ORIGINAL ARTICLE

Primary Medullary Fixation for open fractures of Long Bones

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Abstract

Introduction: *The aim of this study was to assess the role of primary medullary fixation in the management of open fractures of long bones appreciating its advantages and disadvantages.* ***Methods:*** *Twenty-eight patients who had open fractures of long bones (Gr II, IIIA & IIIB) were treated with wound debridement and unreamed intramedullary nailing. The criteria for fracture union were pain-free, unaided walking and bridging callus in two radiographic views.* ***Results:*** *The overall function results were graded as excellent without limitation in 50%. Good and were able to jog but some limitation of athletic participation in 35.71%. 14.28% were able to perform daily activities but unable to jog. There was no apparent correlation between functional rating and type of fracture, grade of soft-tissue injury, pain, and post-traumatic arthritis. About 86 percent of patients who had been employed before injury returned to their previous work within six months. The median time to walking with partial weight-bearing (seven) was seven weeks (range: 5 -7 weeks). The time to full weight-bearing (twelve) ranged from 10 to 24 weeks (median 12 weeks). None had evidence of post-traumatic arthritis at the last follow up.* ***Conclusion:*** *We recommend debridement with primary closure, primary medullary fixation and early antibiotic therapy for open fractures of femur and tibia. Primary skin closure not only covers the soft tissue and bone but also protects from secondary infection and improves blood supply so that early union is facilitated.*

Keywords*: Open fractures of femur, open fractures of tibia, debridement, primary medullary fixation*

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Introduction

Severe bone and soft tissue injuries have become very common now days. The mortality and morbidity associated with these injuries are the main sources of the burden to the individual and to the society at large. William WC et al; have predicted that more than 4.5 million open fractures occur per year in India.[1] The increase in a number of open and complicated fractures of long bones makes a formidable challenge to trauma surgeon. Injuries caused by an automobile bumper striking a pedestrian, a rider was thrown from a motorcycle or an operator crushed by a heavy machine impart much more energy to the tissues than the simple falls and sports injuries that typically cause closed fractures. High energy trauma includes more than half the total tibial fractures and 90 percent of the open fractures, characterized by Bone and soft tissue loss, widely displaced comminuted fragments, with impairment of blood supply at times. [2] The foundation to treat these open fractures was well laid down during and after the Second World War. Yet, the problems of skin coverage, infection and delayed/ malunion / nonunion of fractures remain a challenge to the surgeon.

With improvements in plastic surgery, early skin coverage has proved to lessen the rate of infection. But the controversy remains, as far as the modality of bone fixation i.e. External or Internal with either having their own drawbacks. [3] Aim of this study was to assess the role of primary internal fixation in the management of open fractures in comparison with the conventional methods, appreciating its advantages and drawbacks. The study is undertaken mainly to assess the convenience of management of open wound without

compromising the stability that is necessary for fracture healing. The duration of fracture healing in open fractures and their long-term results are studied.

Materials and Methods

This study was conducted at Prathima Institute of Medical Sciences, Karimnagar from January 2016 to December 2016. Twenty-eight patients who had open fractures of long bones (Gr II, IIIA & IIIB) were treated with wound debridement and unreamed intramedullary nailing. Only fractures which are located within the nailable segment of femur and tibia were included in the study. Medullary canal of femur and tibia was large enough to accept a nail without reaming. Only salvageable limbs with Gr-II, IIIA and IIIB open fractures and a wound that could be rendered clean at operation before nail was inserted were treated with this technique. All patients were available for evaluation. The average duration of follow-up was 12months. There were 26 men and 2 women, ranging from 21yrs to 55yrs (6 femurs and 22 tibias). Most of the fractures were caused by high energy trauma. 24 fractures were caused by RTA(6 motorcycle, 4 pedestrians, 14 MVA) two by occupational injury and two by fall from height. Three pts had associated injuries. Fracture grading was done according to system of Gustilo *et al;* [4] Only fractures of Grades II, IIIA and IIIB were included in the study. 12 fractures were of Gr -II, 4 were Gr-IIIA and 12 were Gr-IIIB. As soon as possible after evaluation and treatment of life-threatening injuries, the wound was thoroughly debrided and irrigated. Time from injury to debridement ranged from 6hrs to 24hrs. Antibiotics administered intravenously in emergency room. All contaminated/devitalized tissues were excised and fragment of bone devoid of soft tissue attachments excised. Nailing was performed immediately after debridement. Nailing of 27 fractures was performed at the time of initial debridement. Nailing of one open femoral fracture was performed 3 days after injury but in this case, debridement was done within 7hrs of injury at a District Hospital. Patients were given cephalosporin and an aminoglycoside. Metronidazole was added for severely contaminated wounds. Efforts were made to obtain definite coverage of wound as soon as possible. 8 wounds were closed by primary suturing, 14 needed split thickness grafts and 6 required flaps including three fascio-cutaneous flaps, two Gastrocnemius flaps and one free flap (perforator based anterolateral thigh flap). All plastic procedures were carried out after bone stabilization. Bone stabilization was done with interlocking intramedullary nail in all cases. Weight-bearing was not allowed till radiological evidence of callus. Patients were scheduled for follow-up visits at 6 week intervals. X-rays of affected leg (AP &lateral) were taken at each follow-up.

