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Comparing the Functionality in Outcomes for Management Tibial Shaft Fracture Using Intramedullary Interlocking Nailing Technique in Patients Coming with Tibial Shaft Fracture in Dr. Hardas Singh Orthopedic Hospital and Superspeciality Research Centre, Circular Road, Amritsar, Punjab

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Abstract **Original Research Article**

Background: Tibial shaft fractures are often the result of high-energy injuries in younger people, Fractures of the tibial shaft that are identified as 4 cm distal to the tibial tuberosity and 4 cm proximal to the ankle are treated with interlocking techniques. Intramedullary nailing is one widely used form of fixation with excellent results. The study aims to document the treatment benefits being offered and measure the functional outcome using a standard tool. ***Methodology****: a prospective* ***observational study****:* was planned for patients coming in the orthopedics department with fracture shaft tibia. They were included only after satisfying the laid down inclusion criterion while after performing routine procedures they were given the treatment of intramedullary interlocking nailing if indicated. Data collected on excel sheets were analyzed using SPSS for tests of association and measures of central tendency. ***Results:*** 55 participants were there who were offered the treatment of intramedullary nailing with interlocking nailing majority of them were males from BPL. Most of the injury was of type A from Motor vehicle accidents involving proximal shaft. John Wruh's criterion was used to assess the functional outcomes with 47% having excellent results. Only 3 (5%) of the patients had poor results. ***Conclusion*****:** Interlocking Intramedullary nailing for tibial shaft fractures is an excellent method of surgical management. Intramedullary nailing decreases the occurrence of complications such as infection thus by decreasing the time to recover in patients receiving such injuries.

Keywords: Tibial shaft fractures, younger people, injuries, treatment.

INTRODUCTION

- Tibia being a large bone in humans anatomically is always prone to fracture in cases of trauma owing to its capacity to bear load the recovery can be complicated easily by instability, delayed recovery, and long illness.
- Tibia has been raising concerns for the world's orthopedists. With the growing amount of industrialization urbanization and road vehicles in India, complex cases of injury caused by road car accidents have increased dynamically.
- Tibial diaphyseal fracture is the most common long bone fracture suffered by the vast majority of specialists in orthopaedics. Normally 26 Tibial diaphyseal fractures are happening in population for every 1 lakh people around the globe occurs yearly.
- Males are more commonly affected than females, with a male rate of about 41 for every lakh per year and a female rate of about 12 for every 1 lakh per year [1]. Tibial shaft fractures are often the result of high-energy injuries in younger people, and patients must be assessed according to Advanced Trauma Life Support (ATLS) guidelines for traumatic complications.
- The affected lower limb must be properly inspected. It is important to record and log injuries to the underlying skin and soft tissues, such as fracture blisters, skin abrasions, burns, ecchymosis or skin tenting.
- It is important to recognize open fractures and to initiate an effective tetanus update and antibiotics immediately upon initial presentation. It is important to undertake and record a thorough neurovascular review. A high suspicion of a related compartment syndrome should be retained by the assessing surgeon and serial clinical tests are required for these patients.
- Recent research has shown that the prevalence of associated compartment syndrome can be as high as

11.5 percent in diaphysis tibial fractures. Tibial surface is 33% is subcutaneous making it more prone to develop open fracture along the majority of its length when compared to other large bones [2, 3]. Younger people in general tend to be more predisposed to develop the compartment syndrome.

