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The Clinical and Functional Outcome of Unreamed Intramedullary Nailing (UTN) In Grade I, II and IIIA (Gustilo-Anderson) Open Diaphyseal Fractures of Tibia – A Prospective Study

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ABSTRACT

Background: The tibial shaft is one of the most common sites of open fractures of all the open fractures. The optimum treatment for open fractures of the tibia remains controversial between so many treatment options. Now there is ongoing controversy between use of reamed and unreamed IMN in open tibial shaft fractures. The aim of our study was to observe the clinical and functional outcome of UTN in open (grade I, II and IIIA) diaphyseal fractures of tibia. **Methods:** In this study, 40 skeletally mature patients with open fractures of both bones of the leg were included for unreamed tibial nailing. **Results:** In 85% patients excellent to good results were obtained, fair in 10% and poor in 5%. **Conclusion:** UTN for open tibia fracture is good option, with, proper and early debridement and fixation very excellent to good results can be obtained in open tibial diphyseal fractures grade I, II and IIIA.

Keywords: Intramedullary Nailing, Fracture.

INTRODUCTION

The tibial shaft is one of the most common sites of open fractures. Approximately 63% open fractures are involving tibia.[1] Associated soft tissue trauma invites many complications such as non-union, delayed union and infection etc. Ramon Gustilo has laid down the foundations of open fracture management; thorough debridement and irrigation, fracture stabilization, early soft tissue coverage and rehabilitation.[2] This management protocol as well as his scheme of open fracture grading revolutionized open fracture treatment. The classification system most commonly used for compound fractures of tibia is modified Gustilo and Anderson classification. This system uses the amount of energy, the extent of soft-tissue injury and the extent of contamination for determination of fracture severity. Progression from grade 1 to 3C implies a higher degree of energy involved in the injury, higher soft tissue and bone damage and higher potential for complications.3 The optimum treatment for open fractures of the tibia remains controversial; treatment options include cast immobilization, open reduction and plate fixation, external fixation and intramedullary nailing. Cast immobilization leaves the wound relatively inaccessible also it may not be possible to achieve or maintain reduction by cast immobilization. Open reduction and internal fixation with plates & screws has yielded unacceptably high rates of infection. External fixation, considered the treatment of choice by many orthopaedic surgeon has the disadvantages of the bulky frames and frequent pin tract infection, non-union, malunion and angular instability.[4,5]

Reamed Intramedullary implants in open fractures of the tibia cause damage to the endosteal blood supply, which may thereby increase the risks of deep infection and non-union. It has, therefore,

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been suggested that insertion of nails without reaming is safer. Also with the advent of image intensifier, high class antibiotics and meticulous debridement technique, stabilization of fractures, and soft tissue cover many orthopaedic surgeons are now using intramedullary interlocking nailing as a primary method of fixation in open fractures of tibia Grade I and II (Gustilo–Anderson classification). Ultimate functional outcome depends on timely union and joint movements preservation.[6,7]

MATERIALS AND METHODS

In this study, 40 patients with open fractures of both bones of the leg were included. All the cases were treated at Department of Orthopaedics Govt Medical College Amritsar and were followed for 9 months. All the fractures in this series were post-traumatic. Skeletally mature patients with Gustilo and Anderson Grade I, II and IIIA compound tibia fractures. Each and every patient so admitted was thoroughly examined clinically and any injuries are ruled out. Careful evaluation of the injured limb as per Gustilo and Anderson classification was done and documented. Copious irrigation of the wound with normal saline solution was done in the Emergency and fracture immobilized temporarily with the help of crammer wire splint or POP back-slab. Every case was given prophylactic intra-venous cefuroxime 1.5g which were continued for 24 hours postoperatively to control and treat infection. Patients were then subjected to surgery after thorough investigations and pre anesthetic checkup. Procedure was carried out as soon as possible under spinal anesthesia. Patient was placed in spine over a radiolucent operating table with leg hanging freely over the edge of operating table. Pneumatic tourniquet was used in all patients. Debridement of the wounds were carried out and wound thoroughly looked for any foreign body if any found it was removed. Wounds irrigated. Patellar tendon splitting approach was used. Entry portal created with awl making sure it is in line with the center of medullary canal. Indirect reduction of the fracture was carried in under image intensifier. Thereafter nail insertion was done without reaming under c arm guidance. All the nails were statically locked with two distal screws and 2 proximal screws. Post-operative daily anti-septic dressing of the wound was done till the clearance of all the dead and necrotic tissue and then shifted to alternate day dressings. Split-skin grafting were considered in case of skin loss after the wound was covered by healthy granulation issue. Partial weight bearing walker was individualized as per fracture type and nail diameter, depending upon the type of fracture and associated injuries. Immediate post-operative and then regular x rays were taken during follow up (4, 8, 12, 24 and 36 weeks). Final outcome was assessed as per modified Johner and Wruh`s criteria.

