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Clinical profile of patients with open fractures of the tibia

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Abstract

The pattern of fibular fracture associated with a tibial fracture indicates the degree of blunt trauma to the soft tissues and the energy imparted to the fracture. Severe comminution of the fibula or diastasis between the fibula and tibia, representing a disruption of the interosseous membrane, indicates an unstable fracture with relative revascularization of the fracture fragment and the surrounding soft tissue envelope, along with a tendency for a higher rate of delayed union, nonunion and malunion. All patients treated at Hospital for open fractures of the tibial shaft with Primary Interlocking Nail were evaluated for inclusion in the present study. Approval from the Hospital Ethics Committee was obtained before the study was begun, and the patients gave informed consent. 5 patients were struck by motor vehicle as a pedestrian, 12 were involved in a motor vehicle accident as either the driver or passenger, 10 were in a motorcycle accident, 5 were in jeep. 9 had sustained the fracture as the result of domestic injury by fall etc, 3 had industrial accident. Among the fractures treated 4 involved the proximal third of the tibia, 4 at the junction of the proximal and middle third, 20 at the middle third, 6 at the junction of the middle third and distal third, 3 at the lower third, six segmental fractures in middle and lower third and one segmental fracture in upper and lower third.

Keywords: tibial fracture, torsional injuries, devascularisation

Introduction

For the tibial shaft to fracture, a significant amount of energy must be applied in one of three modes. Torsional injuries are more common with low energy trauma where the foot becomes fixed and the body rotates about this fixed point. Three and four point bending forces produce short oblique and transverse fractures. As the points of bending are spread farther apart and as the amount of energy applied increases, comminution increases and even segmental fractures develop. Direct force applications result in crushing injuries with high concentrations of energy to a smaller area with resulting increased damage to the bone and soft tissues. The exposed, subcutaneous location of the tibia offers little protection from a direct blow and in a mechanized society, high energy trauma as a result of motor vehicle, motorcycle, or motor vehicle pedestrian accidents involves the tibia in over 15% of accidents^[1].

The pattern of fibular fracture associated with a tibial fracture indicates the degree of blunt trauma to the soft tissues and the energy imparted to the fracture. Severe comminution of the fibula or diastasis between the fibula and tibia, representing a disruption of the interosseous membrane, indicates an unstable fracture with relative devascularisation of the fracture fragment and the surrounding soft tissue envelope, along with a tendency for a higher rate of delayed union, nonunion and malunion^[2].

Osteomyelitis of the tibia and infected nonunion are the most severe complications after tibial fracture and not infrequently necessitate amputation. Causes include high velocity injuries, open injuries with skin necrosis or loss and after open reduction and internal fixation with failed flaps or skin coverage. Perioperative antibiotics has proved to lower infections. Most important is preventive surgical technique with adequate debridement and irrigation and preservation of the periosteum whenever possible^[3].

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General management principles include drainage of the infected area, debridement of all devascularized bone and soft tissues, stable fixation, appropriately timed soft tissue coverage and judicious use of appropriate antibiotics. The traditional approach is to first achieve union and then eradicate the infection. External fixation is preferred for stabilization. For infections after internal fixation in which the fixation is stable, the implant may be left in place until union and then removed along with any necrotic or devascularised tissue. This principle has been proven to be effective by Court Brown for acutely infected intramedullary nails. In limb salvage situations, reamed intramedullary nailing combined with radical debridement may be performed in cases of infected nonunion (Sledge) [4]. Bone transport techniques may be especially helpful after resection of the osteomyelitic focus, resulting in less length discrepancy when compared with conventional treatment.

Autogenous cancellous bone grafting is most frequently used to create a synostosis between the tibia and fibula especially when there is anterior tibial bone loss with the posterolateral approach as described by Harmon.

The Ilizarov technique has been advocated to induce regeneration of bone to fill defects. Cierny and Zorn studied 44 patients with segmental debridement defects of the tibia. The Ilizarov group averaged 9 fewer hours in the operating theatre, 5 fewer months of disability.

A variant of this technique involves simultaneous compression at the defect site and bone regeneration and resultant lengthening from a corticotomy in the opposite hmetapyseal area. Saleh and Rees found that bone transport required an average of 16 months compared with 9.8 months for simultaneous compression and distraction with a bifocal technique with bone transport [5].