- Tibial shaft fractures (fractures in the bone in the long middle portion of the tibia or shin bone) are often caused by high-energy injuries, such as collisions with motor vehicles. Fractures of the tibial shaft that are identified as 4 cm distal to the tibial tuberosity and 4 cm proximal to the ankle are treated with interlocking techniques. Intramedullary nailing is one widely used form of fixation with excellent results.
- This is done by inserting a metal rod often from the upper side of the tibia into the medulla (inner cavity) of the tibial shaft. The rod is held in both ends by screws.
- Traditionally, either by splitting the patellar tendon (transtendinous approach) or alternatively by dissecting just adjacent to the patellar tendon (paratendinous approach), the starting point for intramedullary nailing of tibial shaft fractures was developed through an infrapatellar approach.
- Using this conventional form, the knee is positioned in a flexed or hyper flexed position over the radiolucent triangle. While the starting point is set, the radiolucent triangle acts as a system to place the leg in a flexed position. During the reduction manoeuvre and nail insertion, the radiolucent triangle can also aid in applying traction.
- The intramedullary nailing beneath imaging system fulfils the goal to secure minimal tissue damage resulting in better and faster unions of fracture. The application of intramedullary nails with either reaming to match the maximum diameter nail to protect the tibia better or without reaming in compound cases is an accessible and commonly used surgical technique of intramedullary nailing to avoid the spread of infection. Reamed nailing has been used with better results in terms of post implant infection.

*Various treatment modalities are being given to patients coming to the department with suitable treatment according to the needs and availability of other items required to provide best care. With an aim to document various methods of treatment given for fracture shaft tibia and their functional outcome this study was intended with these objectives –

1. To determine the nature of patients coming with Shaft Tibia fracture and know the underlying causes.
2. To determine the treatment given to these patients and assess the functional outcome of these treatments.

METHODOLOGY

After taking IEC approval from the institutional authority this stdy was done in the Orthopedics department on patients which met the inclusion criterion given below.

Study Type – A prospective observational study which aimed on documenting the various modalities of treatment used and comparing their functional outcomes.

STUDY DURATION

Study started in Dec 2018 and continued the data collection till Jan 2020.

Study participants – A total of 60 participants were evaluated who met the inclusion criterion for the study of which data for 57 were available for analysis as 3 patients didn't completed the follow up.

Study settings – Hospital based study

INCLUSION CRITERION

All consenting patients who had fracture tibial shaft open or closed, were of age group 18-60 who were readily available for follow up for one year.

EXCLUSION CRITERION

All participants who had compound or comminuted fracture and age not within age criterion, malunion, aseptic nonunion, pathological fracture, medically unfit patients.

Usual Procedures followed - In the emergency, the patient was received and his vital parameters were registered & monitored. Related injuries to the limbs, chest, abdomen and head were removed. An intravenous line was developed, tetanus prophylaxis and I/V cephalosporin antibiotics were given, fluid substitution began and pressure bandage managed haemorrhage from the wound. The wound was washed and dressed over the fracture site, and a groin was added to the toe slab by simply aligning the bone. Other wounds, if any, were properly taken care of. The patient was transferred to the orthopaedic ward after he had settled from the acute injury.

- Detailed history, documenting the degree and severity of the injury, degree and form of trauma to the tissues, and detailed examination of the affected extremity were taken upon admission to the ward. Skiagrams in order to describe the fracture were analysed in depth.
- Details of the Implants - A full collection of 28-38 cm long IL-nails available in diameters of 7, 8, 9 and 10 mm. An osteotome, a hammer and an elevator periosteum. A diamond tip bone awl and a nail with a V. Hexagonal tipped screw driver, tourniquets, Image intensifier television (IITV), Versatile Reamer, guide wire, an aluminium tissue protector, a nail extractor, Hand / Power drill and drill bits of

3.2 mm, Depth gauge, bone tap and 4.5 mm cortical screw collection.

- A specially constructed IL-nail was used for the purpose in all cases. IL-nail is a hollow, metallic modified clover-leaf nail having a D-shaped platform at its proximal end (head) and a proximal locking hole. It has proximal bent of 20° in antero-posterior direction to compensate for the proximal Herzog's curve within the medullary canal. The nail has a slot along its whole length on the posterior direction which facilitates un reamed nail insertion. About 2.5cm above the tip of the nail, the anteroposterior direction is a distal locking grip.
- Measuring from the tibial tuberosity to the base of the medial malleolus on the unaffected foot, the required length of the nail is picked. The nail diameter is measured on the X-ray or by reaming, depending on the extent of the medullary canal.

