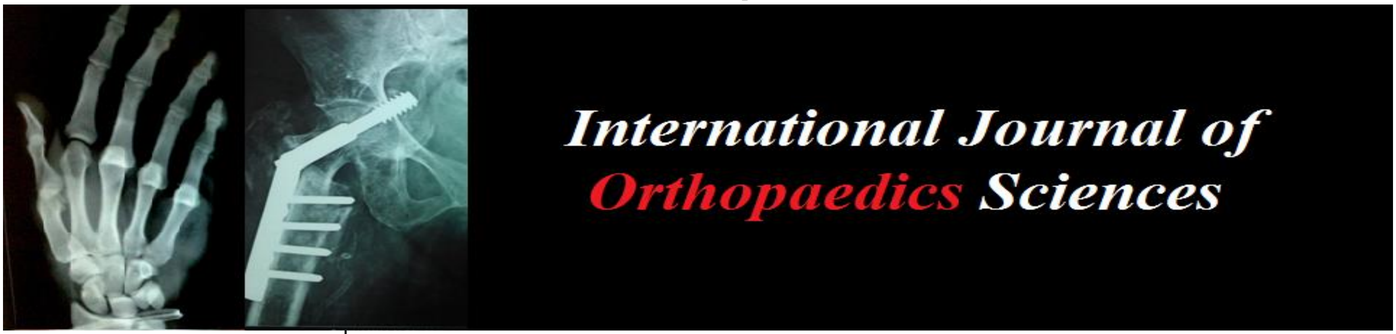

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Outcome analysis of interlocking nailing for tibial shaft fractures

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Abstract
The results of closed intramedullary nailing technique are excellent for treating fractures of the tibial shaft. We decided to analyse the outcome of primary interlocking nailing done for tibial fractures. All patients with tibial shaft fractures treated with primary interlocking nail were evaluated. Static or dynamic locking was done depending upon the fracture pattern and stability. 44 fractures were included in the study. Reaming was done in 41 (93%) patients rest of them being unreamed nailing for compound fractures. Nine (20%) of the nails were dynamically locked. 95.6% united uneventfully except two (4.4%). The average time to union was 26 weeks. Primary Interlocking nailing for tibial shaft fractures is an excellent method of definite surgical management of closed and compound fractures of tibia. Interlocking nailing has less chance of complications like infection and non union as expected in compound injuries with bone loss. It is more acceptable to patients than external fixators in these scenarios.

Keywords: Outcome analysis, interlocking nailing, tibial shaft fractures

Introduction

Fractures of the tibial shaft (breaks in the bone situated in the long middle section of the tibia or shin bone) are mostly caused by high-energy trauma, such as motor vehicle accidents [1]. One commonly used method of fixation is intramedullary nailing. Tibial shaft fractures which are defined as ones occuring 4 cm distal to the tibial tuberosity to 4 cm proximal to the ankle are treated with interlocking techniques [2]. The results of this technique have given excellent for treating fractures of the tibial shaft [3-6]. This involves the insertion of a metal rod, usually from the upper side of the tibia, into the inner cavity (medulla) of the tibia. The rod is generally held in place by screws [7]. An available and widely used surgical technique of intramedullary nailing is inserting intramedullary nails with either reaming to fit the maximum diameter nail for support the tibia better or without reaming in compound cases to prevent dissemination of infection. Reamed nailing was more associated with a lower implant failure, such as broken screws, than unreamed nailing [8]. Moreover, there was some weak evidence that reamed nailing may be associated with fewer major re-operations for non-union when used for closed fractures compared with open fractures [9].

All patients with tibial shaft fractures treated with primary interlocking nail between September 2017 to June 2018 were evaluated for inclusion in the present study. After obtaining ethical committee approval, the study was begun and informed consent was obtained from patients included in the study.

Inclusion criteria

1. All fractures of the tibial shaft
2. Closed injuries and compound injuries except Gustilo Anderson Type IIIc.
3. All those patients who had a follow up of minimum of one year.

Exclusion criteria

1. Fracture in the proximal end of the tibia
2. Fracture within four centimetre of the ankle
3. Significant medical or surgical disorders that influence fracture healing

4. Paediatric patients with open growth plates.

In case of compound fractures, the wound was closed primarily if there was no severe contamination or severe soft tissue injury. If it was not compatible with primary closure options like split thickness skin grafting after 1 or 2 weeks or flap cover if the bone or tendons exposed were done. We did thorough wound debridement followed by fixation of fracture by primary unreamed interlocking nailing with immediate soft tissue cover for compound cases.

