



INCIDENCE OF INFECTION AFTER EARLY INTRAMEDULLARY NAILING OF OPEN TIBIAL SHAFT FRACTURES STABILIZED WITH EXTERNAL FIXATORS

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ABSTRACT

Thirty-two patients had a severe open fracture of the tibia that was initially treated by external fixation and subsequently by unreamed intramedullary nailing. The external fixation had been maintained for an average of sixty-one days (range, ten to 260 days). The mean interval between removal of the external fixator and intramedullary nailing was twenty-five days (range, 10 to 40 days). Eight out of twelve patients who had an infection at one or more of the pin sites, an infection later developed around the intramedullary nail. In comparison, only five of the twenty-five patients who had not had a pin-site infection had an infection later around the nail. An analysis of other variables, including the duration of external fixation, wound coverage, other injuries, and the type of fracture, showed that none was a predictor of infection either at the pin sites or around the intramedullary nail. We concluded that a pin-site infection that develops during external fixation is a contraindication to the subsequent use of unreamed intramedullary nailing in patients who have a fracture of the tibia. **Background:** Compound fractures of the shaft of tibia represent one of the most common lower extremity fractures. Definite intramedullary nailing of tibial shaft fracture after external fixation (EF) is controversial due to infection risk, which can be much. On the other hand, isolated EF management is also problematic. It also improves patient comfort (healing care, ankle rehabilitation) and may enable earlier return to work, if sedentary. It may be performed early (within 2 months of fracture), after a "damage control" phase, or later with a view to facilitating fusion. It remains a subject of debate, with varying reported rates of fusion and of infection. The present continuous retrospective series was therefore analysed to determine: **Materials and Methods:** We retrospectively reviewed 32 cases of open diaphyseal fractures of the tibia of varying severity that were managed at our institute from 2013 to 2019 with primary stabilization with tubular fixator. All the cases included in the study had a staged treatment (primary external fixation followed by intramedullary nailing) because of either delayed presentation or multiple associated injuries. Cases that had less than two-year follow-up were not included in the study. Once there were no signs of local wound infection (no swelling, erythema, or discharge), patients were allowed for definitive internal fixation with intramedullary nail. The present study therefore analyzed tibial shaft intramedullary nailing, to determine infection and union rates, and whether intramedullary nailing associated to external fixator ablation increased the risk of infection. **Results:** Fourteen patients (43.7%) in which one (16.7%) from Gustilo type I, five (35.7%) from Gustilo type II and eight (66.7%) from Gustilo IIIB injuries were developed intramedullary infection, in which three patients were cured by debridement and implant retention till the fracture union. Later on the implants were removed in two patients within two years of period. In Gustilo type I fractures, the average time to union was 20 weeks, whereas for Gustilo types II and III, it was 28 and 44 weeks, respectively. There were two cases of frank nonunion (6.25%), both followed by infection of the fracture site and loosening of the implant. There was one case of malunion which was treated with Ilizarov external ring fixator. **Conclusion:** Definite intramedullary nailing after external fixation is a controversial treatment option. Statistically, the sole factor significantly increasing infection risk was skin wound severity on the Gustilo classification. In Gustilo type IIIB and IIIC fracture, there are high rates of EF pin site infection. We concluded that a pin-site infection that develops during external fixation is a contraindication to the subsequent use of intramedullary nailing in patients who have a fracture of the tibia.

KEYWORDS : Open tibial fracture, External fixator, intramedullary nailing

INTRODUCTION

Tibia is the commonest site for open fractures. These injuries often result in extensive damage to the soft tissue and bone. With high rates of infection and frequent injury to neurovascular structures, they have a high incidence of complications and poor treatment outcome. Treating these injuries requires experience and judgment. It remains one of the most challenging problems facing the orthopedic surgeon. Modern-day management of these injuries has focused on thorough debridement, immediate bony stabilization, and tissue cover to enable early mobility and restoration of optimum function.