Operations Procedure

All cases of fracture shaft tibia were operated on within seven days of the injury. In the orthopedic procedure theatre, both cases were carried out. Near intramedullary nailing was conducted without opening and with or without reaming of the fracture site. The standard procedure for operating such cases were done with all aseptic precautions and as described.

- After operations were done at all times, the limb was held elevated and vigorous toe movements were encouraged. Excessive swelling, pain and distal circulation were controlled by the patient. After 5 days of surgery, the first dressing was carried out. When the suture line is clean, suture removal was performed under complete asepsis after 10 to 12 days. The compression bandage was removed and a crepe bandage from the knee to the ankle was added to the GT slab. Immediately after dressing, aggressive mobilization of the knee and ankle begins. As per the symptoms present suitable advice was given to patients for weight bearing and weight training.

Monthly evaluation of patients was done; apart from their wellbeing functional parameter was evaluated using John Wruh's Criterion.

DATA ANALYSIS

Data was collected using MSOffice Excel Sheets as per the different variables of quantitative and qualitative types. The data collected was thus analyzed using SPSS software. Analysis was done using standard measures of central tendency like Mean, Standard Deviation while tests for association were used like Chi square test etc. p value of <.05 was considered as statistically significant.

RESULTS

Table-1: A brief description of various socioeconomic indicators of the study participants

		Gender		Total	p value
		Male	Female		
Age in years Mean age 33.25	18-25	10	2	12	**>.05**
		18.2%	3.6%	21.8%	
	25-35	9	3	12	
		16.4%	5.5%	21.8%	
	35-55	15	7	22	
		27.3%	12.7%	40.0%	
	>55	6	3	9	
		10.9%	5.5%	16.4%	
Residence	Urban	17	5	22	**>.05**
		30.9%	9.1%	40.0%	
	Rural	23	10	33	
		41.8%	18.2%	60.0%	
Religion	Hindu	20	10	30	**>.05**
		36.4%	18.2%	54.5%	
	Muslim	10	3	13	
		18.2%	5.5%	23.6%	
	Christian	4	2	6	
		7.3%	3.6%	10.9%	
	Others	6	0	6	
		10.9%	0.0%	10.9%	
SES	APL	17	5	22	**>.05**
		30.9%	9.1%	40.0%	
	BPL	23	10	33	
		41.8%	18.2%	60.0%	
Total		40	15	55	
		72.7%	27.3%	100.0%	

Our research had 55 participants with more males (n=40, 72.7%) while females were less. More of the participants were from rural background (n=33, 60%), majority were Hindus and from below poverty line (Table1).

While on the trauma front we saw that more participants suffered the injury due to motor vehicle accidents (n=42, 76%) and only 23% were from fall from height of high statistical significance. There was more closed fractures then open ones involving the right side (Table2) Most commonly involved was the distal segment (n=30,54.5%) while most were of type A ,83.6% and of statistical significance.

Table-2: Trauma details, and other types of fracture, their association with Gender

Trauma details		Gender		Total	p value
		Male	Female		
Side Involved	Right	20	8	28	<.05
		36.4%	14.5%	50.9%	
	Left	20	7	27	
		36.4%	12.7%	49.1%	
Fracture Details	Open	16	6	22	>.05
		29.1%	10.9%	40.0%	
	Closed	24	9	33	
		43.6%	16.4%	60.0%	
Trauma mode	MVA	29	13	42	<.05
		52.7%	23.6%	76.4%	
	Fall from Height	11	2	13	
		20.0%	3.6%	23.6%	
Fracture Type	Mid shaft	12	3	15	>.05
		21.8%	5.5%	27.3%	
	Proximal Segment	7	3	10	
		12.7%	5.5%	18.2%	
	Distal Segment	21	9	30	
		38.2%	16.4%	54.5%	
AO Type Fracture	Type A	32	14	46	<.05
		58.2%	25.5%	83.6%	
	Type B	8	1	9	
		14.5%	1.8%	16.4%	

The union time in our study took 30.0 weeks with SD of 10 days, considered when callus formation appeared on three or four cortices on the AP and lateral X-rays.

