STUDY OF OUTCOME OF SURGICAL MANAGEMENT OF DIAPHYSEAL FRACTURES OF TIBIA TREATED WITH INTRAMEDULLARY INTERLOCK NAILING

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ABSTRACT

Tibial diaphyseal fractures are commonly seen in physically active young people and are commonly seen as a result of road traffic accidents (RTA). The intramedullary interlock nailing combines control of length, alignment and rotation, preserves periosteal blood supply, some amount of endosteal blood supply and with biological osteosynthesis, lowers the infection and malunion. Closed intramedullary interlock nailing under C arm guidance is a well estabilished standard procedure for treatment of diaphyseal fractures of tibia. Patients operated with this technique can be ambulated early without external immobilization in majority of cases, patients are allowed to resume work as early as tolerated and this procedure also reduces the hospital stay and boosts up the morale of the patient. Patients of both sexes of adult age who had a tibia fracture were admitted to the orthopaedic department were included in the study. Type of fracture and the level of fracture were assessed and the follow up was done using Alho and Ekland criteria. Average age of the patient in our study is 32.9 years. Road traffic accidents were the main mode of injury in 87% of cases. Females required smaller sizes of nail 8 mm and 9 mm and males required larger than females i.e 10 mm and 11 mm. Six patients required dynamisation (13.33) and one patient required dynamisation & fibulectomy (2.22%). In our study superficial infection is seen in 4.44% of patients and anterior knee pain in 11.11%

of patients and fat embolism is seen in 2.22% of patients and delayed union is seen in 6.67% of patients. In the present study 35 patients (77.78%) had excellent, 7 patients (15.56%) had good, 3 patients (6.67%) had fair functional outcome.

Keywords: Diaphyseal fractures, tibia, Management of the fractures, nailing

INTRODUCTION

Tibia is the large bone of body and one of the principal load bearing bones in lower extremity, fractures of tibia can cause prolonged morbidity, extensive disability unless treatment is appropriate. The overall incidence of diaphyseal fractures of tibia is 26 in 1,00,000 population. [1] With the increasing number of vehicles on roads in India, complex trauma cases caused by road traffic accidents have increased progressively.

Being sub-cutaneous in location, the tibia is the commonest bone to be fractured and seen commonly in orthopaedic practice. Open fractures are more common, because one third of its surface is subcutaneous throughout most of its length. Furthermore, the blood supply to the tibia is more precarious than that of bones enclosed by heavy muscles. The presence of hinge joints at the knee and ankle allows no adjustment for rotatory deformity after a fracture. Delayed union, non-union and infection are relatively frequent complications especially after open fractures of the shaft of tibia. Due to its frequency, topography and mode of injury it has become a major source of temporary disability and morbidity. Hence special care and expertise is necessary when treating such fractures. It requires the widest experience, the greatest wisdom and the nicest of the clinical judgement in order to choose the most appropriate treatment for a particular pattern of injury.

Management of the fractures of the shaft of the tibia remained a controversial subject despite advances in both non-operative and operative care. Sir John Charnley stated that, "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" in 1961.[2] Several published series regarding treatment of fractures of the shaft of tibia have shown that closed treatment of fractures can have excellent results. But the drawbacks of prolonged healing time, malalignment and non-compliance of the patient has led to the thought of other modalities of treatment, finally resulting in the use of closed interlocking intramedullary nailing which has given excellent results.[3]

The method of closed nailing with or without reaming followed by early ambulation and weight bearing has

positive advantages over all existing methods, significant lower complication rates and has comparable results. The intramedullary interlock nailing under image intensifier fulfils the objective of stable fixation with minimal tissue damage resulting in better and quicker fracture unions. The important aspects for its use are its ability to prevent axial collapse, rotational and angulation deformities and most important of all being ealiest possible ambulation.[4] The present study has been taken to review the results of diaphyseal fractures of tibia treated with intramedullary interlock nailing.

MATERIALS AND METHODS

Patients of both sexes of adult age who had a tibia fracture were admitted to the orthopaedic department, SMBT Institute of Medical Sciences and Research Centre were included in the study. This study was conducted from Oct 2018 to Sep 2020.

