words: Tibial Shaft Fractures, Intramedullary Interlocking Nail, Intramedullary Fixation, and Diaphyseal Tibia Fracture

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INTRODUCTION

Fractures of the tibia and the fibula are subject of ongoing controversy and discussion. Despite newer innovations in implants and external fixation devices, tibial fractures essentially remain unresolved; they are among the most challenging fractures to be treated by an orthopedic surgeon.

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This problem is predominantly attributed to the high prevalence of concomitant closed and open soft-tissue injuries. Approximately, 90% of all open tibial fractures are located in the shaft.[1] The annual incidence has been estimated to be 5.6 per 100.000 persons a year.[2] Significant rates of infection, non or delayed union are reported complications of those injuries[2,3].

The ideal treatment for open fractures of the tibia is less clear. However, Intramedullary (IM) nailing has been the treatment of choice for closed diaphyseal tibial fracture as demonstrated by excellent results of multiple clinical studies.[1] Twenty years ago an open fracture was the classical indication for the treatment with an external fixator.[4] Since the 1990s, a number of studies demonstrated favorable outcomes with intramedullary nailing, resulting in amendment of policy. Advances in

the surgical technique, antibiotic therapy, and tissue coverage have occurred concurrently, enabling surgeons to reduce the rates of infection and improve overall clinical outcomes in open fractures. Delayed-union, non-union and knee range of motion remains a challenging complication not only in the treatment of open but also closed tibial shaft fractures.

Patients with open fractures are known to be at higher risk for superficial or deep wound infection, soft tissue infection or acute purulent infection of the medullary cavity.[5,6] The literature shows deep wound infection rates in open tibial fractures treated by intramedullary nails, varying greatly from 2.5% to 33.3%.[7-11] In a current multicenter analysis of open tibial fractures treated with unreamed, small diameter tibial nails, Gaebler et al. published a rate of deep wound infections ranging from 2.5% to 5.4% [10].

Delayed union of tibial fractures treated by intramedullary interlocking nails range for 0%–11% for closed and from 9% to 47% for open fractures. In published data, non-union occurs in 0% to 8% of the closed and 3% to 17% of the open cases.[9,12-15] In Gustilo type I fractures, the average time to union was 19 weeks, whereas for Gustilo types II and III, it was 26 and 39 weeks, respectively[16].

The objective of the study was to evaluate the functional outcome of diaphysial tibia fracture treated by closed intramedullary interlocking nail by looking at the rate of infection, time of union and knee range of motions. This study was undertaken with the view to have a clear picture of the intramedullary interlocking nailing modality, so the same could be used in future in diaphyseal tibial fracture with confidience

MATERIALS AND METHODS

This was a non randomized controlled trial of patients with diaphysial tibia fracture treated by Intramedullary interlocking nail. Study was conducted at Orthopaedic department of our hospital. Duration of study was six months from November 2007 to December 2008.

Forty patients with diaphyseal tibia fractures (the fractures 7cm below the articular surface of knee and 4 cm above the ankle joint) were included in this study. Diagnosis was made on clinical grounds & radiological examination. Closed intramedullary nail were performed in all skeletally mature (the patients whose epiphysis has been united) patients with diaphysial tibial fracture. Intramedullary interlocking nail were performed in static method in all closed as well as open tibial fractures upto Gustillo Anderson type III-b. Skeletally immature patients, patients who showed signs and symptoms of infection at the site to be operated or elsewhere in the body, pathological fractures, having any medical illness which effect the bone healing, any previous knee or ankle disease and Gustilo Anderson open fractures with neuro-vascular injuries (Gustilo III-C) were excluded from the study.

The functional outcome was measured in terms of the rate of infection. Union was assessed both clinically and radiologically. Clinical assessment was done for local tenderness; radiological assessment was done with presence of callus or loss of fracture line. Knee range of motions was measured with the help of Goniometer. Normal range of movements was taken from 0^o to 135^o.

