Basrah Journal Of Surgery

Bas J Surg, December, 22, 2016

LOCKING INTRAMEDULLARY NAIL VERSUS PLATE AND SCREWS FOR FIXATION IN TIBIAL DIAPHYSEAL FRACTURE

Ali A Alwan Al-Tamimi[*] & Aram Abdullah Rasheed[#]

[*]FICMS(Ortho.), Lecturer, College of Medicine; University of Sulaimaniyah. [#]MB,ChB, Higher Diploma(Ortho.), Orthopedic Surgeon, Halabja General Hospital, Sulaimaniyah, IRAQ.

Abstract

Diaphyseal tibial fracture is the most common fractured long bone because of it is subcutaneous position anteromedially and thinner diaphysis distally. Tibial diaphysis has poor blood supply and poor soft tissue envelope around it so it is more susceptible to infection, delay union, and non-union. For these reasons many modalities including cast and brace, external fixation, plate and screws, and locking intramedullary nail were used for treating diaphyseal tibial fracture.

The aim of this study is to compare the outcome of locking intramedullary nail(LIMN) fixation versus plate and screws fixation in treating diaphyseal tibial fracture in term of operation time, early weight bearing, time to union, and complications.

The study was carried out in Sulaimaniyah Teaching Hospital, Department of Orthopedics prospectively from May 2010 to July 2014 on 74 patients, 40 of them underwent surgical fixation by locking intramedullary nail (26 close method and 14 by open method), and 34 of them underwent open reduction and internal fixation by plate and screws. The outcome was assessed by clinical and radiological evaluation.

The results show that young male are more affected by trauma, and the main mechanism of injury was Road Traffic Accident. Operation time was shorter among plate and screws group with a mean of 51.4±4.9 minutes, than locking intramedullary nail group with a mean of 88.5±12.5 minutes. Weight bearing(WB) time achieved earlier in the locking intramedullary nail group with a mean of 2.6±0.8 weeks than the plate and screws group with a mean of 4.2±1.4 weeks. There were no significant difference between the two groups regarding time to full weight bearing(FWB), time to union, and complications.

In conclusion, Locking intramedullary nail and plate fixation are ideal option for treatment of diaphyseal tibial fractures since there were no significant differences between them in time of union and the post-operative complications.

Introduction

Tibial diaphyseal fracture is the most commonly fractured long bone, because one third of the tibial surface is subcutaneous throughout most of its length. Open fractures are more common in the tibia than in any other major long bone[1].

Fractures of the tibia are the 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. These injuries are different and variable in presentation, and their outcomes are unpredictable.

Patients and methods

This is a prospective comparative study carried at Orthopaedic Department in Sulaymaniyah Teaching Hospital from May 2010 to July 2014. A total number of 74 patients sustained non-pathological fracture of tibial shaft were included in this study. The age of the patients ranged from 16 to 62 years. Those patients were divided randomly into two groups

Group I: (locking intramedullary nail group): this group consisted of 40 patients

(34 male and 6 female) in whom locking intra medullary nail fixation were used as definitive treatment for their fractures.

Group II: (plate and screws group): this group consisted of 34 patients (24 male and 10 female) in whom plate and screws fixation were used as definitive treatment for their fractures.

Patients were asked and evaluated for the age and sex, mechanism of injury, side of fractures, type of fractures, shape of fractures and duration from hospitalization.

Inclusion criteria: all closed tibial diaphyseal fracture and open fracture Gustilo type I and II were included in this study.

Exclusion criteria: proximal and distal fracture of tibia with metaphyseal extension, open fracture Gustilo type III, pathological fractures and patient aged below 12 years.

General assessment was done for all patients in cooperation with an anesthesiologists and sometimes with physicians.

In the theatre, prophylactic antibiotic (1gm ceftriaxone) was used intravenously at the time of induction of anesthesia and repeated 12 hourly post operatively for at least 3 days except for those with open fracture we continue antibiotics in form of oral amoxiclav 1 gm. twice daily for another one week.

