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Outcome of Open Fracture of Lower Limb Long Bone Managed with Tens Nail

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Abstract

Aim: The aim of the present study was to assess the functional outcome of open fracture of lower limb long bone managed with TENS in adolescent / adult population.

Material & methods: This study included all patients admitted with fracture involving tibia and femur fracture admitted at Department of Orthopaedics, JLN Medical College & Hospitals, Ajmer (Rajasthan), in between the duration of June 2022 to December 2023 treated with TENS in lower limb long bone fracture in adolescent / adult population after approval from Ethical Committee.

Results: In our study shows that out of 30 patients were maximum number 10 cases (33.33%) were in the age group of 10-20 years and only 8 cases (26.67%) were in the age group of 31-40 years respectively. Out of 30 patients male cases 22 (73.33) and female 8 (26.67) were present in our study. In our study shows that out of 30 patients maximum cases 19 (63.33%) have 40-50 kg. of weight and only 1 case (3.33%) have more than 70 kg of weight in our study. Maximum number of tibia fracture in 28 cases (93.33%) and femur fracture in only 2 cases (6.67). Out of 30 patients lower limb fracture mainly due to RTA 24 cases (80%) and only 6 (20%) due to fall from height was observed. In our study only open lower limb fracture included, out of 30 patients GA Grade I was observed in 8 cases (26.67), Grade II 17 (56.67%) and Grade IIIA 5 cases (16.67%). Out of 30 patients maximum radiological union Grade 8-12 week cases were observed in 24 cases (80.00) and Grade 13 – 14 in 1 case (16.67%). Out of 30 patients maximum functional outcome in 22 cases (73.33%) in 13-16 week. and only 5 cases (16.67%) were observed in 21 weeks and above for better functional outcome. In our study the follow-up in at 24 weeks LLD as per Flynn's Criteria excellent result was found in 23 cases (76.67%) and no poor result was observed.

Conclusion: The better outcome of management suggests that titanium elastic nailing can be a viable option in early management of open fracture long bone with some merit over other procedures.

Keywords: Fracture of Long Bones, TENS Nail, Union, Complications, Outcome.

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1. INTRODUCTION

Open fracture of lower limb long bone can involve significant morbidity and are troublesome. Fracture of femur and tibia are the most commonly observed long bone fracture in the adolescent and adult population.[1] the most common site of fracture of the femoral shaft is its middle third, where the normal anterolateral bowing of the diaphysis is at its maximum, this is also the area most commonly subjected to severe direct violence. The torsional force produced by indirect violence results in a long spiral or oblique fracture, whereas a transverse fracture is caused by direct trauma. When the direct force is very severe, there may be comminution, or the fracture may be segmental, or both. These are often associated with high energy trauma which may lead to additional complications. The displacement of fragments in fractures of femur, depends upon breaking force, the pull of the attached muscles and the force of gravity acting upon the limb.[2]

Tibia or Shin Bone, is the most commonly fractured long bone in the body. It typically takes a major force to cause this type of broken leg. Motor vehicle collasion is a common cause of tibial shaft fracture. Tibial fracture varies greatly, depending on the force that cause the break. If fractured in alignment (Stable fracture) or be out of alignment (displaced fracture).[3]

Open fracture managed with many surgical corrections.[1] Goals of open fracture management include the prevention of infection, achievement of bony union, and the restoration of function. When deciding on the open fracture treatment strategy, the treating surgeon must consider the patient's condition, the mechanism of injury, and the fracture type. Although some of the most impressive injury patterns are from high-energy mechanisms, more commonly, patients present with an open fracture from a simple low-energy mechanism such as a fall.

