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FUNCTIONAL OUTCOMES IN CASES OF GUSTILO GRADE IIIB OPEN TIBIA FRACTURES TREATED WITH LIMB RECONSTRUCTION SYSTEM(LRS)

Orthopaedics

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ABSTRACT

Background: Management of open tibia fractures is very challenging. Limb reconstruction system (LRS) offers rigid stabilization of fracture fragments and with an easy access to soft tissue care. The aim of the study was to determine the efficacy of LRS for treatment of Gustilo grade IIIB open tibia fractures

Methods: This prospective study included 30 cases of both the sexes aged between 11-60 years with grade IIIB open tibia fractures. Their Clinical, radiological and functional evaluation was done by ASAMI scores.

Results: ASAMI bony score were excellent (63.3%), fair (6.7%), good (30.0%) and poor (6.7%). And ASAMI functional results were excellent (60.0 %), fair (13.3%), good (20 %) and poor (6.7%) in our study.

Conclusions: LRS is a good option for use in the primary management of grade IIIB open tibia fracture and is less cumbersome to the patient, promotes bone transport and has a low learning curve.

KEYWORDS

INTRODUCTION

Tibia is the most common fractured long bone.[1] Epidemiological studies have shown that open fracture comprises 23.5% of all tibial shaft fracture[2]. Court-Brown and McBirnie reported that over 40% of all open fractures involve the tibia.[1] The common causes of fracture are road traffic accident(62.2%), falls(18.7%), sports(7.4%) and direct blows(8.3%). They present with a 10–20 fold increased risk of developing infection than open fracture in any other anatomical areas and a nonunion rate as high as 28% because of the poor blood supply of tibia[3] ,[4], [5], [6], [7]. The rates of infection and non-union are higher in Gustilo type IIIB than in types I, II, and IIIA open fractures.[8] This study was conducted with the objective to assess the improvement in limb function after the use of Limb reconstruction system(LRS) as a definitive orthopaedic fixation device in cases of grade IIIB open tibia fractures.

MATERIALS AND METHODS:

From october 2016 to November 2018 a prospective observational study of patients with gustilo grade IIIB open tibia fractures treated with the limb reconstruction system was carried out at a tertiary care centre. In this study, 30 patients with gustilo grade IIIB open tibia fracture, between the age group of 11 and 60 years were treated with the LRS. Their clinical and radiological evaluation was done at presentation and certain specific intervals and evaluated for signs of bone union and associated complications. Excluded from the study were Grade I, II, IIIA, IIIC open tibia fractures, Closed fracture, other associated long bone fractures, pathological fractures, tibia fractures with intra articular extension Clinical and Radiographic signs such as callus formation and clinical signs such as limb length discrepancy(LLD), deformity, time for bony union, pintrack infections, neurovascular injuries were assessed and tabulated.

All the selected patients underwent routine investigations, evaluated clinically in detail regarding the mode of injury and treatment taken prior to admission. A detailed examination was done to assess, soft tissue injury, bony injury, tendon and neurovascular injury around tibia and surrounding region. Standard antero-posterior and lateral x-ray views of the affected leg including distal ankle and upper tibia was taken and fractures were classified according to Gustilo and Anderson classification. Unstable patients were stabilized first and salvageability of extremity was assessed with Mangled extremity severity score. Stable patients were subjected to all relevant preoperative investigations and were taken up for surgery as soon as he/she was fit for anaesthesia.