The criteria for determining malunion of the tibial shaft that requires operative intervention are not clearly defined.

Malalignment more than 15 to 20 degrees may require corrective osteotomy if clinically symptomatic with ankle or knee pain. Internal rotation of more than 10 degrees may cause gait disturbances, whereas external rotation of as much as 20 degrees usually does not cause a significant gait disorder.

A high malunion rate is seen with proximal third fractures treated with interlocking intramedullary nails. Lang and coworkers experienced an 84% malunion rate with angulation of 5 degrees or greater in the frontal or sagittal plane [6].

Methodology

All patients treated at Hospital for open fractures of the tibial shaft with Primary Interlocking Nail were evaluated for inclusion in the present study. Approval from the Hospital Ethics Committee was obtained before the study was begun, and the patients gave informed consent.

Inclusion criteria

All grades of open injury were considered for the study except Type III C. All those patients who had a follow up of minimum of one year were included in the study.

Exclusion criteria

Patients were excluded if they had a fracture in the proximal fourth of the tibia or a fracture within four centimeters of the ankle, neither of which was judged to be amenable to interlocking nailing; if the patients did not turn for follow up; if the patients had significant medical or surgical disorders to minimize their influence on fracture healing and union; or if they had open growth plates. There were no other exclusion criteria.

Thus 44 patients with 44 fractures were included in the study. The data of the patients were recorded as shown in the proforma Form A and Form C. These are as per the AO guidelines and are in the appendix.

Results

Finally 44 patients with 44 fractures were included in the study. The average age of 38 male and 6 female patients was 33 years (range 18 to 80 years).

Table 1: Gender

Sex	Male	Female
Number	38	6

Table2: Age

Age	Number
11 to 20 years	6
21 to 30	19
31 to 40 years	10
41 to 50 years	6
51 to 60 years	2
Above 60 years	1

23 of the patients had right sided fractures, the left sided ones were 21 in number.

Table 3: Side

Side	Number
Right	23
Left	21

5 patients were struck by motor vehicle as a pedestrian, 12 were involved in a motor vehicle accident as either the driver or passenger, 10 were in a motorcycle accident, 5 were in jeep. 9 had sustained the fracture as the result of domestic injury by fall etc, 3 had industrial accident.

Among the fractures treated 4 involved the proximal third of the tibia, 4 at the junction of the proximal and middle third, 20 at the middle third, 6 at the junction of the middle third and distal third, 3 at the lower third, six segmental fractures in middle and lower third and one segmental fracture in upper and lower third.

Table 4: Level of Fracture

Level of the fracture	Number
Proximal third	4
Jn. Of P/3 and M/3	4
Middle third	20
Jn. Of M/3 and L/3	6
Distal third	3
Segmental	7

There were 24 oblique fractures, 4 transverse, 7 segmental fractures, 3 spiral fractures and 6 comminuted fractures.

Table 5: Type of fracture

Type of fracture (pattern)	Number
Oblique	24
Transverse	4
Segmental	7
Spiral	3
Comminuted	6

The severity of the open injury was determined with use of the classification of Gustilo *et al.*, on the basis of the initial appearance of the wound and the findings during debridement. No type III C open fractures were taken up for nailing. 15 type I,

19 type II, 9 type III A, 1 type III B fracture were treated. The difference in the distribution of the type of open injury was not significant.

Table 6: Type of open fracture-Gustilo

Type of Open Fracture-Gustilo	Number
Type I	15
Type II	19
Type III A	9
Type III B	1

Discussion

The range of age of patients in our study was 18 to 80 years. The average age was 33 years. The following table compares it to that of other studies reported in the literature. The average age is

almost the same as in other studies. The slightly higher average in the western countries could be due to higher life expectancy there. Thereby prevalence of older population is slightly higher than the Asiatic population.

Table 7: Comparison of age

Study	Average Age (years)	Range (years)
Present	33	18 - 80
Keating <i>et al.</i> [7]	37	16 - 88
Singer <i>et al.</i> [8]	36	-
Whittle <i>et al.</i> [9]	34	17 - 69
Court Brown <i>et al.</i> [10]	39.1	17 - 89
Bone and Johnson <i>et al.</i> [11]	31	14 - 77

The overall Male: Female ratio was 38: 6. Thus the male patient was more widely affected than the female. All the studies corroborate the same findings. This is due to the fact that males

are the more physically active group and are hence prone to accidents, vehicular, industrial etc, assaults, fall from heights, trees etc.