Goals of open fracture management include the prevention of infection, achievement of bony union, and the restoration of function. Each fracture could conceivably be treated quite differently, ranging from external fixation and delayed closure or fixation to immediate irrigation, debridement, and primary closure. Current treatment strategies in the care of open fractures are continuously studied and improved. Plate and screw, external fixator, rigid intra-medullary nails, and TENS (Titanium Elastic nailing system) may be used in surgical treatment. The popularity of TENS has been gradually increasing due to its ease of use and low complication rate. TENS has been used successfully primarily in femur fractures and in various long bone fractures with many published reports in the literature.[4,5,6] Hence the aim was to study the functional outcome of open fracture of lower limb long bone managed with TENS in adolescent / adult population.

2. MATERIAL & METHODS

This study included all patients admitted with fracture involving tibia and femur fracture admitted at Department of Orthopaedics, JLN Medical College & Hospitals, Ajmer (Rajasthan), in between the duration of June 2022 to December 2023 treated with TENS in lower limb long bone fracture in adolescent / adult population after approval from Ethical Committee.

Inclusion Criteria

- 10 to 60 years of age
- Gustilo-Anderson Grade 1, 2 and 3A and 3B open trauma
- Lower limb long bones fractures

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- Total number of patients in this study will be 30.

Exclusion Criteria

- Age < 10 years
- Medical contraindication for surgery
- Patient refusal
- Gross bone loss (more than 1 cm or more than 2/3 or circumference.
- Individuals unable to give consent.
- Gustilo-Anderson Grade 3 C open trauma

Methodology

As soon as the patient was brought to casualty, patient's airway, breathing and circulation were assessed. Then a complete survey was carried out to rule out other significant injuries. Wound washed, dressing was done, temporary splinting and patient was send for plain radiographs of AP and lateral view of – the involved extremity including one joint above and one joint below was taken to assess the extent and geometry of fracture. On admission to ward, as detailed history was taken. Routine blood investigations were done for all patients.

Pre-operative planning of Nail size Nail length:

Lay one of the selected nails were determined that it is of the appropriate length by fluoroscopy. Patients were kept nil by mouth overnight before surgery. Adequate amount of compatible blood was kept ready for any eventuality. The whole of the extremity below the umbilicus, including the genitalia was prepared appropriately. A systemic antibiotic, usually a 3rd generation cephalosporin was administered 1 hour before surgery. Under anaesthesia, closed reduction and internal fixation with TENS nails done under C-arm guidance.

Post-Operative Care and Follow Up:

Patients were kept nil orally 4 to 6 hours post operatively IV fluids / blood transfusions were given as needed. Analgesics were given according to the needs of the patient. The limb was kept elevated over a pillow. IV antibiotics were continued for 5 days and switched over to oral antibiotics on the 5th day and continued till the 10th day. Sutures were removed on the 10th postoperative day and patients were discharged.

Gentle knee exercises and quadriceps strengthening are begun as soon as patient is comfortable. Any passive aggressive knee bending is deplored because it causes quadriceps spasms.

In our study patients were allowed partial weight bearing with axillary crutches at 5-6 weeks and full weight bearing was generally started on 8-12 weeks depending on the fracture configuration and callus response.

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Follow up

1. Patients were called at 1st week, 6th week than 3 months and 6 months.
2. At each follow up patients were assessed on subjective ground, clinically and radiographically.

Statistically Analysis

Statistical Analysis Appropriate statistical software, including but not restricted to MS Excel, SPSS ver. 20 were used for statistical analysis. Quantitative data was presented with the help of Mean and Standard deviation. Comparison among the study groups was done with the help of unpaired t-test as per-results of normality test. Qualitative data was presented with the help of frequency and percentage table. Association among the study groups was assessed with the help of Fisher test, student‘t’ test and Chi-Square test. ‘p’ value less than 0.05 was taken as significant.