RESULTS

A total of 40 patients with diaphyseal tibial fracture diagnosed on clinical and radiological examination by taking X-ray AP and lateral view. The average age of the patients was 42.57 ± 13.45 years. Out of 40 patients, 34 (85%) were males and 06 (15%) females with 5.7: 1 male to female ratio. Regarding type and sub type of fracture, linear type of fracture was observed in 20 (50%) patients in whom subtype linear fracture was transfer 14 (35%), oblique 4 (10%) and spiral 2 (5%). Comminuted type of fracture was observed in 16 (40%) patients and segmental type fracture was in 4 (10%) patients as shown table 1. According to the modified Gustilo- Anderson classification: Out of 13(32.5%) open fracture, type I was the most common that was found in 11 (84.6%) patients, 1 (7.7%) type II fracture, 1 (7.7%) type III-A.

Superficial infection was found in 4 (10%) patients at 2^{nd} weeks follow-up but at 12 weeks infection was completely resolved (p=0.012) as shown in table 2. Partial weight bearing at 6^{th} week and full weight bearing were allowed after clinical and radiological evidence of union. 34(85%) patients were allowed partial weight bearing in 6 week, while 4(15%) patients were not allowed weight bearing in 6^{th} weeks (Table 3).

Table No.1: Type and Subtype of Fracture (n=40)

Type of Fracture	Number of patients	Percentage
Linear	20	50
Transfer	14	35
Oblique	4	10
Spiral	2	05
Comminuted	16	40
Comminuted < 50%	10	25
Comminuted > 50%	6	15
Segmental	4	10
Two level	4	10
Type of open fracture	13	32.5
Type I	11	27.5
Type II	1	2.5
Type III-A	1	2.5
TYPE III-B	0	0

36(90%) patients were allowed full weight bearing in 12th weeks while 4 (10%) patients were not allowed. 22(55%) patients were allowed full weight bearing in 18^{th} weeks and 18 (45%) patients were allowed full weight bearing in 18^{th} week. Finally at 24^{th} week

39(97.5%) patients allowed full weight bearing while 1 (2.5%) patient was only allowed partial weight bearing (p=0.0001), as shown in table 3.

Radiological evidence of union according to follow-ups visit of patients is presented in table 3. Union occurred in 39 (97.5%) cases in 24th weeks while one (2.5%) case had non-union at 24 weeks (p=0.0005), as shown in table 3. Range of motion according to follow-up is presented in table 3. Four patients 10% patients had range of motion was 0 to 125^0 and one patients (2.5%) had $0\text{-}90^0$ range of motion but at 18th weeks all patients had improved their range of motion (p=0.002).

Table No.2: Postoperative complications:

Complications	Follow-Up Visit				
	2-Weeks	6-Weeks	12-Weeks	18-Weeks	24-weeks
Wound condition					P=0.0005
Clean	32 (80)	35 (87.5)	38 (95)	39 (97.5)	40(100)
Inflamed	08 (20)	05 (12.5)	02 (05)	01 (2.5)	0 (0)
Condition of infection					P=0.012
Non	36 (90)	38 (95)	40 (100)		
Superficial Infection	04 (10)	02 (05)	0 (0)		
Deep Infection	0 (0)	0 (0)	0 (0)		

Table No.3: Postoperative outcome

Outcome	Follow-Up Visit				
	2-Weeks	6-Weeks	12-Weeks	18-Weeks	24-weeks
Weight bearing				P-value	0.001
Non	40 (100)	6 (15)	4 (10)	0 (0)	0 (0)
Partial	NA	34 (85)	36 (90)	22 (55)	1 (2.5)
Complete	NA	NA	0(0)	18 (45)	39 (97.5)
Radiological union				P-value	0.0005
Non	40(100)	40(100)	1(2.5)	1(2.5)	1(2.5)
Progress in union	0(0)	0(0)	39(97.5)	29(72.5)	0(0)
Union	0(0)	0(0)	0(0)	10(25)	39 (97.5)
Range of motion					P= 0.002
$0\text{-}90^0$	1(2.5)	0(0)	0(0)	0(0)	--
$0\text{-}125^0$	4(10)	4(10)	1(2.5)	39(97.5)	--
$0\text{-}135^0$	35(87.5)	36(90)	0(0)	40(100)	--

DISCUSSION

Tibial shaft fractures are the most challenging fractures to fix for an Orthopedic Surgeon. Most of our patients were young and very active. As most of the young patient's live active life, motorbike is their favorite vehicle to drive. That is the reason males are affected more common than females in our study. In our study 34 (85%) males are affected while remaining six (15%) were females. Study conducted in Toulouse by Bonnevialle P and friends in 2003 show involvement of 34 men (85%) and 15 women (15%).[17] International studies show little difference as compared to our local studies because of cultural difference. Out of 13 open fractures, 11 were type I, one was type II and remaining one was type III A according Gustilo-Anderson classification[18].

