

Comparative study between interlocked nail and plating for management of tibial shaft fractures

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Abstract

Background: Tibial and/or fibular shaft fractures accounted is a common problem, the incidence is approximately 25% of all fracture of lower limb. Majority of these fractures are successfully managed with interlocking nail (ILN) or plate & screws, which has become the mainstay of treatment of diaphyseal injuries with less complications in comparism to other methods of treatment

Aim of the study: This study is to evaluate and to compare the effectiveness of treatment of patients with fractures of tibial shafts using interlocking nail or plate & screws fixation.

Study design; case control

Methods: From January 2010 to july2014, forty six patients with fractures shaft of tibia were treated surgically in Al-Yarmouk Teaching Hospital. Evaluation using functional score of Karlstrom& Olerud [20]. All patients were followed up regularly for an average 12 months with. The patients were divided into two groups, depends on the method of treatment. The ILN group group (1) included 21 patients with an average age of 35years. The Plating group (2) included 25 patients with an average age of 40.0 years.

Results: In our study, both groups were similar in the location of fractures, mean age, mechanism of the injury, type of fracture and gender (all *P* values were approximately 0.38). The wound size is smaller in the ILN group (2-4cm) group when compared to the Plating group (10-14) cm (*P*<0.001). The rate of union , time of healing and rate of malunion were not significantly different between the two groups (*P*>0.05).Evaluation of the consecutive postoperative roentgenograms for assessment adequacy of reduction were recorded. The rates of malunion between the ILN group (14.6%) and the Plating group (5%) showed no significant difference (*P*=0.36).

Conclusion: using interlocked nailing for treatment of tibial shaft fractures is effective, simple and assures maintenance of the reduction. Plate & screws gives rigid fixation without cast immobilization except in distal third in both group needs either fixation of distal fibular fracture or cast immobilization, after surgery, most patients return to their previous jobs about 6 months.

Key words: tibial shaft fractures, interlocking nail, plating.

INTRODUCTION

The tibia by its location is exposed to frequent injuries as one third of its surface is subcutaneous. Treatment of tibial fracture in adult is a challenge to orthopedic surgeons due to poor soft tissue coverage and blood supply. Moreover compartment syndrome,

neurovascular injury and infection might add to this burden [1]. Later non union, delayed union and malunion may include. [1] The acceptable treatment goal for fracture tibia is union maintaining normal length, normal alignment without rotation, deformity, normal joint movement and reduced hospital stay [2]. About 40 years ago charnley (1961) said, "We have still a long way to go

before the best method of treating a fracture of the shaft of tibia can be stated with finality" [2]. Many classification were put for tibial shaft fracture, the ideal classification system should be simple, practicable include direction for fracture management & should implied useful information about prognosis. In our study, we depend the AO/ASIF classification of long bone fractures [1,2]. When determining treatment of tibial fracture, the following factors must be considered.[3]:

- 1-displacement of the fracture.
- 2-alignment of the fracture.
- 3-associated injury.
- 4-soft tissue condition around the fracture.
- 5-patient general condition.
- 6-Location of the fracture

Treatment options are both operative and nonoperative ones. The three basic operative techniques are intramedullary nailing, plating, and external fixation. Intramedullary nailing has widely using in management of tibial shaft fractures although many studies showed that use of such technique has lots of complications [4, 5]. Many studies have suggested various clinical outcomes in cases managed by plating fixation [6]. Intramedullary nail plate fixation and are two effective and well-accepted methods. Plate fixation for treatment of tibial shaft fractures can achieve perfect reduction, but may result in complications regarding delayed union non-union or soft-tissue damage [7]. Interlocking nail although can reduce the damage to soft tissue, but may result in breakage of the nail and locking screws, malunion and risk of knee joints problems or propagation of the nail into the ankle joint.[8,9] Due to absence of defined criteria in the literature for the surgical approaches to such fractures, this study centered to assess and compare the treatment results of IM nailing technique and plating approach

PATIENTS AND METHODS

Between January 2010 and July 2014, (55) patients with fracture of tibial shaft fractures were treated operatively in Al-Yarmouk Teaching Hospital. **Inclusive criteria of this study were;**

- a-Acute fracture (< 2weeks).
- b- Unilateral fracture.
- c-Adults after closure of epiphysis.
- d-Closed fracture.
- e-Site of the fracture (5cm) below knee joint & (3cm) above the ankle joint.

f-Patients had the ability to walk without any assistance (i.e. not crippled) .

