

TIBIAL SHAFT FRACTURES MANAGED BY INTRAMEDULLARY INTERLOCKING NAIL: A PROSPECTIVE STUDY

Maruthi C. V¹, Shivanna²

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ABSTRACT: Tibial shaft fractures of tibia are most common due to increase in road traffic accidents and fall from height. Presently the intramedullary Interlocking is the surgical treatment of choice for the closed and type 1, 2 and 3A fractures. Here I conducted a study for the management of tibial shaft fractures using intramedullary interlocking. **MATERIALS AND METHODS:** Sixty cases of closed, type1, 2 and 3A open fractures of tibia were managed with intramedullary interlocking nail between March 2010 and April 2014. And post operatively followed at 6, 12, 24 weeks and results were evaluated using Johner and Wruh's criteria. **RESULTS:** We achieved 76.67% excellent, 15% good and 8.33% fair results. **CONCLUSION:** Intramedullary interlocking nail is an excellent method for closed, type1, 2 and 3A open fractures of tibia. This has excellent functional outcome.

KEYWORDS: Closed, Type1, Type 2 and Type 3A open fractures, Intramedullary Interlocking nail.

INTRODUCTION: Tibial shaft fractures of tibia are most common due to increase in road traffic accidents and fall from height. Presently the intramedullary Interlocking is the surgical treatment of choice for the closed and type 1, 2 and 3A fractures. Here I conducted a study for the management of tibial shaft fractures using intramedullary interlocking.

MATERIALS AND METHODS: Sixty cases of closed, type1, 2 and 3A open fractures of tibia were managed with intramedullary interlocking nail between March 2010 and April 2014. And post operatively followed at 6, 12, 24 weeks and results were evaluated using Johner and Wruh's criteria. This included both males and females within the age group of 20 – 80 years. Fractures were classified using OTA (Table 1) and Tscherne (Table 2) classification. All cases were operated by intramedullary interlocking.

Type A: Unifocal Fractures		
Group A1	Spiral Fractures	
Subgroups	A1.1	Intact Fibula
	A1.2	Tibia and Fibula fractures at different level
	A1.3	Tibia and Fibula fractures at same level
Group A2	Oblique fractures (Fracture line >30degrees)	
Subgroups	A2.1	Intact Fibula
	A2.2	Tibia and Fibula fractures at different level
	A2.3	Tibia and Fibula fractures at same level
Group A3	Transverse Fractures (Fracture line <30degrees)	
Subgroups	A3.1	Intact fibula
	A3.2	Tibia and Fibula fractures at different level
	A3.3	Tibia and Fibula fractures at same level

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Type B: Wedge Fractures		
Group B1	Intact Spiral wedge Fractures	
Subgroups	B1.1	Intact Fibula
	B1.2	Tibia and Fibula Fractures at Different level
	B1.3	Tibia and Fibula Fractures at same level
Group B2	Intact Bending Wedge Fractures	
Subgroups	B2.1	Intact Fibula
	B2.2	Tibia and Fibula Fractures at different level
	B2.3	Tibia and fibula fractures at same level
Group B3	Communited Wedge Fractures	
Subgroups	B3.1	Intact Fibula
	B3.2	Tibia and Fibula Fractures at different level
	B3.3	Tibia and Fibula Fractures at same level
Type C: Complex fractures (Multifragmentary, segmental or comminuted fractures)		
Group C1	Spiral Wedge fractures	
Subgroups	C 1.1	Two Intermediate fragments
	C 1.2	Three Intermediate fragments
	C 1.3	More than Three intermediate fragments
Group C2	Segmental Fractures	
Subgroups	C2.1	One segmental fragment
	C2.2	Segmental fragment and additional wedge fragment
	C2.3	Two segmental fragments
Group C3	Comminuted Fractures	
Subgroups	C3.1	Two or Three intermediate fragments
	C3.2	Limited Communion (<4cm)
	C3.3	Extensive Communion
Table 1: Orthopaedic Trauma Association (OTA).^[1] AO Classification of Tibial Shaft Fractures.		

