

Antibiotic Coated Intramedullary Interlocking Nailing for Compound Lower Extremity Fractures – Assessment of Clinico-Radiological and Functional Outcomes

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Abstract

Introduction: Compound lower limb fractures are prone to infections that cause significant morbidity, increased health care cost, duration of hospital stays, and occupational loss. Antibiotic coated intramedullary nailing is one of the effective methods in preventing implant related infection. This study was designed to assess the clinico-radiological and functional outcome of compound lower limb fractures treated with antibiotic intramedullary interlocking nailing.

Material and Methods: Thirty-two cases with compound lower limb fractures between age group 21 to 60 years belong to Gustilo grade I, grade II, grade IIIA and grade IIIB types were recruited. The antibiotic coated intramedullary nail was prepared by incorporating antibiotic bone cement, 4g vancomycin and 80mg gentamycin. Postoperative follow up was done till six months and parameter like status of infection, status of wound, and radiological assessment of fracture union were assessed.

Results: Road traffic accidents (68.75%) were common cause of fractures. Postoperatively, 9.37% reported superficial and 3.15% showed deep infection. In regard to clinical outcome, 50% fair, 31.5% good and 15.62% excellent outcome recorded. The radiological outcome was good in 62.5%, and excellent in 25%. The functional outcome was good in 43.75%, excellent in 31.25% and fair in 18.75%.

Conclusion: Antibiotic coated intramedullary nail was safe, effective management option for compound tibial fractures with minimal deep infection rate.

Keywords: Antibiotic intramedullary nail, lower limb fractures, efficacy, infection.

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Introduction

Compound bone fractures and associated infections are major challenges for orthopedic surgeons [1]. Compound fractures result from high energy trauma mainly due to road traffic accidents [2]. It causes decreased mobility and increased incidence of

infection. Deep wound infections related to bony fractures are associated with increased duration of hospital stay, morbidity and involves with higher costs [3]. The rate of infection is depending on the implant type and fracture severity.

Intramedullary nailing is the gold standard treatment choice for the open closed limb bone fractures due to its biological and biomechanical advantages. However, postoperative infection of intramedullary nailing is unusual, with a reported rate of 0.9 to 3.8%. If not managed timely that was associated with osteomyelitis, physical disability, nonunion of fracture and systemic sepsis [4]. However, appropriate management after intramedullary nailing is unclear and controversial [5,6].

Antibiotic coated implants are best in line to mitigate such infection [7]. A systemic review suggested that antibiotic treatment can mitigate the incidence of infections in open tibial fractures [8]. Few comparative studies on antibiotic coated and non-coated nails in the management of tibial fractures suggested that antibiotic coated implants are effective in reducing the incidence of infection and cost burden [9]. The present study was designed to assess the clinico-radiological and functional outcome of compound lower limb fractures treated with antibiotic intramedullary interlocking nailing.

Materials and Methods

The present prospective study was conducted in the Department of Orthopaedics at MNR Medical College and Hospital, Sangareddy during March 2021 to August 2022. A total of 32 cases with compound fractures attending emergency of Orthopaedics department between age group 21 to 60 years were recruited. Cases with grade I, grade II, grade IIIA and grade IIIB types of compound fractures treated with antibiotic coated intramedullary nailing within 24 hours of injury were included.

Cases with segmental fractures, limb and skeletal deformities, fractures associated with severe pathologic conditions and cases not

willing to participate were excluded. Written informed consent was obtained from all the study participants and study protocol was approved by institutional ethics committee.

According to ATLS guidelines, cases were resuscitated and fractures were graded as per Gustilo and Anderson classification. All the participants were subjected to necessary laboratory investigations. X-ray of antero-posterior view and lateral view of fracture site of the limb was taken. After the anesthesiologist evaluation and procedure, wound debridement was performed till adequate exposure of the fracture site. The antibiotic coated intramedullary nail was prepared by incorporating antibiotic bone cement, 4g vancomycin and 80mg gentamycin by manual or using hand gun. Antibiotic coated intramedullary nail was inserted and fixed through jig and distal screws.

In the postoperative management, routine antibiotics and periodic dressings were done till the patient discharge. Stitches were removed on 12th postoperative day. Static or dynamic quadriceps strengthening exercises and knee movement exercises were advised to start after surgery. Skin grafting was done depends on wound condition. The cases were followed up till 6 months after surgery. The routine laboratory investigations, status of knee and ankle pain, status of infection, status of wound, radiological assessment of fracture union by RUST score, and range of joint movement were recorded at every follow-up.