Inclusion criteria:

1. Age >20 years of age
2. All closed diaphyseal fractures of tibia.
3. Open type 1 and Type 2 (according to Gustilo Anderson Classification) diaphyseal fractures of tibia presenting within 24 hours of injury

Exclusion criteria:

1. Age < 20 years
2. Patients with open physis
3. Open fractures of tibia type 3A, type 3B and type 3C (according to Gustilo and Anderson Classification)
4. Immunocomprised patients

Type of fracture and the level of fracture were assessed and the follow up was done using Alho and Ekland criteria. Patients were followed up periodically on an outpatient basis at 4^{th}, 8^{th}, 12^{th}, 16^{th}, 20^{th} weeks and 6 months and in between if required. The complaints were noted and the clinical and radiological assessment of the patients were done for pain, swelling, tibial malalignment and shortening, range of motion of knee, ankle and foot.

RESULTS

This study includes 45 patients with diaphyseal fractures of tibia treated with closed intramedullary interlock nailing.

Table 1: Age distribution according to sex

AGE	MALE	FEMALE
20-29	14	4
30-39	7	4
40-49	5	3
50-59	2	1
60-69	4	1
TOTAL	32	13

The minimum age of the patient is 20 years. Average age of the patient is 32.9 years. The tibial shaft fractures are common in the age group of 20-29 years. 71.11% of males and 28.89% of females.

Table 2: Mode of injury

Mode of injury	Number of patients	Percentage
RTA	39	86.67
Fall	6	13.33
Total	45	100.00

Road traffic accident is the most common mode of injury. Total 39 patients (86.67%) has diaphyseal fractures of tibia with road traffic accident as mode of injury. 33 fractures are simple (73.33%). 8 fractures are compound type 1 (17.78%) and 4 fractures are compound type 2 (acccording to Gustilo and Anderson classification).

Table 3: Anatomical location of fracture

Anatomical location of fracture	Number of patients	Percentage
Upper third	8	17.78
Middle third	25	55.56
Lower third	12	26.67
Total	45	100.00

The commonest anatomical location of fracture is at the middle-third of the tibia. This constituted 55.56% of diaphyseal fractures of tibia. The diaphysis is a more rigid bone, so fractures are common in middle third of tibia. Communited fractures are seen in 40% of patients, followed by transverse fractures in 22.22% of patients, wedge fractures in 20% of patients, oblique fractures and spiral fractures are seen in 8.89% of patients. Communited fractures are common because of high energy trauma.

Table 4: Weight bearing:

Weeks	P W B	F W B
4-8	36	0
8-12	9	12
12-16	0	9
16-20	0	18
20-24	0	3
>24	0	3

Partial weight bearing is started at 4-8 weeks in 36 patients (80%), at 8-12 weeks in 9 patients (20%). Full weight bearing is started at 8-12 weeks in 12 patients (26.67%), at 12-16 weeks in 9 patients (20%), at 16-20 weeks in 18 patients (40%), at 20-24 weeks in 3 patients

(6.67%), and >24 weeks in 3 patients (6.67%). In 6 patients dynamisation is done at 8-12 weeks and they are mobilized with full weight bearing.

Table 5: Radiological fracture union

Fracture union	Number of patients	Percentage
8-12	3	6.67
12-16	8	17.77
16-20	27	60
20-24	5	11.11
24-32	2	4.44
Total	45	100.00

Majority of fractures united within 20 weeks. This is comparable with other series. The average healing time was 20.13 weeks.

Table 6: Complications

Complications	Number of patients	Percentage
Superficial infection	2	4.44
Delayed union	3	6.67
Anterior knee pain	5	11.11
Fat embolism	1	2.22
Shortening	3	6.67

The infection rate is around 4.44%. Anterior knee pain is seen in 5 patients. In one patient, nail is abutting the patellar tendon and tibial tuberosity and this can be relieved after removal of the nail. One patient has fat embolism postoperatively and it is treated.