C0	Fracture has little or no soft tissue injury
C1	The fracture has mild-to-moderate severe fracture configuration with superficial abrasions
C2	The fracture has a moderately severe fracture configuration and deep contamination with local skin or muscle contusion
C3	The fracture has severe fracture configuration and extensive contusion or crushing of skin or destruction of muscle
Table 2: Tscherne.^[2] classification of closed fractures	

Surgical Technique: In supine position, by hanging the leg along the side of fracture table, under anaesthesia with appropriate aseptic precautions and tourniquet control, anterior midline patellar tendon splitting approach was used. An awl was introduced proximal to the medial half of the tibial

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tuberosity or LAP (Lateral Anterior and Proximal) entry for the proximal one third fractures, perpendicular to the long axis of tibia 1cm to 1.5cm depth.

Awl was made vertical along the axis of the tibia and introduced into the medullary canal with swivel movements. A beaded guide wire was introduced after closed reduction. The position confirmed by reduced mobility at the fracture site, bony end feel of guide wire and by passing rigid cannulated reamers over the guide wire under image intensifier guidance. Reaming done using cannulated reamers up till zero point five to one mm more than the determined nail size.

Guide wire was exchanged and the determined nail is introduced with proximal jig assembly. Length was assessed by intraoperative guide wire length difference. Locking started from distal under image intensifier guidance by bulls' eye technique to proximal using jig.^[3] Wounds were closed in layers after a saline wash.

Post-operative Protocol: Patient was given intravenous antibiotics for five days and oral antibiotics for another five days. Check x ray was taken immediately after the surgery. Sutures were removed on 14th day. Physiotherapy started with active quadriceps strengthening, range of motion and non-weight bearing ambulation with the support of axillary crutches. And patients were followed up at 6, 12 and 24 weeks and assessed for subjective, clinical, radiological sign of union and ability to do strenuous activity. Fracture Union was considered when patient was full weight bearing without pain; fracture site was not tender on palpation and radiograph showed osseous union. Finally, functional assessment was done at 6 months using the Johner and Wruh's criteria.^[4] (Table 3).

Criteria	Excellent	Good	Fair	Poor
Non-union, Osteomyelitis, Amputation	None	None	None	Yes
Neurovascular disturbances	None	Minimal	Moderate	Severe
Deformity				
Varus/valgus ⁰	None	2-5	6-10	>10
Anteversio/recurvatum ⁰	0-5	6-10	11-20	>20
Rotation ⁰	0-5	6-10	11-20	>20
Shortening	0-5mm	6-10mm	11-20mm	>20mm
Mobility				
Knee%	Normal	>80%	>75%	<55%
Ankle%	Normal	>75%	>50%	<50%
Subtalar%	>75%	>50%	<50%	-
Pain	None	Occasional	Moderate	Severe
Gait	Normal	Normal	Insignificant	Significant
Strenuous activity	Possible	Limited	Severely limited	Impossible

Table 3: Johner and Wruh's Criteria.⁴

OBSERVATIONS AND RESULTS: In our study 20(33.33%) patients were between 20 and 30 years, 9(15%) between 31 and 40 years and 12(20%) between 41 and 50 years, 51 to 60 5(8.33%) and 2(3.33) in 60 to 70 and 2(3.33) in 70 to 80. Most of them were males 46(76.66%), females 14 (23.33%). Majority of the injuries were due to road traffic accident, i.e., in 48 (80%) followed by fall

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from height in 12 (20%). The right leg was affected in 37 cases (61.66%) and the left leg in remaining 23 (28.33%).

Fracture at mid 1/3rd constituted the majority at 52(86.66%), lower third 7(11.66%) and upper third constituted 1.66%. Radiologically oblique type was common with 30(50%), spiral and transverse constituted 12(40%) each and wedge fragment in 6(10%). Using the AO classification type A constituted 52(86.66%), B 6(10%) and C 2(3.33%). Tscherne type C1 38(53.33%), C0 32(36.66%) and C2 1(10%).