Only 10 (25%) patients received definitive treatment within 6 hours of injury. The remaining 30 (75%) of the patient's management was delayed. The causes of delay in definitive treatment were so many; out of them the most common was late presentation in our hospital. Out of 13 patients (32.5%) who presented with open fractures, 7 (17.5%) were operated within six hours in our hospital. All other patients were operated within 24 hours.In western world most of the tibia fractures were operated within 24 hours as proved by different studies.[19] Our patients were also operated within 24 hours. All the open fractures were operated early, debrided and washed thoroughly and wounds were closed primarily. In the international literature immediate debridment, irrigation of the wound and its primary closure with stabilization of fractures is the routine.[20]. Due to this protocol we obtain better results especially rate of infection as compared with other Asian studies.[21] Time of union is as per other national and international studies.[22,23]. i.e: between 17 – 24 weeks. None of our patients were allowed full weight bearing in the first week of their operation. Partial weight bearing was allowed at 6th week and full weight bearing after clinical and radiological evidence of union. 36(90%) were allowed full weight bearing in 12th week while 4(10%) were not allowed. Finally at 24th week 39(97.5%) patients were allowed full weight bearing while only 1(2.5%) remained partial weight bearing at the end of our study because of associated ankle fracture on same side. Union was achieved in almost all patients, the radiological and as well as clinical union was achieved in our 39 (97.5%) patients. only one patient did not have radiological sign of union, although clinically he was pain free and was allowed full wt bearing at the end of this study. International studies also suggest excellent result in regard of union in diaphyseal fractures of tibia.[25]None of our patient got any wound infection either superficial or deep.

Knee range of motions remained remarkable at the end of our study. 35(87.5%) patients got almost full range of motions of knee at the end of 2 weeks, while 4(10%) patient's knee range of motions were restricted, they were able to move their knees from 0 to 125 degrees, while one (2.5%) had range of motion up to 90 degrees. This was because of lack of exercises and physiotherapy by these patients. At the end of our study all patients were able to move their knees with in full range of motion (0 to 135 degrees).As comparing with other national and international studies none of our patients had postoperative complications like infection, knee stiffness, and malunion, screw breakage, misplacement of screw.[26,28].

Our study is comparable to other international studies. As compared to our national studies our study is so far superior to all other studies, due to better modern facilities with trained and experienced staff present in our hospital. Most of our patients were also educated and they were on regular follow-ups in our outpatient department throughout the study period.

CONCLUSION

Intramedullary interlocking nail is the treatment of choice in all diaphyseal tibia fractures. Both open and closed fractures can be managed effectively by this method of treatment. Intramedullary interlocking nail is now recommended worldwide. It provides early mobilization of the patient and decreases hospital stay, thus total cost of treatment is reduced. Early rehabilitation and early return to work make it more important and economical for the patients."

Conflict of Interest: The study has no conflict of interest to declare by any author.