3. RESULTS

Table 1: Baseline Characteristics

Age Distribution	Number	Percent
10-20	10	33.33
21-30	6	20.00
31-40	8	26.67
40 & Above	6	20.00
Sex		
Male	22	73.33
Female	8	26.67
Weight (in Kg)		
40-50	19	63.33
51-60	7	23.33
61-70	3	10.00
70 & above	1	3.33
Bone		
Tibia	28	93.33
Femur	2	6.67
Mode of Injury		
RTA	24	80.00
Fall from Height	6	20.00

In our study shows that out of 30 patients were maximum number 10 cases (33.33%) were in the age group of 10-20 years and only 8 cases (26.67%) were in the age group of 31-40 years respectively. Out of 30 patients male cases 22 (73.33) and female 8 (26.67) were present in our study. In our study shows that out of 30 patients maximum cases 19 (63.33%) have 40-50 kg. of weight and only 1 case (3.33%) have more than 70 kg of weight in our study. Maximum number of tibia fracture in 28 cases (93.33%) and femur fracture in only 2 cases (6.67). Out of 30 patients lower limb fracture mainly due to RTA 24 cases (80%) and only 6 (20%) due to fall from height was observed.

Table 2: GA Classification and Radiological Union

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Grade	Number	Percent
I	8	26.67
II	17	56.67
III A	5	16.67
Radiological Union (Week)		
8-12	24	80.00
13-14	1	3.33
15 & above	5	16.67

In our study only open lower limb fracture included, out of 30 patients GA Grade I was observed in 8 cases (26.67), Grade II 17 (56.67%) and Grade IIIA 5 cases (16.67%). Out of 30 patients maximum radiological union Grade 8-12 week cases were observed in 24 cases (80.00) and Grade 13 – 14 in 1 case (16.67%).

Table 3: Functional Outcome and Limb Length Discripency (24 Weeks) As Per Flynn's Criteria

Functional Outcome (weeks)	Number	Percent
10-12	1	3.33
13-16	22	73.33
17 - 20	2	6.67
21 & Above	5	16.67
LLD (24 Weeks)		
Excellent	23	76.67
Satisfactory	7	23.33
Poor	0	0.00

Out of 30 patients maximum functional outcome in 22 cases (73.33%) in 13-16 week. and only 5 cases (16.67%) were observed in 21 weeks and above for better functional outcome. In our study the follow-up in at 24 weeks LLD as per Flynn's Criteria excellent result was found in 23 cases (76.67%) and no poor result was observed.

Table 4: Angular Deformity (24 Weeks), Pain (24 Weeks) As Per Flynn's Criteria and Other Complications (24 Weeks)

Angular Deformity (24 Weeks)	Number	Percent
Excellent	16	53.33
Satisfactory	6	20.00
Poor	8	26.67
Pain (24 Weeks)		
Excellent	13	43.33
Satisfactory	10	33.33
Poor	7	23.33
Other Complications (24 weeks)		
Excellent	14	46.67
Satisfactory	9	30.00
Poor	7	23.33

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In our study angular deformity as per Flynn's Criteria excellent result was found in 16 cases (53.33%) and poor result was found in 8 cases (26.67%). In our study pain as per Flynn's Criteria excellent result was found in 13 cases (43.33%) and poor result was found in 7cases (23.33%). In our study other complications as per Flynn's Criteria excellent result was found in 14 cases (46.67%) and poor result was found in 7 cases (23.33%).

4. DISCUSSION

Open fractures of the lower limb represent a significant and often debilitating injury that can have long-lasting consequences, leading to chronic disability and a diminished quality of life. These fractures typically occur as a result of high-energy trauma such as motor vehicle accidents, falls from considerable heights, or sports-related incidents. The estimated incidence of open fractures of the lower limb is approximately 11 cases per 100,000 individuals per year, with a higher prevalence observed among males and younger age groups.[7]