Table 7: Deformity assessment

Deformity(in degrees)		Number of patients	Percentage
Valgus	None	39	86.67
	2-5	5	11.11
Varus	None	39	86.67
	2-5	1	2.22
Flexion deformity	None	44	97.78
	0-5	1	2.22
Recurvation	None	45	100

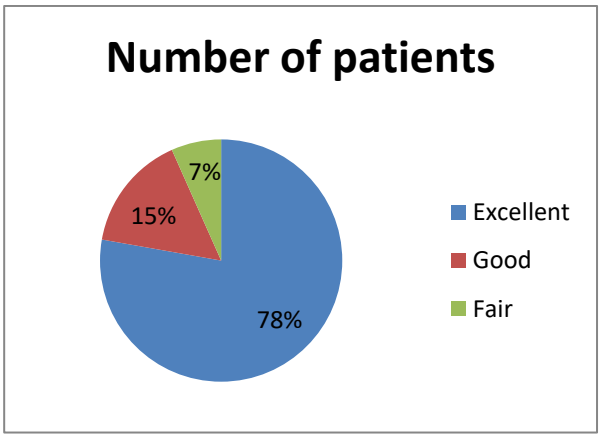
Valgus deformity of <5 degrees is seen in 5 patients. Varus deformity is seen in one patient of <5 degrees and no patients had valgus and varus deformities >5 degrees. Flexion deformity is seen in one patient of 5 degrees. No other patients had deformities >5 degrees of flexion deformity and none of the patients had recurvation deformities.

Table 8: Range of motion

Movements	Flexion	Extension	Number of patients	Percentage
KNEE	> 120º	05º	36	80.00%
	120º	10º	6	13.33%
	90º	15º	3	6.67%
	<90º	>15	0	0
Ankle	**Dorsi flexion**	**Plantar Flexion**		
	> 20º	>30º	38	84.44%
	20º	30º	2	4.44%
	10º	20º	5	11.11%
	< 10º	< 20º	0	0
Foot Motion (as compared to normal)	5 / 5		39	86.67%
	2 / 3		2	4.44%
	1 /3		4	8.89%
	< 1/3		0	0

Knee movements are reduced in 9 patients probably due to proximal end of the nail is abutting the tendon and anterior knee pain and menisci damage and transverse ligament damage. Ankle and foot movements reduced in 7 patients each probably due to angulation in the fracture site, altered alignment and due to prolonged non weight bearing.

Figure 1: Functional outcome



77.78% patients had excellent functional results and 15.56% had good functional outcome, while only 6.67% had fair functional outcome.

DISCUSSION

In the present study, the majority of the patients are in the age group of 20-29 years. There were 18 patients in this age group and the average age of the patient in our study was 32.9 years. Diaphyseal fractures of tibia are seen in the younger age groups as they are the persons who are physically active, were engaged in increased various outdoor activities and as a result most of the injuries sustained were high-velocity injuries. Arne Ekeland et al in a study series of 45 patients noted the average age of patients to be around 35 years. [5] Kiran Kumar et al in their study of 42 cases noted average age of patient to be around 34.6 years. [6]

In the present study, males predominated the females. There are 32 male patients (71.11%) and 13 female patients (28.89%). Court Brown et al in their study noted the male incidence to be around 81.3% while the female incidence to be around 18.7%. [7] Hooper et al noted male incidence at 82% and female incidence at 18%.[8] Mohamed A abdelalet found male incidence as 80% and females 20%.[9] R Gupta et al in their study of 25 cases 52% fractures of right side and 48% of left side. [10] In the present study 56% fractures on right side and 44% on left side.

In the present study, majority of the tibial diaphyseal fractures occurred due to road traffic accidents. In the majority of cases, they involved the patients who were the motorists, while the remaining patients tended to be pedestrians or motor vehicle occupants. The incidence of fracture shaft of tibia due to road traffic accidents (86.67%) seemed to be higher in the present study compared to Court Brown et al in whose study, the incidence was around 37.5%.[11] But in this study, also the commonest mode of injury was road traffic accidents followed by fall. Lawrence B Bone et al reported in an earlier study 90% incidence of road traffic accidents in tibial shaft fractures.[12]

In the present study, the anatomical location of the fracture is in the middle-third of the shaft of tibia in 25 (55.56%) patients, followed by the lower third in 7 (16.67%) of the cases. This is comparable to Lawrence B Bone et al series, where 53.5% were middle- third fractures.[12] Hooper et al, where 48% were middle-third fractures.[8]

R Gupta et al in their study of 25 cases 18 (72%) simple, 8 (20%) open type I and 2 (8%) open type II fractures.[10] The

present study reported 33 (73.33%) simple fractures, 8 (17.78%) open type I and 4 (8.89%) open type II fractures.