RESULTS

Majority of the patients in the study were males 30(75%) and 10(25%) of the patients were females. average age of the patients was 39.85. Most of the fractures were caused due to road side accidents. 32 fractures were due to road side accidents. 6 fractures were caused due to fall from height and 2 fracture was due to assault. Associated injuries were found in 5 patients. Two patients had rib fracture, two had clavicle fracture and 1 had distal radius fracture.

Out of the 40 fractures, 20(50%) were type I, 16(40%) were type II and 4(10%) were type IIIA. As per A.O. classification 22(55%) were of Type 42-A, 14(35%) were of Type 42-B and 24(10%) were of Type 42-C. Seventeen patients were operated within 12 hours. Most of the cases were operated under 24 hours. Average diameter of the nail was 8.4mm. Primary wound closure was performed in 31 of the patients. Delayed closure was done in 2 cases. 3 patients required split skin grafting. Four patient required flap coverage.

Knee and ankle range of movement exercise were commenced on first post op day. Patient were kept on non-weight bearing for a period of 4 weeks. Partial weight bearing was started by 4 to 8 weeks as per fracture patterns. Full weight bearing was started between 12 to 28 weeks as guided by clinical and radiological union.

Union was achieved in 38 of the patients with an average time of 23.3 weeks or 5.6 months. 28(70%) Of the fractures were united by 6 months, rest 10(25%) fractures were united between 6 to 9 months. Two (5%) of the fracture did not unite one was type II and other was type IIIA. The average time taken by type I fractures was 22.2 weeks or 5.2 months. The average time taken by type II fractures was 23.8 weeks or 5.75 months. While the average time taken by type IIIA fractures was 27

Table 1: COMPLICATIONS

Complications	Cases			Total
	Grade I	Grade II	Grade IIIA	
Superficial infections	1	2	1	4(10%)
Deep infections	0	1	1	2(5%)
Anterior knee pain	3	4	2	9(22.5%)
Fracture site pain	3	2	1	6(15%)
Non-union	0	1	1	2(5%)
Delayed union	2	4	2	8(20%)
Mal-union	0	1	1	2(10%)
Knee stiffness	3	2	2	7(17.5%)
Ankle stiffness	4	3	1	8(20%)
Shortening >1cm	0	0	0	0
Neuro-vascular def.	0	0	0	0
Screw breakage	0	2	1	3(7.5%)
Compartment syndrome	1	1	0	2(5%)

Infections were seen in 6(15%) cases out of 40 out of which two had deep infection and four had superficial infection which was treated with antibiotics. Mal-union was seen in 2(5%). One hand rotational deformity of 10 degrees and one has varus of 10 degrees. Knee joint stiffness was seen in 7(17.5%) cases 3 of them had range of motion more than 80% as compared to opposite side, 4 had range of movement between 75-80% as compared to opposite side and ankle stiffness was seen in 8(20%) cases out of 20 cases. 4 patients had shortening of < 1cm. None of the patients had shortening > 1cm and non-union was seen in 2(5%) of the cases.

Dynamization was done in 12 patients who were showing sign of delayed union to boost up the healing process. Autologous bone grafting was done in 3 cases of delayed union and 2 were managed with autologous bone marrow aspirate injection.