Based on the clinical and radiological parameters, patients were started on partial weight bearing and full weight bearing. We started partial weight bearing for 50 patients at 4 weeks, 7 patients at 6 weeks and for remaining 3 at 8 week. Dynamisation was done in fifteen transverse (25%) and five oblique (8.33%) fracture at eight weeks as there was no signs of healing. Full weight bearing was started by 10 weeks in 50 patients, 12 weeks in 7, and 14 in two and 16 in the remaining 1. Complete radiological healing of fracture was noted by 20 weeks in 50 patients, 16 weeks in 7 and 22 weeks in remaining 3. In our series, majority of fractures united within 20 weeks (50 patients).

The average time of union was 17 weeks. Complications like non-union, osteomyelitis and patients undergoing for amputation was not seen in any of our patients, but we found delayed union in 2 patients. Neurovascular disturbances were not seen in any of our patients.

COMPLICATIONS: Four patients had superficial wound infection which subsided by regular dressings and antibiotics according to the culture report. One patient went to fat embolism intraoperatively, managed in ICU by appropriate measures, patient recovered by 7 days and shifted to the ward.

Results were evaluated using Johner and Wruh's criteria. We achieved 76.67% excellent, 15% good and 8.33% fair results (Table-4).

Criteria	Excellent	Good	Fair
Non-union, osteomyelitis, amputation	60	0	0
Neurovascular disturbances	60	0	0
Deformity			
Varus/valgus ⁰	48	3 ⁰ Varus 5	7 ⁰ 3
		5 ⁰ Varus 3	9 ⁰ 1
Anteversio/recurvatum ⁰	2 ⁰ Anteversion 15	7 ⁰ Recurvatum 3	13 ⁰ 3
	0 ⁰ Anteversion 32	6 ⁰ Recurvatum 5 8 ⁰ Anteversion 1	15 ⁰ 1
Rotation ⁰ (External)	2 ⁰ 11 0 ⁰ 37	6 ⁰ 5	12 ⁰ 5
Shortening in mm	5mm 8	10mm 7	15mm 4
	0mm 40	8mm 1	
Mobility			
Knee%	50	95%	78% 1
		9	75% 1
Ankle%	49	95%	65% 4
		7	60% 1
		90%	1

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Subtalar%	90% 85%	32 20	70% 68%	5 1	45% 2
Pain (visual analogue scale)	49		7		4
Gait	55		1		4
Strenuous activity	50		8		2

Table 4: Distribution of Cases based on Johner and Wruh's criteria

DISCUSSION: Fracture shaft of tibia is the most common fractures seen in casualty department by orthopaedic surgeon. Over the years, various modalities of treatment have been invented. The principle of biological osteosynthesis is rightly applied in long bone fracture healing and hence the selection of intra-medullary interlocking nailing in this study for the management of closed, type1, 2 and 3A open fractures.

Arne Ekeland et al.^[5] (1988), in their study series of 45 patients noted the mean age of patients to be 35 years. In my study 12 were between 30 to 40 years. Tibial shaft diaphyseal fractures were seen in the younger age group probably because they are the people who are physically active, were engaged in increased various outdoor activities and as a result most of the injuries sustained were high-velocity injuries.

Court Brown et al.^[6] (1990) showed the incidence among males was 81.3%. In our study, incidence in male was 76.66% in concordance to the other studies, pointing to the face that incidence in male is higher probably because of their more outdoor activities, while women majorly confined themselves to the domestic activities.

Lawtence B. Bone et al.^[7] (1986), reported in an earlier series a 90% incidence of road traffic accidents tibial shaft fractures. In our study, we have found that 80% had history of road traffic accident. Patients with mid third tibial shaft fractures accounted for an incidence of 86.66%. This is comparable to Lawrence B Bone et al.^[7] (1986) series, where 53.5% were middle - third fractures.