REFERENCES

1. Schmidt AH, Finkemeier CG, Tornetta P. Treatment of closed tibial fractures. Instr Course Lect 2003;52:607–22.
2. Court-Brown CM, Rimmer S, Prakash U, McQueen MM. The epidemiology of open long bone fractures. Injury 1998;29:529–34.
3. Court-Brown CM, McBirnie J. The epidemiology of tibial fractures. J Bone Joint Surg Br 1995;77:417–21.
4. Bach AW, Hansen ST Jr. Plates versus external fixation in severe open tibial shaft fractures. A randomized trial. Clin Orthop Relat Res 1989;241:89–94.
5. Ostermann PA, Henry SL, Seligson D. Timing of wound closure in severe compound fractures. Orthopedics 1994;17:397–9.
6. Seligson D, Klemm K. Adult posttraumatic osteomyelitis of the tibial diaphysis of the tibial shaft. Clin Orthop Relat Res 1999;360:30–6.
7. Henley MB, Chapman JR, Agel J, Harvey EJ, Whorton AM, Swiontkowski MF. Treatment of type II, IIIA, and IIIB open fractures of the tibial shaft: a prospective comparison of unreamed interlocking intramedullary nails and halfpin external fixators. J Orthop Trauma 1998;12:1–7.
8. Keating JF, O'Brien PJ, Blachut PA, Meek RN, Broekhuyse HM. Locking intramedullary nailing with and without reaming for open fractures of the tibial shaft. A prospective, randomized study. J Bone Joint Surg Am 1997;79:334–41.
9. Bonatus T, Olson SA, Lee S, Chapman MW. Nonreamed locking intramedullary nailing for open fractures of the tibia. Clin Orthop Relat Res 1997;339:58–64.
10. Gaebler C, Berger U, Schandelmaier P, et al. Rates and odds ratios for complications in closed and open tibial fractures treated with unreamed, small diameter tibial nails: a multicenter analysis of 467 cases. J Orthop Trauma 2001;15:415–23.
11. Smith JE. Results of early and delayed internal fixation for tibial shaft fractures. A review of 470 fractures. J Bone Joint Surg Br 1974;56B:469–77.
12. Puno RM, Vaughan JJ, Stetten ML, Johnson JR. Long-term effects of tibial angular malunion on the knee and ankle joints. J Orthop Trauma 1991; 5:247–54.
13. Gaebler C, Stanzl-Tschegg S, Heinze G, Holper B, Milne T, Berger G, Vécsei V. Fatigue strength of locking screws and prototypes used in small-diameter tibial nails: a biomechanical study. J Trauma 1999;47:379–84.
14. Singer RW, Kellam JF. Open tibial diaphyseal fractures. Results of unreamed locked intramedullary nailing. Clin Orthop Relat Res 1995;315:114–8.
15. Wiss DA, Stetson WB. Unstable fractures of the tibia treated with a reamed intramedullary interlocking nail. Clin Orthop Relat Res 1995; 315:56–63.
16. Kulshrestha V. Incidence of infection after early intramedullary nailing of open tibial shaft fractures stabilized with pinless external fixators. Int J Orthopaedic 2008: 42 (4):401-9.
17. Fan CY, Chiang CC, Chuang TY, Chiu FY, Chen TH. Interlocking nails for displaced metaphyseal

fractures of the distal tibia. Injury 2005;36(5): 669-74.
18. Gustilo RB, Anderson JT. Prevention of infection in the treatment of 1,025 open fractures of long bones. J Bone Joint Surg 1976; 58:453-8.
19. Gustilo RB. Management of open fractures and complications. Instr Course Lect 1982; 31:64-75.
20. Edwards CC, Simmons SC, Browner BD, Weigel MC. Severe open tibial fractures: results treating 202 injuries with external fixation. Clin Orthop 1988; 230:98-5.
21. Rev Chir Orthop Repraratrice Appar Most 2003; 89:423-32.
22. Blachut PA, O'Brien PJ, Meek RN, Broekhuyse HM. Interlocking intramedullary nailing with and without reaming for the treatment of closed fractures of the tibial shaft: a prospective, randomized study. J Bone Joint Surg Am 1997; 79:640-6.
23. Bone LB, Johnson KD. Treatment of tibial fractures by reaming and intramedullary nailing J Bone Joint Surg 1986; 68 :877-8.
24. Freedman EL, Johnson EE. Radiographic analysis of tibial fracture malalignment following intramedullary nailing. Clin Orthop 1995; 315: 25-33.
25. Reuss BL, Cole JD. Effect of delayed treatment on open tibial shaft fractures. Am J Orthop 2007;36: 215-20.
26. Court-Brown CM, Gustilo T, Shaw AD. Knee pain after intramedullary tibial nailing: its incidence, etiology, and outcome. J Orthop Trauma 1997; 11:103-5.
27. Orfaly R, Keating JF, O'Brien PJ. Knee pain after tibial nailing: does the entry point matter? J Bone Joint Surg Br 1995;77 :976-977.
28. Krettek C, Glüer S, Schandelmaier P, Tscherne H. Intramedullary nailing of open fractures. Orthopade1996; 25: 223-33.