Operative procedure:

Surgery was performed under spinal anaesthesia without the use of touniquet. Wound swab was taken at a time of surgery and sent for culture and sensitivity testing. Patient was placed in supine position with bump under ipsilateral hip. C-arm was placed on contralateral side. Once the patient is under the effect of Spinal anaesthesia, proper scrubbing with Betadine scrub (10%) and painting with Betadine solution (7.5%) was done. Affected extremity was properly drapped and then thorough debridement of wound and wound wash with 3–6 liters 0.9% Normal saline done. Loose pieces of bone were removed. Limb was arranged in proper alignment before inserting the first most proximal schanz screw parallel to the knee joint line. Another schanz screw parallel to ankle joint was then inserted. Templates attached and rest of the screws inserted. Acute docking was done in cases of bone loss of less than 2cm.in bone loss of more than 2cm. Corticotomy at nearest metaphysis was done after wound cover and distraction –compression started after around 10 days of corticotomy at the rate of 1 mm a day. Bone grafting procedures were done at compression site for union if necessary. In immediate post op period, all patients were given limb elevation, analgesics, injection cefotaxim 1 gm iv BD with injection amikacin 500 mg iv BD with injection metronidazole 100cc iv TDS for 5-10 days according to wound status.

Repeat debridement was performed in case of unhealthy wound containing slough. VAC was applied for a period of 5 days in all wounds post operatively. All patients were taught quadriceps and hamstring strengthening exercises from second post op day along with straight leg raising exercises to avoid joint contracture and muscle atrophy. Depending upon fracture configuration, partial weight bearing walking with walker or crutches was taught to patients. Wound coverage with flap surgery was planned once there was no evidence of infection in proximal or distal pin sites and after the wound looked healthy.

Patients were followed up at 6 weekly intervals for a minimum of 18 months. Assessment of complications like muscle contractures, joint subluxation, axial deviation, neurological or vascular insult, premature consolidation, delayed consolidation, refracture and pin-site infection were done at each follow up visit and were managed accordingly. Assessment of quality of regenerate was done by plain x-

ray at weekly intervals. Healing was defined radiologically by the presence of a bridging callus. If there was no radiological progress of healing at fracture site during subsequent follow ups, bone grafting was done to achieve union at fracture site. Union was defined clinically by the absence of pain and motion at fracture site. The fracture was considered as united radiologically if three of four cortices showed bridging callus. Dynamisation was started after fracture site started showing callus. Implant was removed after achieving union at fracture site and consolidation of regenerate.

Final assessment for bone results and functional results were done using ASAMI (Association of the study and application of the method of Ilizarov) score

RESULT

In our study 30 cases of gustilo grade IIIB open tibia fractures treated with limb reconstruction system were selected and followed up for a period of 24 months to evaluate the efficacy of the LRS as a primary and definitive mode of fixation in open fractures.

The result was classified as excellent, good, fair, poor or failure according to the Association for the Study and Application of the Methods of Illizarov (ASAMI) criteria and interpreted as follows:

Bone Results	Description	Score
Excellent	Union, no infection, deformity < 7, limb length discrepancy < 2.5 cm	10
Good	Union + any two of the following: absence of infection < 7 deformity and limb length inequality of < 2.5 cm	2
Fair	Union + only one of the following: absence of infection, deformity < 7 and limb length inequality < 2.5 cm	0
Poor	Non union/refracture/union + infection + deformity > 7 + limb length inequality > 2.5cm	0
Functional	**Description**	**Score**
Excellent	Active, no limp, minimum stiffness (loss of < 15 knee extension/ < 15 dorsiflexion of ankle), no reflex sympathetic dystrophy (RSD), insignificant pain	6
Good	Active, with one or two of the following: limp, stiffness, RSD a, significant pain	4
Fair	Active, with three or all of the following: limp, stiffness, RSD a, significant pain	0
Poor	Inactive (unemployment or inability to perform daily activities because of injury)	2
Failures	Amputation	0

Abbreviation: RSD, reflex sympathetic dystrophy

RESULTS

Table 1: Distribution of Study Subjects according to the Time of Union as seen on X Ray (N=28)

Time of Union (X Ray) in weeks	No.	Percent
32	2	7.1
36	5	17.9
40	4	14.3
42	2	7.1
44	1	3.6
48	7	25.0
52	5	17.9
56	1	3.6
60	1	3.6