Criteria for assessment of result

1. Amount of shortening
2. Range of Movement
3. Alignment of medullary canal
4. Pain
5. Time taken for union
6. Malunion/ non-union
7. Infection
8. Functional outcome.

Results

The Mean follow up was 12 months ranging from 4 months to 30 months. 93%of the patients were male of 20-40 age groups, with an average age of 28 years.51% of injuries were road traffic accidents, 21% due to falling from the height. There were 26 Male patients and 2 female patients. Femur fractures were in 6 cases 21.43% and tibia fractures were in 22 cases 78.57%.

Table 1: Age wise distribution of the patients involved in the study

Age (years)	Number of cases	Percentage
21 – 30	16	57.14
31 – 40	10	35.71
41 – 50	0	0
51 – 60	2	7.14
Total	28	100

There were 12 type II, 4 type IIIA and 12 Type IIIB fractures. Most of the compound fractures involved tibia (78.5%) and 21% were of the femur. Three patients (21%) had associated injuries (fractured pelvis, femur, and tibia). Eight wounds were closed by primary suturing, 14 needed split thickness grafts and 6 required flaps including three Fascio cutaneous flaps, two Gastrocnemius flaps and one free flap

(perforator based anterolateral thigh flap) table 2.

Table 2: Method of suturing used in the treatment of the patients

Method	No of cases	Percentage
Primary suturing	8	28.57
Primary SSG	14	50
Primary Flaps	6	21.43
Total	28	100

Table 3: types of nails used in the treatment

Type of nail used	No of cases	Percentage
K nail	6	21.42
V nail	10	35.71
Tibial IL Nail	12	42.86
Total	28	100

The average duration of hospitalization for Gr II type was 17 days, for Gr IIIA is 19.5 days and for Gr IIIB is 22.83days. Total average duration of hospital stay is 19.66 days. None of the cases had any gross restriction of motion either at the hip, knee. Two had 5-degree equinus at ankle. No malunions were noted. There were ten superficial infections which were controlled well with antibiotics for 3weeks after culture. Two had deep infection necessitating wound debridement. The wound was left open until the infection was quiescently followed by split skin graft as a secondary procedure. This patient was kept on antibiotics for six weeks.

Table 4: Complications of the treatment done in the patients

Complications	No	Percentage
Nerve Damage	0	0
Malunion	0	0
Delayed union	10	35.71
Nonunion	0	0
Superficial Infection	10	35.71
Deep Infection	2	7.14

The overall function results was graded as excellent -- without limitation in 50% good -- able to jog but some limitation of athletic participation in 35.71% were able to perform daily activities but unable to jog in 14.28%. There was no apparent correlation between functional rating and type of fracture, grade of soft-tissue injury, pain, and post-traumatic arthritis. About 86 percent of patients who had been employed before injury returned to their previous work within six months. The median time to walking with partial weight-bearing (seven) was seven weeks (range: 5 -7 weeks). The time to full weight-bearing (twelve) ranged from 10 to 24 weeks (median 12 weeks). None had evidence of post-traumatic arthritis at the last follow up.