All the interlocked nails were inserted closely with closed reduction except for those with open fracture, we did open reduction since the fracture site is already opened[1].

All the patients were treated with plate and screws by anterior approach and the plate placed directly on the shin of tibia antero-medially[1,2].

Postoperative care: Patients were nursed in supine position with the operated leg slightly elevated. In the first 24 hours, close observation for vital signs and distal neurovascular examination was done. Next day, looking for the dressing, laboratory investigations in form of complete blood picture and X-ray checking were done.

Physiotherapy was started in the first postoperative day in form of active knee and ankle flexion–extension if the patient is comfortable. The wound examined, dressing changed and patient discharged.

Operation time, methods for LIMN group, partial weight bearing (PWB), full weight bearing (FWB) and time to union (TTU) were evaluated postoperatively.

The patient was directed to visit the outpatient clinic or private clinic for removal of stitches after 10-14 days following surgery. Patients were followed regularly monthly till union and every 2 months till complete consolidation. During the follow-up period; Complications (anterior knee pain, infection, angulation, leg length discrepancy, screw loosening, and skin necrosis and delay union) were evaluated.

Results

A total 74 patients with diaphyseal tibial fractures were included in this study. Mean age of studied patients was 28±10 years, 54 patients (73%) of them were 15-30 years age. Gender: 58 patients (78.4%) were males while females represents only 21.6% in our study (16 patients).

The main mechanism of injury was RTA in 64.9%, followed by fall from height(FFH) in 32.4% and others 2.7%.

Right tibia was involved in 42 patients and left tibia fractured in 32 patients. Close fracture represented 75.7% of our patients; followed by Gustilo type I 18.9% and Gustilo type II 5.4%.

Most of our patients have comminuted and oblique fracture in (81%), while transverse fracture found in (13.6%), spiral in (2.7%) and segmental in (2.7%).

Table I: Mid-shaft tibial fractures patient's characteristics.

Side of fracture	No.	%
Right	42	56.8
Left	32	43.2
Total	74	100.0

Mechanism of injury	No.	%
RTA	48	64.9
FFH	24	32.4
Others	2	2.7
Total	74	100.0

Fracture shape	No.	%
Transverse	10	13.6
Oblique	30	40.5
Comminuted	30	40.5
Spiral	2	2.7
Segmental	2	2.7
Total	74	100.0

Type of fracture	No.	%
Close	56	75.7
Gustilo type I	14	18.9
Gustilo type II	4	5.4
Total	74	100.0

Intramedullary nail was used for 40 patients (26 patients operated on with closed approach and 14 patients with open approach) and plates & screws were used for 34 patients. Mean duration for hospitalization for all patients was 2.6±2.7 days, Mean operation time for all patients was 71±21minutes; mean time for PWB for all patients was 3±1 weeks, mean FWB for all patients was 13±2 weeks and mean time for TTU for all patients was 16±3 weeks.

Table II: Operative characteristics for tibial fractures patients.

Variable	No.	%
Operative technique		
Intramedullary nail	40	54.1
Plates & Screws	34	45.9
Total	74	100.0
Method		
Close	26	16.2
Open	48	83.8
Total	74	100.0
Duration from hospitalization mean±SD (2.6±2.7 day)		
Operation time mean±SD(71±21minute)		
Partial weight bearing mean±SD(3±1 week)		
Full weight bearing mean±SD(13±2 week)		
Time to union mean±SD (16±3 week)		

Table III: Distribution of durations according to operative techniques.

Variable	Intramedullary nail	Plates & Screws	t-test	P
Hospitalization duration (day)	3±2.9	2.1±2.2	1.03	0.3
Operation time (min.)	88.5±12.5	51.4±4.9	11.4	<0.001
PWB (week)	2.6±0.8	4.2±1.4	4.3	<0.001
FWB (week)	13.2±2.1	13.3±1.8	0.07	0.9
TTU (week)	17.2±3.2	15.5±1.7	2.4	0.06

The operative time was significantly longer among patients operated with close method for intramedullary group (p=0.003). No significant difference was observed between close and open methods regarding PWB, FWB and TTU (p>0.05).