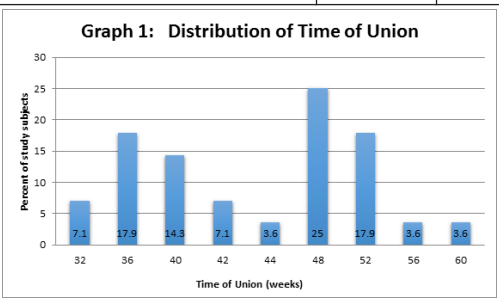
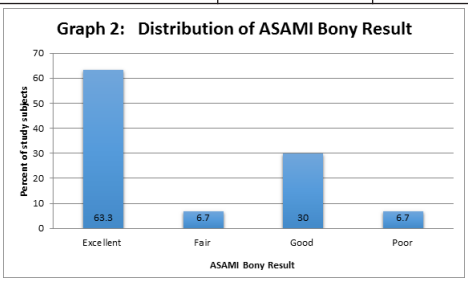


Table 2: Distribution of Study Subjects according to the ASAMI Bony Result (N=30)

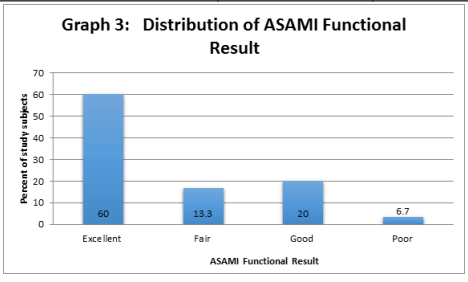
ASAMI Bony Result	No.	Percent
Excellent	17	63.3
Fair	2	6.7
Good	9	30.0
Poor	2	6.7



ASAMI bony result showed excellent in 63.3 % cases while poor result was seen in 6.7 % cases

Table 30: Distribution of Study Subjects according to the ASAMI Functional Result (N=30)

ASAMI functional Result	No.	Percent
Excellent	18	60.0
Fair	4	13.3
Good	6	20.0
Poor	2	6.7



ASAMI functional results were excellent in 60% cases while it was poor in 6.7 % cases

DISCUSSIONS

All the patients included under the study were between 18 years to 67 years of age. The maximum number of patients were less than 30 years of age with a mean age of 39.6 years. Males constituted 90%(27 cases) of the patient population. Females constituted the rest of the 10%(3 cases). All trauma was due to high velocity road traffic accidents. Middle 1/3rd of the tibia was the most common site of tibia to be fractured in 73.3% (22 cases) followed by distal 1/3rd in 20% cases(6 cases) . Grade IIIB open tibia fracture at proximal 1/3rd had the least incidence seen in only 6.7 %(2 cases) of the population. In a study by Ajmera and Verma [13] 92% (n = 23) of the fractures were located in the middle or lower third of the tibia. In present study all 100%(30 cases) underwent debridement surgery within 12 hours of advent of trauma.56.7% (17 cases) were fixed with LRS within the same sitting. Rest 44.3% (13 cases) were fixed with monolateral external fixators in different institution with unsatisfactory alignment and then visited our institution for further care. In these 13 cases unsatisfactory alignment was corrected by removing the external fixator and revising it with a LRS. Due to this delay in visiting our institution 10% of the cases (3 cases) were applied LRS as late as 5th day post trauma. Delay in surgery was due to the excessive time taken in transportation of patient from rural location to a tertiary care hospital and associated life threatening conditions which does not allow to intervene early for management of compound fractures. In a study by Naique et al[16] they compared debridement of compound fractures within 6 h and between 6 and 24 h and excluded any difference in infection rates. 10% patients (3 cases) had no bone loss after trauma and after first debridement. In 33.3% of patients (10 cases) bone loss was less than 2 cm. In these 13 cases acute bone docking was performed without the need of corticotomy or subsequent distraction. Functional outcome was excellent in all these cases. Mean bone loss seen was 2.6 cm which required corticotomy and distraction–compression for correcting the limb length