Primary internal fixation in the form of interlocked nailing is being undertaken in most of these fractures. Staged treatment with primary external fixation is preferred only for patients who either present late, or have multiple injuries precluding

immediate intramedullary nailing. Pin tract infection is seen in more than 40% cases. ,, Maurer and Gustilo in their study showed that exchange nailing after external fixation using pin fixator had 25% chance of deep infection, and the same was as high as 71% when nailing was done after there was an evidence of pin tract infection. Most of the studies have shown a high risk of deep infection (more than 20%) when exchange intramedullary nailing is done after external fixation with pin fixators. ,,] McGraw and Lim reported 44% deep infection after exchange nailing. The primary objective of this study was to analyze the incidence of deep infection on conversion to intramedullary nail and the union time.

Materials and Methods:

We retrospectively reviewed 32 cases of open diaphyseal fractures of the tibia of varying severity that were managed at our institute from 2013 to 2019 with primary stabilization with

tubular external fixators. All the cases included in the study had a staged treatment (primary external fixator followed by intramedullary nailing) because of either delayed presentation or multiple associated injuries. Cases that had less than two-year follow-up were not included in the study. Once there were no signs of local wound infection (no swelling, erythema, or discharge), patients were allowed for definitive internal fixation with intramedullary nail. The present study therefore analysed tibial shaft intramedullary nailing, to determine infection and union rates, and whether intramedullary nailing associated to external fixator ablation increased the risk of infection.

All the fractures were classified as per AO fracture classification for fracture anatomy and Gustilo and Anderson classification for nature of open injury. All the fractures selected were of the diaphyseal segment. The fixator was applied under spinal anesthesia. Attempt was made to achieve soft tissue cover by loose closure of soft tissue or by immediate flap cover done by the plastic surgeon. However, in two cases of Gustilo type III injuries, adequate soft tissue cover could not be achieved in the first sitting. These were managed by Vac dressing and secondary flap cover.

In all cases, intravenous antibiotics were used. Choice of antibiotic to use depends on the local antibiotic sensitivity patterns. Pin site care was given in the form of removal of crust, gentle massage of soft tissue around the pin site, and simple dressing with saline and betadine. Once there were no signs of local wound infection (no swelling, erythema, or discharge), patients were allowed for definitive internal fixation with intramedullary nail. The mean interval between removal of the external fixator and intramedullary nailing was Twenty-five days (range, 10 to 40 days). The average time between injury and nailing, twelve weeks. All patients were followed until either the fracture had united or there was an established non-union or infection.

All cases were closely followed in the postoperative period for evidence of superficial or deep infection at the fracture site including pin-site infection. Cases with local pain, swelling, erythema, and serous discharge (culture positive for pathogen) from the fracture site were labeled as superficial infection and were managed with elevation, drainage, and additional course of antibiotics as dictated by culture sensitivity. Patients were also monitored for evidence of deep infection in the form of wound abscess and systemic features of infection including radiological evidence of periostitis or osteomyelitis. Pin-site infection was considered to be present when there was culture-positive purulent discharge from one or more pin sites when the fixator was removed. All the cases were followed up for 6 months to 2 years for union and other complications like secondary osteomyelitis and nonunion. The subjective and objective criteria used for establishing union were absence of pain on full weight bearing, lack of swelling, tenderness, or abnormal mobility at the fracture site with radiographic evidence of bridging callus in various phases of consolidation. The injured limb was labeled free of infection in the absence of pain, swelling, or discharge from the fracture site or any of the clamp sites along with the absence of any radiological evidence of osteomyelitis, like sclerosis, osteolysis, and implant loosening.

RESULTS:

The mean age of the patients was 32.4 years (ranged 18 to 65 years). Fifteen fractures were AO type 42B, six fractures were simple AO type 42A fractures, and eleven had complex AO type 42C fracture pattern. On debridement, 14 patients had Gustilo type II injury, 6 patients had Gustilo type I, and 12 patients had Gustilo type III injury and complex fracture anatomy. Average delay in debridement and application of

external fixator was 18.4 h (range, 3-36 h) from the time of injury. The delay was due to late presentation, as many cases had to be moved from remote locations. Average delay in intramedullary nailing was 14 days. Most of the type I and type 2 injuries were taken up within 5-14 days for nailing, and type 3 injuries were taken up 15-21 days after injury.