Complications were significantly higher among patients operated with intramedullary nail (p=0.02) (Table IV).

Table IV: Distribution of complications according to surgical technique.

Variable	Intramedullary nail		Plates & Screws		χ^2	P
	No.	%	No.	%		
Complications					4.9	0.02
Yes	24	60	8	23.5		
No	16	40	26	76.5		
1: Knee pain					-	-
Yes	16	40	0	-		
No	24	60	0	-		
2: Infection					0.04	0.9
Yes	1	2.5	2	5.8		
No	39	97.5	32	94.2		
3: Angulations					0.5	0.4
Yes	2	5	4	11.7		
No	38	95	30	88.3		
4: Leg length discrepancy					0.8	0.3
Yes	2	5	0	-		
No	38	95	34	100		
5: Screw loosening					-	-
Yes	2	5	0	-		
No	38	95	0	-		
6: Skin necrosis					1.2	0.2
Yes	0	-	2	5.8		
No	40	100	32	94.2		
Delayed union					0.8	0.3
Yes	2	5	0	-		
No	38	95	34	100		

Anterior Knee pain was present among 16 patients operated with intramedullary nail. Knee pain represented 40% of post-operative complication for patients operated with intramedullary nail, 5% infection, 5% angulations, 5% screw loosening, 5% delayed union and 5% leg length discrepancy. Angulations represented 11.7% of post-operative complications recorded for patients operated with Plate & Screw, 5.8% infection and 5.8% skin necrosis.

Discussion

There are different methods of treatment according to the type of fracture. Closed treatment with casting and functional bracing now is generally reserved for closed, stable, isolated, minimally displaced fractures caused by low-energy trauma and some stable low-velocity gunshot fractures[1]. Our study includes two methods of treatment of diaphyseal tibial fracture locking titanium intramedullary nail (LIMN) and locking compression plate (LCP).

Age and Sex: In our series, the age was ranging between 16-62 years; the mean age of our patient was 28±10 years. Male patients were represented most of our cases 78.4% in both groups, our results was comparable to the study published by (Bombaci H et al 2004)[3], (A Tavakoli et al 2010)[4],(Huang P et al 2008)[5], (C.M. Court-Brown et al 1995)[6] and the study published by (Marco Aurelio Sertorio Grecco et al 2002)[7].

No significant differences were observed in our study between patients operated with intramedullary nail and those operated with plate & screw regarding age and gender ($p>0.05$), and our study shows that fracture shaft tibia is more common in young age males.

Mechanism of injury: in our study, the main mechanism of injury was road traffic accident(64.9%), followed by fall from height (32.4%) and others (2.7 %), this is comparable with the epidemiological studies done by (C.M. Court-Brown et.al 1995)[6] and (Marco Aurelio Sertorio Grecco et al 2002)[7].

Side of fractures: our study shows that right side fractures more common in 42 patients 56.8%, while 32 patients 43.2% had left side fractures, and this is comparable with the study done by (Huang P et al 2008)[5], (Marco Aurelio Sertorio Grecco et al 2002)[7].

Type of fractures: in our study, most of the fractures were closed in 56 patients 75.7%, and this is comparable with the study done by (Madadi F et al 2010)[8].

Shape of fractures: Our study shows that most of the fractures were comminuted 40.5% and oblique fracture 40.5%, this is due to the mechanism of injury since most of them happened due to road traffic accident or fall from a height.

Duration from hospitalization: our study shows no significant differences (p-value 0.3) between two groups in duration of hospitalization in which locking intramedullary nail (LIMN) group with a mean of 3±2.9 days while the mean of plate and screws group was of 2.1±2.2 days, hospital stay in absence of serious complications is not mandatory especially with good operation technique and good tissue handling, and our result is comparable with a study done by (Huang P et al2008)[5].