The recorded data was analyzed by using SPSS version 23.0. Descriptive statistics was used to analyse categorical variables and reported in frequency and percentages. Association analysis was performed by Chi-square test. $P < 0.05$ was considered as statistically significant result.

Results

Table 1: Sociodemographic details of study participants

| Demographic variables | Total o of cases (n=32) | |
|---|-------------------------|------------|
| | Frequency | Percentage |
| Age | | |
| 21-30 | 09 | 28.12% |
| 31-40 | 11 | 34.37% |
| 41-50 | 07 | 21.87% |
| 51-60 | 05 | 15.62% |
| Gender | | |
| Male | 26 | 81.25% |
| Female | 06 | 18.75% |
| Side of fracture | | |
| Unilateral right | 13 | 40.62% |
| Unilateral left | 19 | 59.38% |
| Mode of fracture | | |
| Road traffic accidents | 22 | 68.75% |
| Fall from height | 09 | 28.12% |
| Assault | 01 | 3.12% |
| Fracture site | | |
| Proximal part | 08 | 25% |
| Middle part | 13 | 40.62% |
| Distal part | 11 | 34.37% |
| Fracture type (Gustilo Anderson score) | | |
| Grade I | - | - |
| Grade II | 18 | 56.25% |
| Grade III-A | 08 | 25% |
| Grade III-B | 06 | 18.75% |
| Duration between injury to surgery | | |
| <24 hours | 29 | 90.62% |
| >24 hours | 03 | 9.37% |
| RUST score | | |
| Score 4 | 02 | 6.25% |
| Score 8 | 05 | 15.62% |
| Score 10 | 18 | 56.25% |
| Score 12 | 07 | 21.88% |

Table 2: Details of fractures, associated injuries and postoperative infection

| | Total cases (n=32) | |
|-------------------------------|--------------------|------------|
| | Frequency | Percentage |
| Fractures and injuries | | |
| Tibial plateau fractures | 01 | 3.15% |
| Fibular fractures | 32 | 100% |
| Metatarsal fractures | 01 | 3.15% |
| Distal radius fractures | 03 | 9.37% |

| | | |
|--------------------------------|----|--------|
| Pelvic injury | 01 | 3.15% |
| Pattern of fracture | | |
| Short oblique | 18 | 56.25% |
| Transverse | 05 | 15.62% |
| Comminuted | 06 | 18.75% |
| Spiral | 02 | 6.25% |
| segmental | 01 | 3.15% |
| Postoperative infection | | |
| No infection | 28 | 87.5% |
| Superficial infection | 3 | 9.37% |
| Deep infection | 1 | 3.15% |

Table 3: Association between duration of surgical delay and postoperative infection

| | Duration of surgical delay | |
|---------|----------------------------|-----------|
| | >24 hours | <24 hours |
| Grade 0 | 01 | 22 |
| Grade 1 | 02 | 01 |
| Grade 2 | 05 | 01 |
| p-value | 0.001 | |

Table 4: Clinical, radiological and functional outcome among study participants at 6th month

| | Total cases (n=32) | |
|---|--------------------|------------|
| | Frequency | Percentage |
| Clinical outcome | | |
| Excellent | 05 | 15.62% |
| Good | 10 | 31.25% |
| Fair | 16 | 50% |
| Poor | 01 | 3.12% |
| Radiological outcome (RUST score) | | |
| Excellent | 08 | 25% |
| Good | 20 | 62.5% |
| Fair | 03 | 9.37% |
| Poor | 01 | 3.12% |
| Functional outcome (Johner-Wruhs criteria) | | |
| Excellent | 10 | 31.25% |
| Good | 14 | 43.75% |
| Moderate | 06 | 18.75% |
| Poor | 02 | 6.25% |

Discussion

Majority participants were between age group 31-40 (34.3%), 21-30 (28.12%) and 41-50 (21.87%) years with male predominance (81.25%). Unilateral left side

(59.38%) fractures were common than right side (40.62%). Road traffic accidents (68.75%) were common cause of injury followed by fall from height (28.12%) and

assault (3.12%). Fractures at the middle part (40.62%) of limb were common than proximal (25%) and distal part (34.37%). According to Gustilo Anderson score, grade II type (56.25%) fractures were commonly encountered followed by grade III-A (25%) and grade III-B (18.75%). The timeline between injury and surgery was below 24 hours in 90.62% cases and more than 24 hours in 9.37% cases. Radiological assessment of fractures by RUST score showed that 56.25% had score 10, followed by score 12 (21.88%), score 8 (15.62%) and score 4 (6.25%). A study Patel D *et al.*, found that road traffic accidents (87.5%) was common cause of injury followed by fall from height (12.5%). As per Gustilo and Anderson classification system, type 3A fractures (65%) were common followed by type 2 (22.5%) and type 3B (12.5%) [10]. A study by Prakash P *et al.*, stated that road traffic accidents are common cause of injury in 80% of cases (n=30) [11].