Operative Technique

A separate trolley was used for the debridement in case of open fractures, after debridement the limb was repainted and redraped. The patient was positioned on an operating table with knee in flexed position. A 3 cm midline longitudinal incision over the patellar ligament was done. Using patellar tendon splitting approach, access was gained into the intramedullary canal. The canal was broached with a large bone awl, the point of entry being proximal to the insertion of the ligamentum patellae and below the joint line. We did closed reduction. Then guide wire was passed, and negotiated through the fracture site to reach the distal end. This was also done with the knee in flexion position. Intramedullary position was confirmed using C-arm images. Reaming was done. The decision regarding the size of the diameter of the nail was made intraoperatively on the basis of the size of the reamer that first made cortical contact at the isthmus of the medullary canal. We attempted the reaming procedure with the knee in flexion. Then the nail that has the correct length and diameter was inserted by pushing with or without gentle hammering. The decision to perform static or dynamic was now made depending upon the fracture pattern and stability. After this the proximal locking was done with the help of the jig. Double distal locking was done, depending on the requirement for fracture stability. Early perioperative complications including compartment syndrome, fat embolism, and pulmonary embolism were recorded if any. Patients were advised to remain on partial weight bearing for first six weeks and duration was adjusted with regard to their fracture configuration. After discharge we examined the patients clinically and radiographically at 6 wks, 12 weeks, 18 weeks, 6 months, 9 months and 1 year.

Clinical union was defined as the ability to bear full weight with no pain at the site of the fracture and radiographic union was defined as evidence of bridging of three of the four cortices on standard anteroposterior and lateral radiographs. We defined nonunion as motion at the site of the fracture on manipulation and no evidence of healing as seen on x-ray that were made six months after injury. The ranges of motion of the knee and ankle were recorded for each patient. It was designated as normal or reduced at the time of the most recent follow up examination. The prevalence of pain in the knee and the necessity for the removal of the implant were also recorded.

The assessment was made by the patient by recording them into four groups: excellent, good, fair and poor based on:

1. The final functional outcome
2. Duration required to return to occupation
3. Persistence of pain.

Table 1: Showing the outcome categorisation of tibial fracture post fixation at final follow up

	Excellent	Good	Fair	Poor
Malalignment				
1. Varus or valgus	5º	10º	15º	>15º
2. Procurvatum or recurvatum	5º	10º	15º	>15º
3. Internal rotation	5º	10º	15º	>15º
4. External rotation	10º	15º	20º	>20º
5. Shortening	1cm	2cm	3cm	>3cm
Range of knee motion				
1. Flexion	>120º	120º	90º	<90º
2. Extension deficit	5º	10º	15º	>15º
Range of ankle motion				
1. Dorsiflexion	>20º	20º	10º	<10º
2. Plantar flexion	>30º	30º	20º	<20º
Pain	None	Sporadic	Significant	Severe
Swelling	None	Minor	Significant	Severe

Results

Finally, 44 fractures were included in the study. The average age of 38 male (86%) and 6 female patients was 33 years (range 18 to 80 years). 23 (52%) of the patients had right sided fractures. The mechanism of injury was RTA in 32 (73%) patients, Domestic in 9 (20%) patients and Train traffic accidents in 3 (7%) patients. Among the fractures treated 8 (18%) involved the proximal third of the tibia, 20 (45%) at the middle third, 9 (20%) at the lower third, 7 (15%) segmental fractures.