Table 8: Comparison of gender

Study	Sex M:F	Total no. of patients
Present	38:6	44
Keating <i>et al.</i> [7]	77:14	91
Singer <i>et al.</i> [8]	30:11	41
Whittle <i>et al.</i> [9]	34:13	47
Court Brown <i>et al.</i> [10]	31:8	39
Bone and Johnson <i>et al.</i> [11]	90:20	110 (26 open #, ILN)

As is evident from the chart in the chapter of observations that a large majority of patients sustained their fractures due to Road Traffic Accidents. This fact gets weightage from the reports of other studies given below. These RTAs are common in the

younger age group and involve high energy trauma. Also due to the increasing vehicular traffic with time RTAs are becoming more prevalent.

Table 9: Comparison of mechanism of injury

Study	Mechanism of Injury				
	RTA	Domestic	Industrial	Others	Total #
Present	32	9	3	0	44
Keating <i>et al.</i> [7]	63	13	11	7	94
Singer <i>et al.</i> [8]	32	4	-	5	41
Whittle <i>et al.</i> [9]	41	3	0	6	50
Court Brown <i>et al.</i> [10]	26	7	3	0	39 pts.
Bone and Johnson <i>et al.</i> [11]	99	11	1	0	110 pts.

The middle third of the shaft is much more commonly fractured than other parts as is evident from comparison of various studies although no specific reason was found in the literature, however

it can be hypothesized that it could be due to high velocity injury and because there was less protection offered by the muscles.

Table 10: Comparison of level of fracture

Study	Level of fracture						Total
	Proximal third	Junction of P/3 and M/3	Middle third	Junction of M/3 and D/3	Distal third	Segmental	
Present	4	4	20	6	3	7	44
Keating <i>et al.</i> [7]	3	9	36	31	9	6	94
Whittle <i>et al.</i> [8]	Divided into 4 quarters A, B, C, D: 1, 5, 27, 9					8	50
Court Brown <i>et al.</i> [10]	2	-	16	-	11	12	41
Bone and Johnson <i>et al.</i> [11]	2	5	60	17	16	12	112

It was found that oblique type is predominantly prevalent. This is true in Keating *et al.* 1's study too. This is due to the fact that the leg is commonly subjected to torsional and bending forces giving rise to oblique fracture and comminution especially in RTAs and falls.

Table 11: Comparison of type of fracture

Study	Type of fracture				
	Spiral	Oblique	transverse	segmental	Comminuted
Present	3	24	4	7	20
Keating <i>et al.</i> [7]	6	49	28	11	-

High energy fractures are on the rise, since almost all RTAs are high velocity injuries and the incidence of RTAs is definitely on the rise. [12] But as the previous reports show less good results with primary interlocking nailing for severe open fractures. We, being a private organization, fixed many severe open fractures (III B) with external fixation. We were still left with a moderate number of Type II and III A fractures comparable with few studies like Keating *et al.* Court Brown *et al.* had a previous study with only Type I fractures, hence in this study they had not included Type I fractures. In Caudle's [11] study only six out of 42 III B fractures were nailed intramedullary and two out of 11 III A fractures were done intramedullary nailing.

Table 12: Comparison of Gustilo type of open fracture

Study	Gustilo type of open fracture				
	Type I	II	III A	III B	Total
Present	15	19	9	1	44
Keating <i>et al.</i> [7]	14	34	35	11	94
Singer <i>et al.</i> [8]	6	11	16	9	43
Whittle <i>et al.</i> [9]	3	13	22	12	50
Court Brown <i>et al.</i> [10]	-	14	14	13	41
Bone and Johnson <i>et al.</i> [11]	Type I and II - 25		Type III A and B - 1		26

Conclusion

The variables that were being compared were age, sex, side affected, mechanism of injury and type of fracture. The corrected mean age was 33 years. The overall male: female ratio was 38:6. The Right to Left side ratio was nearly equal. The most common cause of the traumatic event was Road Traffic Accidents that is 65%. Studies by other authors have summarized as the same.

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