Exclusive criteria includes:

- a-pathological fracture.
- b-open fracture.

The 55 patients who corresponded to the inclusion criteria where distributed to two specialist surgeons. Only 9 patients could not be followed regularly (4 patients treated by INL & 5 patients treated by plate fixation. Follow up done regularly only for 46 patients (83.6 %), with an average age of 37.6 years and followed up for 12 months where included in this study, after discharge the patients from the hospital.

The 46 patients were divided into two groups based on the method of treatment. The InterLocking Nail (ILN) group included 21 patients with an average age of 35 years (16 male & 5 female).The plate fixation group included 25 patients with an average age 41 years (18 male & 7 female). In the ILN group (group 1), all of the operations were performed under general anesthesia & tourniquet (except in 4 diabetic patients).The patients placed in a supine position with the injured limb in acute flexion at the knee joint. Gentle traction and closed reduction of the fracture was done under imaging intensifier, then medial parapatellar approach was applied, and using an awl for the starting point was opened, then placing the guide wire control to the proximal subchondral bone, the intramedullary canal was reamed till reaching appropriate fitting of the reamer in the canal was achieved. During reaming, the reduction and alignment of the fractures was maintained and checked repeatedly with the imaging intensifier. After well-preparing of the canal, interlocking nail (tibial nail) of the appropriate size was selected with a diameter of 1 mm lesser than that of the final reamer (8-12) mm. After nail insertion into the distal tibia, at least one distal screw provided sufficient rigid stability. An above-knee splint was applied for 1 week then below knee splint was applied to all of the patients for another 2 weeks. In 7 patients with distal tibial fracture 4 of them associated with distal fibular fractures, fibular fixation done in 2 patients & they kept in below knee splint for 6 weeks (those patients associated with distal fibular fractures). After 4 weeks from time of surgery, patients were allowed to gradual increase their weight bearing. In patients who underwent plate fixation (group 2) by open reduction & internal fixation technique were performed under general anesthesia with use of tourniquet in all patients except in 5 patients(3 patients had diabetes & 2 had moderate skin contusions) with patient supine position on orthopedic table, anteromedial curve incision with stripping of muscle & periosteum, reduction of the

fracture site was performed and fixation using pre contoured plates(DCP or ordinary plates) and appropriate screws.

In 14 patients with distal fibular fracture, fixation done in 10 patients & the other 4 patients, they kept in below knee splint for 6 weeks. Antibiotic injection (ceftriaxone 1gm at induction & continue for 48-72 hours postoperatively). Suture removal was done on (12th -14th) post-operative day in both groups (Table 1).

Postoperative period plain X-rays films (AP & Lat.) views were taken for assessment the adequacy of reduction of fracture for all 46 patients. "Anteroposterior alignment was determined by measuring the angle between a line parallel to the proximal fragment and a line parallel the distal fragment on lateral radiographs". "Varus-valgus alignment was determined by measuring the angle between the lines drawn perpendicular to and bisecting the tibial plateau and proximal medullary canal with a line bisecting the distal medullary canal and tibial plafond on anteroposterior radiographs"[2,4,5]." They defined excellent reduction as <2 mm of fracture gap and approximately 5° of angulatory deformity in any plane (valgus/varus or anterior/posterior)". "Good reduction was defined as 2 to 5 mm of fracture gap approximately

5° of angulations deformity in any plane"." Poor reduction was given for >5 mm of fracture gap or >5° of angulation deformity in any plane". Adequate of reduction included excellent and good reductions [2,4,5,7]." Bony union was defined as evidence of bridging callus formation across the fracture sites or the obliteration of the fracture lines based on X-ray findings"[2,3,4]." Malunion was defined as fractured healing >5° of angulatory deformity in any plane, or internal rotation of 10° or more, external rotation of more than 15° or shortening of 2 cm or more"[3,4,5]. "Nonunion was defined as no evidence of healing after 6 months" [3,5] . Postoperatively with an average follow up for twelve months, the functional outcome was evaluated. The clinical data collected are evaluated using " Karlstrom & Olerud functional score"[20]. In this system ,the clinical data are evaluated ,This score contains three grades (1,2 and 3 points) in each item and the maximum score 36 points, including grades of pain, impairments difficulties of walking, climbing stairs, or previous sports activity, work difficulties, deformity, limb length discrepancy, skin condition, ,atrophy of muscle, , limitations of knee ankle movement. The analysis of clinical data depends on (*P* values) below 0.05 were considered highly significant.