In the present study 40% cases are communited fractures, transverse fractures made up 22.22% cases, wedge fractures 20% cases, oblique fractures 8.89% and spiral fractures 8.89% of cases. This is comparable to Court Brown et al reported 37.2% of transverse and oblique fractures.[13] Sankarsan patro et al in whose series, there were 59% of these fractures.[14] and Arne Ekeland et al reported 42% of transverse and oblique fractures.[5] R Gupta et al in their study of 25 cases noted oblique fractures 36%, transverse fractures 32% and communited fractures 20%.

Depending upon the type of fracture and stable fixation of fracture, partial weight bearing was started between 4-8 weeks when there is evidence of early callus. In the present study, partial weight bearing is started in the majority of patients by the 4-8 weeks. R Gupta et al in their study partial weight bearing are within 2 weeks in 84% cases. [10]

In the present study, the average time of full weight bearing is 18 weeks. Full weight bearing has been delayed in few patients in communited fractures. R Gupta in their study had full weight bearing at 6 weeks in 32% cases.[10] Fracture union is considered when patient is full weight bearing without pain, fracture site is not tender on palpation and radiograph showed osseous union. In the present study, majority of fractures united within 20 weeks (27patients). The average time of union 20.13 weeks. Court Brown et al reported average union time at 16.7 weeks.[13] Arne Ekeland et al reported average union time at 16 weeks.[5]

Lawrence B. Bone et al noted an infection rate of 6.25%.[12] Arne Ekeland et al noted infection rate of 4.4%.[5] R Gupta et al noted infection rate of 8%.[10] In the present study, superficial infection rate is 4.44% and anterior knee pain is seen in three patients 11.11%. In these patients the nail was abutting the patellar tendon and tibial tuberosity and menisci damage causing anterior knee pain and this can be relieved after removal of the nail. R Gupta et al in their study found anterior knee pain in 8% cases. [10] Kiran Kumar et al in their study noted anterior knee pain in 7.14% cases.[6]

In the present study, valgus deformity of 2-5 degrees is seen in 5 patients and varus deformity of 2-5 degrees is seen 1 patient. In Arne ekeland et al study valgus deformity of 6-10 degrees is seen in 6 patients and varus deformity is seen in 4 patients.[5] In Blachut PA et al study valgus deformity of 6-10 degrees is seen in 3 patients and varus deformity of 6-10 degrees is seen in 2 patients.[15]

In the present study flexion deformity is seen in one patient of 5 degrees. No other patients had deformities >5 degrees of flexion deformity and none of the patients had recurvation deformities. In Blachut PA et al study flexion deformity of 6-10 degrees is seen in 1 patient and recurvation of 6-10 degrees is seen in 3 patients.[15]In Hooper et al study flexion deformity and recurvation is not seen in any patients.[8]

Knee movements are reduced in 9 patients probably due to proximal end of the nail is abutting the tendon and anterior knee pain and menisci damage and transverse ligament damage. Ankle and foot movements is reduced in 7 patients each probably due to angulation in the fracture site, altered alignment and due to prolonged non weight bearing. Arne Ekeland et al reported 64.4% excellent, 28.8% good and 4.4% as fair. R Gupta et al reported 72% excellent, 16% good, 8% fair and 4% poor functional outcome.[10] Kiran Kumar et al reported 57.14% excellent, 38.04% good and 4.77% fair functional outcome.[6] The present study noted 77.78% excellent, 15.56% good and 6.67% fair functional outcome.

CONCLUSION

Road traffic accidents were the main mode of injury in 87% of cases. Females required smaller sizes of nail 8 mm and 9 mm and males required larger than females 10 mm and 11 mm. In the present study 35 patients (77.78%) had excellent, 7 patients (15.56%) had good, 3 patients (6.67%) had fair functional outcome.

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