Short oblique types (56.25%) of fractures were common followed by comminuted (18.75%), transverse (15.62%), spiral (6.25%) and segmental fractures (3.15%). Postoperative infection was not observed in 87.5% of cases. However, 9.37% reported superficial infection and 3.15% showed deep infection (Table 2). The association analysis between duration of surgical delay and chances of postoperative infection was significantly associated ($p < 0.05$) (Table 3). A study Patel D *et al.*, found no superficial and deep infection among cases postoperatively (10). A study by Joshi D *et al.*, found anterior knee pain as common complication followed by knee stiffness, screw breakage, superficial early infection, delayed union and infected non-union with chronic osteomyelitis associated with open tibia fractures [12]. A study by Craveiro-Lopes N reported that the infection rate (6%) and complication rate (25%) was significantly low in antibiotic interlocking intramedullary nail [13]. A study by Vigesh S *et al.*, found superficial infection

in two cases and deep infection in one case managed with antibiotic coated intramedullary nailing of open tibial fractures [14]. The findings of present study were similar to the above findings where superficial infection was encountered more than deep infection.

At the 6th month of post-operative follow up, majority cases reported fair (50%) clinical outcome followed by good (31.25%) and excellent outcome (15.62%). Poor clinical outcome was seen in one case (3.12%). According to RUST criteria, radiological outcome was good in 62.5%, excellent in 25%, fair I 9.37% and poor in 3.12% cases. Assessment of functional outcome of joint by Johner-Wruhs criteria showed good outcome in 43.75%, excellent in 31.25%, moderate in 18.75% and poor outcome in 6.25% of cases. A study Patel D *et al.*, reported good functional outcome in 57.5%, excellent in 37.5%, fair in 5% and none of the case showed poor functional outcome. According to RUST criteria, 37.5%, 57.5%, and 5% cases showed excellent, good and fair radiological outcome [10]. A study by Prakash P *et al.*, found excellent clinical outcome in 10% of cases, good in 26.67%, fair in 53.33% and poor outcome in 10% [11]. A study by Joshi D *et al.*, assessed functional outcome as per modified Ketenjian's criteria, reported excellent outcome in 67.9%, good in 17.9%, fair in 3.6% and poor functional outcome in 107% cases [12]. A study by Vigesh S *et al.*, reported good functional and radiological outcomes with prophylactic antibiotic coated nailing in the management of grade II and grade IIIA type open tibial fractures [14].

A study by Taylor H *et al.*, using the antibiotic coated implants in the open fracture management and cases with high risk infection are effective and reduce the economic burden [9]. A study by Craveiro-Lopes N concluded that antibiotic interlocking intramedullary nailing was safe, had minimal infection rate, faster

consolidation and fewer complications compare to standard interlocking nail method [13]. A study by Abdelsalam EA *et al.*, concluded that antibiotic cement impregnated nailing is effective and safe method in the management of tibial fractures [15]. A study by Wasko MK *et al.*, reported that antibiotic cement coated nail was effective method for the management of intramedullary infections of the tibial fracture [16]. A study by Dhanasekhar R *et al.*, opined that antibiotic cement impregnated nailing is cost effective, safe, effective in inflectional control and provided good stability in the management of infected non unions of long bones [17]. The present study outcome was similar to the above studies. In view of limitations, present study has limited sample size and focused on clinico-radiological and functional outcome and not included microbiological outcome. Further studies are required to conduct with higher sample size and compare the multiple methods available to treat limb fractures.

Conclusion

The results of present study showed that majority cases treated with antibiotic coated intramedullary nail showed good to excellent radiological and functional outcome and fair to excellent clinical outcome. Deep wound infection was less countered than superficial infection with better fracture healing capability. The cases underwent surgery within 24 hours had better post-operative outcome in terms of healing and union. To be concluding, the antibiotic coated intramedullary nail was safe, effective management option for compound tibial fractures.

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