Table 1 –Demographic Features of study sample

	Nail	Plate	Ttotal	<i>P value</i>
Male	16	18	34	0.80
Female	5	7	12	0.83
Mean age	35 years	41	37.4	0.87
Mechanism of injury				
Motor vehicle accident	14	15	29	0.8
Fall from hight	5	6	11	1
Sport injury	2	4	6	1
OTA classification				
A	18	22	40	0.57
B	3	3	6	0.37
Right side	14	14	28	1
Left side	7	11	18	0.8
Type of fractures				
proximal	2	3	5	0.82
middle	12	10	22	0.8
distal	7	14	21	0.84
Time of surgery	40-100 minutes	60-110 minutes		0.8
Fibular fracture	14	20	34	0.84
Fibular fixation	2	10	12	0.78
Time of surgery				
1-5 days	17	20	37	0.83
<2weeks	4	5	9	0.85
Average hospital stay	3-7 days	3-10 days		0.87

RESULT

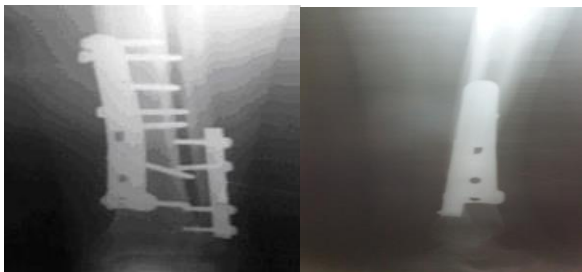
Overall results were based on objective radiographic & functional outcome. The average operating time was significantly less in the ILN group when compared to the Plating group) but the difference was not statistically significant. The size of wound was significantly smaller in the ILN group when compared to the ILN group ($P<0.001$). In both groups were similar in the location of fracture, types of closed fractures, mechanism of injury, mean age, gender, (all P values were approximately 0.38). The hospital stay in the ILN group (average: 5.1 days, range: 3-7 days) and the Plating group (average: 5.9 days, range: 3-9 days), therefore, there was no significant difference ($P=0.38$). In the ILN group, all of fractures except one case healed in 6 months (fig.1 A & B). The mean time of healing was 16 ± 4 weeks. In the plating group, healing occurred in all fractures except two cases (fig.2 A&B) in 6 months with a mean of 18 ± 3 weeks (P value 0.33) & the difference was not significant. The nonunion occur in one case of ILN group was managed by exchanging of nail and bone grafting & in 2 cases of plating group treated by extraction of plating & replaced by external fixation (because of infection). Regarding the rate of union and time of healing were not significantly different between the two groups ($P=0.61$, 0.33, respectively).



A. A-P view

B. Lateral view

Figure 1. 45 years old female patient with right proximal tibial fracture was treated with ILN.



A. A-P view

B. Lateral view

Figure 2. 32 –years old male patient with distal tibia & fibula fracture treated by plate & screws of both tibia & fibula.

Regarding complications four patients in group (1) developed blister on their legs kept under observation for