Discussion

The goal of open fracture management is to obtain an anatomic, functional limb and return the patient to their pre-injury level of functions as quickly as possible. This study once again confirms the importance of early soft tissue cover following radical debridement and fixation. The fundamental principles of management of open fractures of long hones are well accepted: these include immediate wound exploration, irrigation and debridement, bony stabilization, appropriate use of antibiotic therapy, repeated wound debridement and early soft tissue coverage. Past experience with cast immobilization for open fractures leads to high incidence of nonunion, deformity and long-term immobility. [5] External fixation can be effective for the treatment of open tibial fractures, but the technique has long learning curve and has a higher complication rate than intramedullary fixation. In type II and III open fractures, external fixation had 52% rate of delayed union/nonunion compared with 20% for unreamed nails. Malunion greater than 3° developed in 16% of type II and III fractures treated with external fixation compared with 5% of fractures treated with intramedullary nails. [6] In our study all 28 cases were followed completely. All cases were treated as under the protocol with debridement, primary intramedullary fixation and primary wound closure with primary suturing, split-thickness skin grafts or primary flaps. Open fractures of long bones were observed to be more common in the young and middle-aged males. In most of the fractures, internal fixation is done within 24 hrs after hospitalization. Minimal soft tissue handling and thorough debridement was the aim during the operative procedure. Thorough irrigation with normal saline proved to be useful. If reduction of the fracture could not be achieved through the same wound, open reduction was restored by extension of the same wound in majority of cases. Healthy wounds which were taken up early were sutured primarily (8 cases); large areas which were

healthy but could not be sutured were covered by split skin grafts (14 cases) or flaps (6 cases). Daily aseptic dressing of open wounds was done.

In our study most commonly, encountered complications were delayed onion (10 cases) and superficial infection (10 cases). Out of 10 cases of delayed union, 6 are of GrIII B (4 tibia,2 femur) and 4 Gr II fractures (4 tibia). All fractures were united by 32 weeks. Paige Whittle *et al;* reported that out of 50 open fractures of tibial shaft treated with debridement and interlocking nailing without reaming. Nonunion rate was 4% and average time taken to union was seven months. [6] Timothy Bonatus *et al;* reported 71 open fractures of tibia treated with interlock nail in which 68% fractures united by 6 months, delayed union was in 15% and 17% had nonunion. [5] Ronald W Singer *et al;* reported that 98% of open tibial fractures treated with intramedullary nailing united in average time of 6.1 months but 47% of fractures needed an additional procedure before union. [7] Robert Brumback *et al;* reported that all fractures of femur were united by an average of 5.2 months after treating with intramedullary nailing. However, this study includes 31% of Gr I open fractures. [8] In our study, higher incidence of delayed union and nonunion could be explained by high velocity trauma (88.71%); Gustilo type III open fractures (57.14%) and complex fractures. Superficial infection was present in 10 cases(35.71%) and deep infection in two cases (7.14%). Superficial infection was controlled with parenteral antibiotic therapy and daily antiseptic dressings. In one of type IIIB open tibial fractures,distal screw site was infected. It was resolved with screw removal, curettage of screw tract and antibiotic therapy. In another type IIIB tibial fracture, deep infection of soft tissues was present which was treated with local debridement, antibiotics and wound healed secondarily. Singer *et al;* reported deep infection rate of 12% after treating 43 open fractures of tibia with unreamed locked intramedullary nailing. [7]Brumback*et al;* reported that out of 62 open fractures of femur (GrII and Gr III), deep infection developed in three: in one after immediate intramedullary nailing and in two after delayed intramedullary nailing. [8] In 1979, in the series of studies by Rittman et al; there were 214 open fractures, all but nine of which were treated with internal fixation. The overall rate of osteomyelitis was 7 percent, eight (26 percent) of thirty-one fractures with grade-III soft-tissue injury had an infection. [9] We attribute the low incidence of infections in our own study, to several parts of our protocol: the use of prophylactic antibiotics beginning in the emergency room, immediate and thorough debridement, early reduction and stabilization of the fractures, and soft-tissue management by primary skin closure and the use of skin grafts when necessary. This minimizes damage to the blood supply to the skin and other soft tissues and prevented further bacterial colonization of the wound. [10] We strongly believe that the early stabilization of the fracture fragments maximizes the ability of the soft tissues to resist infection and to heal, so that optimum functional results can be obtained.

Conclusion

Our study concludes the importance of aggressive debridement, medullary fixation with nails wound closure and immediate antibiotic therapy. Medullary fixation not only stabilizes the bone but also minimizes the infection, hospital stay, postoperative pain, and facilitates early ambulation. It is further maintains limb length, minimizes angular deformities and promotes mobilization of joints. Primary / early skin cover not only covers the soft tissue and bone but also protects from secondary infection and improves vascular bed so that early union is facilitated. Based on our results, we recommend primary medullary fixation of open fractures of long bones along with early soft tissue cover following wound debridement and early antibiotic therapy.

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