Operation time: our study sample shows highly significant difference(<0.001) between the two groups regarding the duration and time of operation, the mean operation time for locking intramedullary nail (LIMN) group was 88.5±12.5 minutes while the mean time for plate and screw group was 51.4±4.9 minutes. It is well known fact that closed reduction, close inserting the locked nail and the dilemma of the distal screws insertion takes more time from open reduction and direct plate and screws fixation. Our result was supported by the study done by (Huang P et al2007)[9]. While (Bombaci H et al 2004)[3], shows that the mean operation time was similar in both groups.

Methods for LIMN group: in our study for 40 patients with LIMN 14 were done by open method and 26 by close method. The operation time was significantly longer (p=0.003), among patients operated with close method with a mean of 102±5.7 minutes while the mean of open method was 84±10.8, this can be explained by that close method need more time to obtain good reduction and for the insertion of the guide wire to cross the fracture side intramedullary.

Partial weight bearing (PWB): our study shows significant difference (p<0.001) in PWB duration between the two groups, it was longer among patients operated with plate &screw with a mean of 4.2±1.4weeks, while it was 2.6±0.8weeks among LIMN group.

This explained by that we feel LIMN more secured and rigid fixation so we encouraged weight bearing earlier than plate fixation.

Full weight bearing (FWB): our study shows no significant difference between the two groups regarding FWB (p=0.9), 13.2±2.1weeks for LIMN and 13.3±1.8 weeks for plate and screws.

Time to union (TTU): in our study time to union or radiological evidence of union was 17.2±3.2 weeks for LIMN group, while 15.5±1.7 weeks for plate and screw group, which shows that time to union is longer among LIMN group but not significant(p=0.06), and this result is comparable with the studies done by (Bombaci H et al 2004)[3], (A Tavakoli et al 2010)[4], and (Fernandes HJ et al 2006)[10] in which shows longer union time among LIMN group. While (Huang P et al 2008)[5] shows that union time of plate and screws group was longer.

Union time is longer in LIMN because we did not use dynamization for the nail through the period of union.

Complications

Anterior knee pain: in our series anterior knee pain is a complication only found in LIMN group which is represented in 40% of 40 patients and this is comparable with the studies published by (E Katsoulis et al 2006)[11] in which they recorded anterior knee pain in 47% of patients in total of 1460 patients. While (Toivanen JA et al 2002)[12] recorded higher incidence of anterior knee pain which found in 67% of their patients. Other study done by (Huang P et al 2007)[9] showed lower incidence (17.1%) of anterior knee pain.

Anterior knee pain was an acute and short lasting pain due to approach since we introduce the nail through the patellar tendon.

Infection: our study shows no significant difference regarding infection between the two groups (p=0.9). Superficial infection was recorded in 1 patient 2.5% of LIMN group which was compound fracture, and deep infection recorded in 2 patients 5.8% of plate and screws group which also it was compound fracture, and this is comparable with other studies (Huang P et al2007)[9], (Bombaci H et al 2004)[3] and.(A Tavakoli et al 2010)[4].

Angulation: in our study, angulations 5 and 7 degrees were recorded in 2 patient 5% of LIMN group and in 4 patients 11.6% of plate and screws group, study done by (Huang P et al2008)[5] recorded angulation in 3 patients of total 45 patients treated with plate and screws.

Leg length discrepancy: in our series leg length discrepancy of 2 cm and 3 cm recorded only in 2 patients 5% of LIMN group, while (Huang P et al -2007)[9] record leg length discrepancy of 2.5 cm in 1 case for LIMN group, while in studies done by (Bombaci H et al 2004)[3], leg length discrepancy recorded in 2 cases (2 and 2.5 cm) for LIMN group.

The leg length discrepancy found in LIMN group only due to this method used in comminuted fractures which plate fixation is not a suitable fixation for such fractures.

Screw loosening: in our study proximal screw loosening recorded in 2 cases 5% among LIMN group.