compartment syndrome & never found to have signs of it.). Two patients developed infection (superficial infection), this superficial infection occurred in a closed fracture of a female diabetic & male elderly patients. After 7 days treatment with injectable antibiotics and good control of blood sugar of diabetic patient, the wound healed spontaneously. In group (2) infection occur in three patients, implant extracted & external fixation performed. The complication rate of infection in the ILN group (14.2% and this) showed no significant difference comparing with the Plating group (12%) ($P=0.38$). Regarding malalignment, three patients in the Plating group (14.6%) had malunion including two patients with 8° and 10° anterior angulations respectively & one with 7° valgus deformity and 10° angulations posteriorly &, all of these patients with distal tibial fracture associated with distal fibular fracture .. In the ILN group, there was one malunion (5%) with 8° posterior malalignment. The rates of malunion between the group (1) (5%) and the Plating group (14.6%) and this showed no significant difference in between two groups ($P=0.36$). However, in the group (2), fractures of the distal-third of tibia showed high tendency towards increased rates of malunion when compared to fractures of middle-third of tibia, although this was not significant. Clinical assessment for limb length discrepancy, there was no case of significant tibial shortening. One patient with group (1) had delayed union treated later on by dynamization after three months. Knee joint pain in ILN group occur in 18 (85.7%) patients out of 21 patients while only two patients in group (2) had knee joint pain, all in proximal tibial fracture fixed by plating. (P value=0.0001) which is statistically significant. Regarding the range of motion 3 (14.2 %) of ILN group had restricted movement of knee joint flexion (2 cases 10° and one 20°) while 2 (8%) cases had 10° restriction of flexion in fracture proximal tibial fracture treated by plate fixation. In ILN group 20 (95.2%) patients had full range of motion of the ankle joint & one (5.8%) had restricted of 10° of dorsiflexion. In Plating group 2 (8%) patients had restricted movement of the 10° ankle joints dorsiflexion which is statically not significant (P value =0.38) as in Table (2).

Table 2. Types of complication

Complication	ILN	Plating	P value
Infection	2	3	0.38
Non-union	1	3	0.33
Mal union	1	3	0.28
Range of motion of knee joint restriction	3	2	0.38
Knee joint pain	18	2	0.001 (significant)

DISCUSSION

Treatment of tibial shaft fractures nonoperatively carrying increase the incidence of unacceptable shortening and malunion." Hopper et al. [10] concluded that nonoperative treatment gave more malunion and shortening". In our study, found that no one of patients suffering from significant tibial shortening after treatment with intramedullary nailing or plate & screws fixation. Four of forty-six patients in both groups (8.7%) healed with malunion. The rate of malunion was similar to or lowers than that of previous studies [12]. Furthermore, the rate of malunion between the ILN group (5%) and the Plating group (14.6%) showed no significant difference ($P=0.36$). "Stausss et al.[12] reported that interlocked nailing of displaced tibial fractures showed a trend of increased malunion rate when compared to middle-third fractures($P=0.06$)". In our study, evaluation of the functional score showed no difference between the ILN and The Plating groups. However, after surgery in both groups found that most patients return to their previous jobs about 6 months."Fan et al.[19] reported that ILN & Plating fixation of displaced tibial fractures were an effective methods that could achieve satisfactory clinical outcomes". In our study, found that, the interlocked nailing gave very stable and rigid fixation without postoperative cast immobilization except those associated with distal fibular fracture.[4,10,16]. In this study, the wound size was smaller and the operative time was shorter in the ILN group when compared to the Plating group. Using ILN fixation in tibial shaft fractures enables stabilization closely with preserving vascularity of the fracture site and integrity of the soft-tissue envelope; so it is the treatment of choice for treatment of fractures of the tibial shaft but not the distal metaphyseal tibia because the medullary canal at this level prevents direct contact between the nail and endosteum [11]. "There are concerns regarding fixation stability and malunion, especially when less than 2 locking screws are used to secure the distal fragment" [12, 13, 14].therefore using plate fixation for fibula to enhance stability.[14]. Egol et al. [15] "reported that fibular plating was recommended whenever interlocking nailing was used in unstable distal tibiofibular fractures". Good contact of the nail to the end plate, correct nail position, and rigid fixation of the nail-screw-bone construct should accurately be established [16]. Infection was also considered as a challenging complication in the surgical management of tibia fractures. The incidence of infection was reported from 0 - 8.3% and 0 - 5.3% in the plating and INL groups respectively [17, 18].Fang Y, et al. reported that 36 patients with tibial shaft fractures treated with primary nailing the deep infection rate was 2.8% & 43 patients

were treated by plating & screws, the infection rate 6.5% & this corresponding to the results in our study. After reviewing various articles, shows that interlocking nail & plating have given an effective methods & good results when compared with the patients who had undergone fixation by other methods.