Table-3: A brief description about the Johner and Wruh criterion and Trauma types and AO type Fracture

		John Wrugh Criterion				Total	p
		Excellent	Good	Fair	Poor		
Trauma type	MVA	18	10	11	3	42	<.05
		32.7%	18.2%	20.0%	5.5%	76.4%	
	Fall from Height	8	4	1	0	13	
		14.5%	7.3%	1.8%	0.0%	23.6%	
AO Type Fracture	Type A	23	11	9	3	46	<.05
		41.8%	20.0%	16.4%	5.5%	83.6%	
	Type B	3	3	3	0	9	
		5.5%	5.5%	5.5%	0.0%	16.4%	
Total		26	14	12	3	55	
		47.3%	25.5%	21.8%	5.5%	100.0%	

In our study we found that Trauma type and AO fracture types were related to the functional results which were categorized using Johner and Wruh Criterion. Both the types of fracture and reasons for trauma were found to be statistically significant. (Table 3) We saw excellent results in 47.3% patients while 25.5% were having good results based on Johner and Wruh criterion after the intramedullary interlocking nails as the treatment for shaft tibia fracture. Only 3(5%) had poor outcomes.

Fig-1: Pre-operative and Post-operative Skia gram with treatment from intramedullary nail

DISCUSSION

- Reamed nailing facilitates the inserting of a greater diameter of the nail and increases the stability of the fracture, as the torsional stability is proportional to the fourth power of the radius of the nails being used.
- Our study had more males while coming from rural areas with BP status. Studies done in Indian set ups for hospitalized patients usually have similar picture (12) Other studies too have had more results from MVA when compared to fall from height or other reasons.
- The criterion for evaluating the effectiveness of functionality was picked to be evaluated using John Wruh's criterion owing to its ease of use and all round accountability of various components of the recovery associated with such fractures including nonunion, neurovascular disorder, deformity, varus or valgusdeformity, anteversion –recurvation, rotation, shortening, mobility of knee and ankle, pain, gait changes, and the strenuous activity.
- Other studies too have evaluated intramedullary nailing for shaft tibia fracture with excellent results as the majority of clinical outcome. In their studies to the union was achieved after close to 30 weeks while most of the occurrences were Type a fractures.
- While regarding the percentage of closed fractures which was in our study on the lesser side but similar studies done by Finkemeier, Christopher A *et al.* found a higher percentage of closed fractures had been healed at 4 months after reamed nail insertion compared to unreamed insertion ($p = 0.040$), but there was no difference at 6 and 12 months. While in other study length of fracture union averaged 28 weeks in closed fractures and 39 weeks in open fractures.
- In our study it was close to 30 weeks .The results after using the intramedullary nail with interlocking in our study had majority with excellent to good results. Similar findings have been reported and form the basis of recommending this technique in cases of fracture shaft tibia.

Complications

We had only mild problems in the form of knee stiffness that involved physiotherapy, which gradually improved with time. Infection was seen in 3 cases.

CONCLUSION

- The above study tried to document the findings after patients recover from treatment of intramedullary nail in case of fracture shaft tibia. Interlocking Intramedullary nailing for tibial shaft fractures is an excellent method of surgical management.
- Intramedullary nailing decreases the occurrence of complications such as infection (5 percent in our study). Primary nailing provides better support to the stabilizing muscle groups thus by helping early soft tissue healing enabling the patients to move early and reducing the length of stay in Hospital.
- In future more such studies should be planned to have a more rich data base and document the various modalities intricately linked to the fracture shaft tibia and intramedullary nailing techniques.

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