In our study shows that out of 30 patients were maximum number 10 cases (33.33%) were in the age group of 10-20 years and only 8 cases (26.67%) were in the age group of 31-40 years respectively. Out of 30 patients male cases 22 (73.33) and female 8 (26.67) were present in our study. The baseline characteristics of the patients in this study revealed that most of the patients were males within the age group of 30-50 years, which is consistent with the findings of previous studies by Court-Brown et al[1], Santhanam SS et al[8], and Keating et al.[9] In our study shows that out of 30 patients maximum cases 19 (63.33%) have 40-50 kg. of weight and only 1 case (3.33%) have more than 70 kg of weight in our study. Maximum number of tibia fracture in 28 cases (93.33%) and femur fracture in only 2 cases (6.67). Out of 30 patients lower limb fracture mainly due to RTA 24 cases (80%) and only 6 (20%) due to fall from height was observed. the study by Martinez et al (1991)[10] had different observations. Of the 51 patients, only 14 (28%) had a fall from height, 33 (62%) had vehicular accident and 5(10%) were hit by a hard object. Another, important observation made was the variation in the causative factor according to age. While in the younger age group (10-30 years) motor vehicle accidents contributed 72.73% in children above 10 year of age. This corroborates the findings by Hedlund et al (1986)[11] that motor vehicle accident increase as age increases.

In this study only open lower limb fracture included. Out of 30 patients Grade I was observed in 8 (26.67%) cases and Grade II in 17 (56.67%) and Grade III in 5 (16.67%) cases.

An open fracture also called compound fracture, is a fracture in which there is an open wound or break in the skin near the site of the broken bone. Most often this wound is caused by fragment of bone breaking through the skin at the moment of the injury. Most of the fractures are caused by some type of high energy accident like a motor vehicle collision. An open fracture can also result from a lower energy incident, such as a simple fall at home or an injury playing sports. Daily activity worse at 1 month, but improved upto 6 months and mobility functioning significantly impaired at 1 month but improved at 6 months. In our study out of the 30 patients, maximum functional outcome was between 13-16 weeks and 5 cases were in more than 21 weeks. In our study, out of 30 patients as per Flynn's criteria excellent result (<1 cm shortening) in 23 (76.67%) patients. None of the cases was more than 2 cm shortening. Ligier et al (1988)[12] followed 62 children for over one year with an average period of one year and ten months. All 62 children were assessed period radiographically and a mean lengthening of 1.2 mm was noted. They decided to figure out whether this was an algebraic sum of lengthening in transverse fracture without overlap and shortening in spiral fractures. Within narrow limits this hypothesis was confirmed. In 29 simple transverse fractures the mean lengthening was 2.06 mm with four cases of lenthening more than 10 mm (11, 15, 17, 23) and three of shortening

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greater than 10 mm (15, 15, 13 mm) by contrast in 12 spiral fracture the mean shortening was 0.7 mm; the range in this group was from a loss in length of 12 mm to an increase of 17 mm. In our study 16 cases had excellent results, 6 cases had satisfactory results and 8 cases poor results. Ligier et al (1988)[12] in their series observed that none of the patient had angulation exceeding 10 degree. 14 patients had angulation exceeding 5 degree. It was varus in 8, vulgus in 2, anterior in 3 and posterior in one. Absence of pain on weight bearing was the clinical criteria of union on beginning partial weight bearing at 5-6 week with support of G.T slab and full weight bearing within 9-12 weeks. The average time of union in our study week was 12.96 weeks. The average time of union in series of Ozturkman et al (2002)[13] was 7.8 weeks. Galvankar et al (2004)[14] (also achieved union 7-9 weeks. The major advantage of TEN were in rehabilitation and healing with abundant callus, attributed to non-rigid fixation. This resulted in rapid fracture union and early return to full weight bearing while reducing hospital stay and treatment cost. The proximal end of TEN has "hockey stick appearance" which help in "Bounce-off" at opposite cortex during insertion, facilitate placement in proximal femur and distal tibia and prevent migration.

5. CONCLUSION

The better outcome of management suggests that titanium elastic nailing can be a viable option in early management of open fracture long bone with some merit over other procedures.

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