Conclusion:

Using interlocked nailing for treatment of tibial shaft fractures is effective, simple and assures maintenance of the reduction of tibial shaft fractures. Plate & screws gives rigid fixation without cast immobilization except in distal third in both groups need either fixation of distal fibular fracture or cast immobilization. After surgery in both groups found that most patients return to their previous jobs about 6 months.

REFERENCES

1. Charnley, J.. The closed treatment of common fractures. 3rd ed., Edinburg: 1961;105.
2. Lottes, JO. Closed reduction, plate fixation and medullary nailing of fracture of both bones of the leg. J Bone Joint Surg (A). 1972; 34A : 861.
3. Vallier HA, Le TT, Bedi A. Radiographic and clinical comparisons of distal tibia shaft fractures: Plating versus intramedullary nailing. J Orthop Trauma 2008;22: 307 - 11.
4. Mosseiff R, Safran O, Segal D, et al. The undreamed tibial nail in the treatment of distal metaphyseal fractures. Injury 1999; 30: 83 - 90.
5. Dogra AS, Ruiz AL, Thompson NS, et al. Dia -metaphyseal distal tibia fractures - treatment with a shortened intramedullary nail: A review of 15 cases. Injury 2000; 31: 799 - 804.
6. Borg T, Larsson S, Lindsjo U. Percutaneous plating of distal tibia fractures: Preliminary results in 21 patients. Injury 2004; 35: 608 - 14.
7. Muller ME, Nazarian S, Koch P, et al. The comprehensive classification of fractures of long bones. Berlin:Springer - Verlag, 1990.
8. Francois J, Vandeputte G, Veheyden F, et al. Percutaneousplate fixation of fractures of the distal tibia. Acta Orthop Belg 2004; 70: 148 - 54.
9. Helfet DL, Shonnard PY, Levine D, et al. Minimally invasive plate osteosynthesis of distal fractures of the tibia. Injury 1997; 28: A42 - A47P ; 77B: 417 - 421.
10. Hooper GJ, Keddell RG, Penny ID. Conservative management of closed nailing for tibial shaft fractures: A randomized prospective trial. J Bone Joint Surg Br 1991;73:83-85.
11. Morin PM, Reindl R, Harvey EJ, Beckman L, Steffen T. Fibular fixation as an adjuvant to tibial intramedullary nailing in the treatment of combined distal third tibia and fibula fractures: a bio mechanical investigation. Can J Surg 2008;51:45-50.
12. Strauss EJ, Alfonso D, Kummer FJ, Egol KA, Tejwani NC. The effect of concurrent fibular fracture on the fixation of distal tibia fractures: a laboratory comparison of intramedullary nails with locked plates. J Orthop Trauma 2007;21:172-7.
13. Chen AL, Tejwani NC, Joseph TN, Kummer FJ, Koval KJ. The effect of distal screw orientation on the intrinsic stability of a tibial intramedullary nail. Bull Hosp Jt Dis 2001;60:80-3.

14. Tyllianakis M, Megas P, Giannikas D, Lambiris E. Interlocking intramedullary nailing in distal tibial fractures. *Orthopedics* 2000;23:805-8.
15. Egol KA, Weisz R, Hiebert R, Tejwani NC, Koval KJ, Sanders RW. *J Orthop Trauma* 2006;20:94-103.
16. Cheng-yu Fan, Chao-Ching Chiang. Interlocking nails for displaced metaphyseal fractures of distal tibia. *Injury* 2005;36:669-674.
17. Vallier HA, Cureton BA, Patterson BM. Factors influencing functional outcomes after distal tibia shaft fractures. *J Orthop Trauma* 2012;26(3):178-183.
18. Li Y, Liu L, Tang X, Pei F, Wang G, Fang Y, et al. comparison of low, multidirectional locked nailing and plating in the treatment of distal metadiaphyseal fractures. *Int Orthop* 2012;Feb 7. [Epub ahead of print]
19. Fan CY, Chiang TY. Interlocking nails for displaced metaphyseal fractures of the distal tibia. *Injury* 2005;36:97-674
20. Karlstrom G, Olerud S. External fixation of tibial shaft fracture with the Hoffmann frame. *Clin Orthop.* 1983;180:68-77