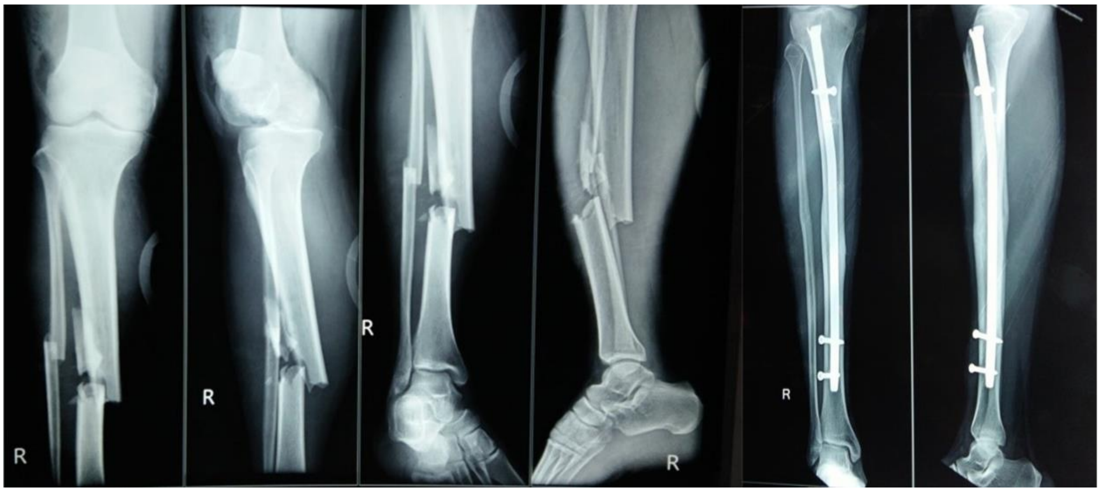

Fig 1: showing pre-operative and post operative images of a compound tibial fracture managed with interlocking intramedullary nailing.

The average duration of time between injury and nailing was 6 hours (range 2 hours to 8 days). 41 (93%) of fractures were fixed after reaming, 3 (7%) without reaming. 10 (23%) nine mm nails, 30 (68%) ten mm nails and 4 (9%) eleven mm nails were used. Nine (20%) of the nails were dynamically locked. Out of the 4 (9%) compound cases done, local flap cover was used in one (2%) patient and split thickness skin graft was used for 2 (4%) fractures. 1 (2%) was treated with delayed primary closure. All united (95%) uneventfully except two (5%). The average duration of hospitalization was 11.86 days (range 8 to 25 days). The average union time was 29.02 weeks among all the patients of our study.

Discussion

Reamed nailing allows larger diameter nail to be inserted and better stability provided to the fracture since the torsional stability is proportional to the fourth power of the radius of the nail used [15]. All the results of our study are similar and comparable with that of other studies.

The average union time in our study was 29.02 weeks. The union time was 36.7 weeks in the study by Court Brown *et al.* [13]. Union occurred between 34.2 weeks (Karlstrom and Olerud) [15] and 38.1 weeks (Chan *et al*.) [16]. All three had used external fixators for open fractures of tibia. So nailing gives better union rates than external fixators in case of compound injuries also.

In our study there was no non-union but malunion rate was 4.4%. Two of our cases went for initial delayed union and which were further treated with bone grafting at 6 months which eventually united 8 weeks later. We did not encounter any cases of pulmonary embolism, compartment syndrome or fat embolism post surgery. This shows that nailing can be a safer surgery giving better alignment of limb.

Table 2: shows the results of our study and comparison with other studies.

Study	Average Age (years)	Range (years)	Sex M:F % M	Total no. of patients	RTA	Middle third	Oblique pattern	Duration from injury to nailing	
								Average	Range
Our study	33	18-80	38:6	44	32	20	24	6 hrs	2hrs-8days
Keating *et al.* [10]	37	16-88	77:14	91	63	36	49	9.5 hrs	3.43-28.75hrs
Singer *et al.* [11]	36	--	30:11	41	32	--	--	5.6 hrs	--
whittle *et al.* [12]	34	17-69	34:13	47	41	27	--	7.5hrs - Debride ILN <8 hrs – 25, 8-13 hrs – 17, 4-21 days – 8	
Court Brown *et al.* [13]	39.1	17-89	31:8	39	23	16	--	--	--
Bone and Johnson *et al.* [14]	31	14-77	90:20	110	99	60	--	--	--

As per the functional and radiological assessment we had 39 excellent results i.e., 89% of patients which were considered satisfactory. In our study infection rate was 2.2% which is also comparable with other studies and which was better when dealing with compound fractures in comparison to other methods of management like external fixators [17, 18].

Conclusion

Primary Interlocking Intramedullary nailing for fractures of the tibial shaft is an excellent method of surgical management. Intramedullary locking nailing reduces the incidence of complications like infection (2.2% in our series), malunion (4.4%) which are acceptable. In case of compound fractures, it is more acceptable to patients than external fixators and wound management. Primary nailing provides early stabilization of fracture and thereby helps early soft tissue healing and early rehabilitation.

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