Similarly Court Brown et al.^[8] (1995), showed 44% were middle - third fractures. The middle third fractures are common because of anatomical features of more rigidity of the bone and its subcutaneous nature makes it more vulnerable to the injuring force.

Our series had a higher incidence of oblique fractures 50%, transverse fractures made up 40%, which was comparable to a study by Court Brown et al.^[8] reported 37.2% and Arne Ekeland.^[5] (1988) reported 42% of transverse and oblique fractures.

Preoperative, Operative and Complications: All patients in our series were operated under spinal anaesthesia. In our series, we have used intramedullary nails ranging from 9 to 10mm in diameter and from 280 to 380mm in length. All four bolts were put in our 60 cases.

In majority of our patients, active Hip, Knee, ankle movements and quadriceps exercises were started on the first postoperative day. These post-operative exercises were delayed in 5 patients who had head injury. Majority of patients were mobilized with the axillary crutches from the third postoperative day, non-weight bearing on the operated leg. Suture removal was done in all patients on 14th day. Complete relief of pain was seen in majority of patients in two weeks.

Depending upon the type of fracture and stable fixation of fracture, partial weight bearing was started. In our series, partial weight bearing was started in 50 patients by the end of 4th week.

Superficial infections occurred in 4(6.66%) patients at the site of proximal surgical incision and healed by dressing and antibiotics. Studies by Lawrence B. Bone et al.^[7] (1986), noted an infection rate of 6.25%.

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In 1996, Christie.^[9] noted embolic phenomenon during nailing. In our series one case had intraoperatively fat embolism. In 1998 Utvag et al.^[10] quoted that there is no evidence to show that the degree of reaming significantly affect healing pattern. We had no neurological or vascular injury in our study.

Full Weight Bearing: Full weight bearing in our series was started at 10th week in 50 patients (83.33%) and at 12th week in 7 patients (11.66%). The appearance of bridging callus on radiographs and clinical assessment was done before the patient has borne full weight. The average time of full weight bearing was 10.81 weeks. Full weight bearing has been delayed in 1 patient as there was communitated fracture. Grosse and Kempf.^[11] (1991), allowed full weight bearing at 8.5 weeks. This is comparable to Lawrence B. Bone et al.^[7] (1986), where in his study weight bearing has been delayed in unstable fractures.

Fracture Union: In our series, majority of fractures united within 20weeks (50 patients). The average time of union was 17.36 weeks. This is comparable to Anglen J.O. et al.^[12] (1995), Lawrence B. Bone et al.^[7] and Court Brown et al.^[6] (1990) where they reported average union time of 22.5 weeks, 19 weeks and 16.7 weeks, respectively.

Second Surgery: Dynamization was successful in 15 cases of transverse fracture and 5 cases of oblique fracture. Wu and Shih.^[13] demonstrated only a 54% success rate in tibial and femoral fractures after dynamisation as compared to 33.33% in our study.

Functional Outcome: Functional outcome was done at 6 months using the Johner and Wruh's criteria which was graded into excellent, good, fair and poor. In our study, 76.67% (45 patients) had excellent, 15% (9 patients) good, 8.33% (6 patients) fair outcome. Arne Ekeland et al.^[5] (1988), reported 64.4% excellent, 28.8% good and 4.4% as fair.

CONCLUSION: Intramedullary interlocking nail is an excellent method for closed, type1, 2 and 3A open fractures of tibia. This has excellent functional outcome.

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AUTHORS:

1. Maruthi C. V.
2. Shivanna

PARTICULARS OF CONTRIBUTORS:

1. Assistant Professor, Department of Orthopaedics, Chamarajanagar Institute of Medical Sciences, Chamarajanagar.
2. Senior Resident, Department of Orthopaedics, Chamarajanagar Institute of Medical Sciences, Chamarajanagar.

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NAME ADDRESS EMAIL ID OF THE CORRESPONDING AUTHOR:

Dr. Maruthi C. V,
Chamarajanagar Institute of Medical Sciences,
Chamarajanagar-571313.
E-mail: orthocvmaruthi@gmail.com

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