Skin necrosis: in our study, skin edge necrosis was recorded in 2 patients 5.8% among plate and screws group. This is due to the fact that the plate is inserted anteromedially, which is superficial and covered only by skin.

Delay union: in our study, delay union was recorded in 2 patients 5% among LIMN group, and this is comparable with the other study done by (Huang P et al 2007)[9]. From our results we conclude that both locking intramedullary nail and plate fixation are ideal option for treatment of diaphyseal tibial fractures since there were no significant difference between them in time of union and the post-operative complications. For those who need shorter time of anesthesia we recommend plate and screws fixation. For those need early mobilization after operation we recommend locking intramedullary nail fixation.

References

1. S. Terry Canale, James H. Beaty, Campbell's Operative Orthopaedics,. Fractures of the lower extremity, tibial shaft, Chapter 51, p2644-2668, 12th Edition; Elsevier Mosby: Canada; (2008).
2. Brett R. Bolhofner, Master Techniques in Orthopaedic Surgery: Fractures, Tibial shaft fractures: Open reduction intertnal fixation, p. (466), 2nd Edition, Lippincott Williams & Wilkins; (2006).
3. Bombaci H, Güneri B, Görgeç M, Kafadar A. A comparison between locked intramedullary nailing and plate-screw fixation in the treatment of tibial diaphysis fractures. Acta Orthop Traumatol Turc 2004; 38:104-9.
4. A Tavakoli, H Mousavi Tadi, A Mahmoodian, A Comparison between Unreamed Locked Intramedullary Nailing and Plate-Screw Fixation in the Treatment of Tibial Diaphyseal Fractures. IRCMJ vol. 12, Issue 6, november2010 p. 640-643.
5. Huang P, Tang PF, Yao Q, Liang YT, Tao S, Zhang Q, Guo YZ, Liang XD, Wang Y. A comparative study between intramedullary interlocking nail and plate-screw fixation in the treatment of tibial shaft fractures. Zhongguo Gu Shang 2008; 21:261-3.
6. Court-Brown and McBirnie Brown and McBirnie J. The Epidemiology of Tibial Fractures. JBJS (Br) Vol. 77 Vol. 77-B. No. 3. May 1995.
7. Marco Aurélio Sertório Grecco, Idyllio do Prado Junior, Murilo Antonio Rocha, José Wagner de Barros, Epidemiology of tibial shaft fracture Acta Ortop. Bras. Vol.10 no.4 São Paulo Oct./Dec. 2002.
8. Madadi F, Vahid Farahmandi M, Eajazi A, Daftari Besheli L, Madadi F, Nasri Lari M. Epidemiology of adult tibial shaft fractures: a 7-year study in a major referral orthopedic center in Iran, Med Sci Monit, 2010 May; 16(5): CR217-21.
9. Huang P, Tang P, Yao Q. Comparison of LCP and locked intramedullary nailing fixation in treatment of tibial diaphysis fractures, Zhongguo xiu Fu Chong Jian Wai Ke Za Zhi; 2007 Nov; 21(11): 1167-70.
10. Fernandes HJ, Sakaki MH, Salvia Jdos S, dos Reis FB, Zumiotti AV. Comparative multicenter study of treatment of multi-fragmented tibial diaphyseal fractures with nonreamed interlocking nails and with bridging plates, Clinics (Sao Paulo). 2006 Aug; 61(4): 333-8.
11. E. Katsoulis, C. Court-Brown, P. V. Giannoudis. Incidence and aetiology of anterior knee pain after intramedullary nailing of the femur and tibia. J Bone Joint Surg [Br]; 2006; 88-B; 576-80.
12. Toivanen JA, Vaisto O, Kannus P, Latvala K, Honkonen SE, Jarvinen MJ, Anterior knee pain after intramedullary nailing of fractures of the tibial shaft, a prospective, randomized study comparing two different nail-insertion techniques, J bone joint surgery Am; 2002 Apr;84-A(4):580-5.