DISCUSSION

There is still controversy regarding the ideal treatment of open fractures of tibia. The treatment program should ensure a low incidence of complications; it should require minimum possible secondary interventions, short hospitalization and convalescence. Either reamed (Burc et al., 2009),[8] or unreamed intramedullary nailing technique (Salem, 2013),[9] has been reported to be used in the treatment of compound tibial diphyseal fractures. Besides, both of them have different advantages on fracture healing: the reamed nailing has a more rigid structure as the larger nail diameter can be used and earlier fracture union, while the unreamed nailing supplies much better blood to the cortex (Chapman, 1998).[10] The present study was designed to evaluate the clinical outcome of unreamed tibial nailing for open fracture tibial shaft. It included 40 patients presented with in open tibial diphyseal fractures gustillo and Anderson grade I, II and IIIA who were treated by unreamed intra-medullary nailing. One of the primary goals in the management of open tibial fractures is to achieve bony union. Sargeant et al,[11] (1994) suggested that cortical necrosis is less likely to occur with a loosely fitted intramedullary nail than a tightly fitted reamed nail. Reaming of the open fractures has been found to spread the contamination from the open wounds along the medullary canal and to strip the small fragments of bone from the soft tissue attachments. In our study 38 of the 40 fractures united. 95% union rate was achieved which is comparable to study Kaeting et al,[12] (88%), Blachut et al13 (89%). The average union time in our study was 23.31 weeks or 5.6 months which was comparable with the mean union time in studies by Donimath 24 weeks,[14] Blachut (22 weeks).[13] This was found to be better than the various studies using external fixators such as in the study by Court Brown et al.[15] (36.7 weeks).

In our study two case developed non-union which were in grade II and grade IIIA, probably due to soft tissue stripping and infection. Thus only 5% non-union rate was observed in our study comparable to A. Abdelaal16 (5.5%), Joshi et al,[17] (6/56). The we encountered 8(20%) cases of delayed union in which, after waiting for about 20 weeks when abundant callus was not visible in the radiograph and the patient had persistent tenderness over the fracture site. Bone grafting was done in 4. And autologous bone marrow aspirate was injected in 4 of the cases. The reason in the cases was probably was a small diameter nail and soft tissue stripping in open fractures. Primary skin closure was reported in 32(80%) of cases, split skin grafting was required in 6 cases and 2 wound were allowed to heal with secondary granulation due to its small size and these results were comparable to those of Yokoyama et al.[18] who reported successful primary closures in 70.2% cases and secondary closures with Split skin grafts/flaps in 29.8% cases. Hohmann et al,[19] reported low

infection rates with primary wound closure in low energy open tibial fractures in selected cases.

In our study, despite a thorough debridement and an adequate soft tissue coverage, there was overall 6(15.0%) infections. 4 of which are superficial, which were treated with anti-septic dressings and antibiotics. Two patient (5%) had deep infection. Despite regular dressing, oral antibiotics and guarded weight bearing was continued, fracture was unable to unite. Then the nail was removed, sequestrectomy done and LRS was applied. The delay in the surgery could be the reason. The delayed management of these high velocity type III injuries with extensive tissue damage and contamination exacerbates bacterial colonization and chronic deep infections. Joshi,[17] observed incidence of infection in 6 of 56 (10.7%) cases, all of which was in type-III open fractures (75% of all type III cases).

Few patients experienced anterior knee pain, pain at fracture site & locking bolt in treatment phase, most of them were controllable with rest and analgesics. Anterior knee pain is the commonest complication in intramedullary tibial nailing. In our series, it was seen in nine (22.5%) cases. We used the midline longitudinal incision made over the patellar tendon for nail insertion and used a tendon splitting approach for insertion. The etiology of anterior knee pain after intramedullary tibial nailing is uncertain, although there may be a combination of factors responsible. Devitt et al,[20] found arthroscopic evidence of chondromalacia patellae in a small number of patients with anterior knee pain after tibial nailing. They described an increase in force and contact pressure on the lateral facet when the medial Paratendinous approach was used and on the medial facet with a Transtendinous approach.

Results were excellent in 16 patients (40%), Good in 18 patients (45%), fair in 4 patients (10%) and poor in 2 patient (5%) of patients assessed by Johner & Wruh's criteria. Means 85% patients had good to excellent results with UTN. Final result showed comparable final results of various series of treatment of tibial fractures with UTN; conducted by Joshi et al,[17] 85.8 good to excellent results, Madhurkar KT et al,[21] with 90% excellent results.

CONCLUSION

It can be concluded that UTN for open tibia fracture is good option, especially keeping in view the socio-economic status of the majority of the population in this part of the country, who cannot afford multiple surgical procedures. However with, proper and early debridement and fixation very excellent to good results can be obtained in open tibial diphyseal fractures grade I, II and IIIA.

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