discrepancy and enhancing union at frature site. Corticotomy was done and bone transport was started after flap cover of the wound was undertaken. In a study by Ajmera A and Verma A et al [13] The mean bone loss was 5.5 cm (range 4-9 cm). 23.3 % patients underwent repeat debridement prior to flap surgery, flap surgery for wound cover was performed in all 30 cases.20% of patients underwent flap surgery on day 6 and day 20 after the date of trauma. All open wounds uptill then were treated with VAC therapy for 3-5 days post debridement. In a study by Gopal S and Majumdar S [10] it was found out that a delay beyond 72 hours for flap surgery is often for critical reasons unrelated to the limb injury. Delay in cover (>72 hours) was associated with most of the problems such as deep infections and subsequent non-union. In present study discharge from flap site was seen in 26.7 % patients (8 cases). All these 8 cases underwent debridement. Most common organism isolated was MRSA in 100% of the infected cases which had sensitivity to linezolid in 25% of the infected cases and vancomycin in the remaining 75% of the infected cases. Pin track infection was seen in 43.3% patients (13 cases) which was treated by removal of one pin each in 2 cases and injection gentamycin topically along the pintrack with additional parenteral broad spectrum antibiotics. Pin loosening was seen in 2 cases. In both the cases the loose pin were removed, which made the LRS construct unstable and resulted in non-union at the fracture site. In a study by Mangukiya H and Mahajan N et al [—14] 5(25%) patients developed pin track infections . Also incidences of pin loosening (15%) and pin breakage (0%) are much lesser as compared to AO fixator where pin loosening was found in 40% and pin breakage in 10% cases. Schanz screw design of LRS is such that it provides more stability to fixator. The use of 6 mm tapering narrow pitch screw increases pin-bone interference and pull out strength. [17] This large diameter pins have higher resistance to bending and it reduces stresses at the bone-pin interface of fixator system[18] and ensures that no flexion of screw occurs at the screw-cortex interface under normal functional loads. [19] This absence of screw flexion minimize the likelihood of osteolysis and subsequent osteitis at these sites. This explains low incidence of pin tract infection and pin loosening. Malunion or deformity at fracture site in present study was seen in 43.3 % (13 cases). All these deformities occurred in distal 1/3rd fractures of tibia with bone loss. Only 15.4% deformities were more than 10 degrees. In a study by Mangukiya J and Mahajan N [—20] , 15 % cases treated with LRS had deformities > 10 degrees while that treated with AO external fixator had 30% cases of malunion which is similar to a study by Dunbar et al which showed a malunion of 31 %. AO monolateral frame being less stable than LRS, results in cantilever bending delivering asymmetric compression to the fracture site which promotes malunion and delayed union[21] The sliding clamp of LRS allows insertion of 3 schanz screws which can be locked and thus provides more stability. In addition to that, the swiveling clamps allows correction of malalignment of fracture ends without disturbing the screw position. In case of more proximal or distal 1/3rd fracture with short segment on one side, the use of T clamp allows more secure fixation of short segment and reduces any malalignment. Milnar et al[22] showed that tibia malunion is associated with increased incidence of osteoarthritis of knee and ankle joint. Incidence of knee stiffness was seen in 6.7%(2 cases). Both the cases had a fracture at proximal 1/3rd of tibia . Full range of ankle movements was seen in 63.3 % patients (19 cases). Equinus deformity seen in 10% of the patients(3 cases). All of these 3 cases had a fracture at lower 1/3rd of tibia . In 13.3% patients (4 cases) ankle was fixed in neutral position which caused slight limping post LRS removal. In 1 case both knee and ankle joint stiffness was seen. It was due to poor compliance in following the instructions provided to the patient and failure to perform adequate physiotherapy for prevention of stiffness. In a study by Mangukiya and Mahajan N et al [—20] joint stiffness was seen in 20% of their cases treated with LRS and in 50% cases treated with AO Monolateral external fixator. Joint stiffness was the most common cause of limping. Limping was seen in 26.7 % of patients (8 cases). LLD was seen in 10% patients (3 cases) which was treated with shoe raise orthoses. In a study by Ajmera and Verma [13] None of the patient had deformity more than 7° The knee ROM, at final followup was more than 120° in 84% (n = 21) cases and ankle ROM of more than 30° in 92% (n = 23) case . 92% having leg length discrepancy of <2.5 cm. In present study bone union was seen in 93.3% patients (28 cases) and nonunion was seen in 2 cases. Both the cases of nonunion were treated with removal of LRS, debridement for the infection to settle and later fixed with bone grafting and plating once the infection settled down. Mean time of union seen was around 44.52 weeks. Mean time of removal of LRS was around 50.66 weeks. This is the time from application of LRS till its removal, which includes time of 1-week waiting, distraction or bone transport time to fill bone gap and 6-18 weeks for fracture consolidation. After approximation of fracture ends, dynamistaion was started which resulted in increased micro motion at the fracture site and enhanced the fracture healing and consolidation. After removal of LRS patient was made to walk on a PTB cast which was removed after a period of 6-12 weeks by which time further consolidation had taken place at the fracture site. In a study by ajmera and verma [13] The mean time for LRS in place was 44 weeks. The mean time to union was 52 weeks. In the present study ASAMI bony score were excellent(63.3%), fair(6.7%), good(30.0%) and poor(6.7%). And ASAMI functional results were excellent(60.0 %), fair(13.3%), good(20 %) and poor(6.7%). Both the patients with non-union had poor bony and functional results.

The above Results of ASAMI score of grade IIIB open tibia fractures treated with LRS was comparable to study by Ajmera et al[13], Patil et al[23] and Pal et al[24] where they found excellent results in 76%,67% and 68.75% respectively; good results in 12%, 25% and 18.75% respectively; fair result in 4%, 4% and 10% respectively; poor results in 8%, 4% and 2.5% respectively. Functional results was also satisfactory in 80% cases which is comparable to functional outcome by Pal et al[24] (75%) and Lakhani et al[25] (75%)

CONCLUSION

Gustilo Open grade IIIB fractures in tibia are commonly seen in adult males less than 30 years of age due to their higher level of activity.

Patients with Gustilo type IIIB fractures should be initially treated with irrigation, serial debridement, antibiotic therapy, adequate fixation with external fixator (LRS) and with sufficient viable soft tissue coverage.

External fixators are the choice of fixation in open fractures of long bones especially in comminuted and Gustilo type IIIB injuries, as there were good to moderate results in our series by using LRS type of external fixator. Also in 93.3% of the cases, the fracture united and 2 patients required revision surgery because of deep infection. Infection is effectively controlled by proper primary wound debridement within 24 hours and fracture fixation with LRS type of external fixator. LRS external fixation with the complexity of the frame configuration provides good fixation. Soft tissue procedures like skin grafting, muscle pedicle flap, myocutaneous flap repair can be easily accomplished with the external fixator in position. Resection of devitalized bone, simultaneous compression of the fracture site or gap can be accomplished with the LRS type of external fixator with low rates of infection and non union. LRS is easy to handle both for surgeon and patient, simple surgical technique with short learning curve, light weighted monolateral simple design that helps in early mobilization of the patient and easy access to soft tissue and wound management, minimal invasive causing less morbidity and shorter hospitalization thus permitting early rehabilitation and less economic burden. Complications are minimal, with good range of movements at neighbouring joints LRS external fixation technique is often successful in salvaging limbs which otherwise would have been at high risk for amputation. Overall LRS proved to be an effective modality of treatment in cases of open fractures tibia with bone loss as definite modality of treatment for damage control as well as for achieving union and lengthening, simultaneously, with the advantage of simple surgical technique, minimal invasive, high patient compliance, easy wound management and relatively lower rate of complications. However further multicentric studies and RCT are suggested before establishing it as an effective modality of treatment in cases of open fractures tibia with bone loss

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