In 12 patients (37.5%), there was infection from the one or two pins sites, which was cured by dressing, changing pins and oral antibiotics.

Fourteen patients (43.7%) in which one (16.7%) from Gustilo type I, five (35.7%) from Gustilo type II and eight (66.7%) from Gustilo IIIB injuries were developed intramedullary infection, in which three patients were cured by debridement and implant retention till the fracture union. Later on the implants were removed in two patients within two years of period. Rest eleven patients (34.4%) again treated with implant removal and Ilizarav external ring fixator. Two patients with Gustilo IIIB injury developed deep infection around the intramedullary nail 3-5 weeks after nailing. The fracture developed into an infected nonunion, requiring removal of the implant and Ilizarav external ring fixator and multiple surgeries. In both these cases, there was more than 18 days of delay in the exchange nailing, and wound cover was achieved with flap rotation by plastic surgeon.

Thus overall, 14 patients (43.7 %) cases were developed intramedullary infection, most of which patients were either from Gustilo type III i.e eight patients (66.6%) or five (35.7%) from Gustilo type II injuries. Most of the patients (66.7%) who developed intramedullary infections were also had pin tracts infection previously.

In Gustilo type I fractures, the average time to union was 20 weeks, whereas for Gustilo types II and III, it was 28 and 44 weeks, respectively. There were two cases of frank nonunion (6.25%), both followed by infection of the fracture site and loosening of the implant. There was one case of malunion which was treated with Ilizarav external ring fixator.

DISCUSSION:

Primary interlocking nail can safely and reproducibly stabilize most low-energy and selected high-energy open fractures of the leg. However, primary nailing may not be feasible in cases of delayed presentation and polytrauma. These cases require staged reconstructive protocol using external fixator as the primary method of bony stabilization External fixator followed by delayed unreamed interlocking nailing minimizes the disadvantages of external fixator alone (bad cosmesis, frequent pin trouble, risk of fracture through the pin tract, risks of malunion, delayed union, and nonunion, and non-compliance of patients in pin tract care affecting fixator durability). This type of fixation is often used for severe open tibial fractures, especially for patients with polytrauma, as a 'damage control' method. It is a useful and safe solution for open or closed femoral fractures in severely damaged multi-trauma patients. However, it risks having intramedullary infection as a result of: pin-site infection, prolonged external fixation, the short safety interval between removal of the external fixator and intramedullary nailing, reamed procedure in secondary nailing, non curettage of pin sites at the removal of the external fixator, and poorly vascularised soft tissue coverage or delayed skin coverage. [.]

Review of the available literature shows that use of conventional pin fixators is associated with a high risk of pin tract infection. Hence, exchange intramedullary nailing within 10-12 days is recommended. If exchange nailing is delayed (more than 3 weeks), the rate of infection rises remarkably (20-45%). If there is established pin tract infection, it may even be as high as 71%.

There are few limitations of the study. First, there were no blind observers. Second, although AO classification of fracture pattern is quite accurate with negligible intra-observer variation, the same cannot be said for Gustilo classification of open injury. Finally, being a retrospective study, proper randomization and comparison with a control cohort who underwent primary stabilization with pin fixator was not possible; hence, the available literature was used to compare the results of this study.

There was only a high rate of Gustilo type III open fracture (66.6%, 8/12), compared to the reports by Matsoukis et al.] (25% type III, and 5% deep infection), McGraw et al. [] (80% type III, and 44% deep infection) and Gustilo et al. [] (42% type III, and 32% deep infection).

66.7% (8/12) patients were developed infection in whom the pin tract had infection during external fixator period. Thus, we concluded that this is a contraindication of the intramedullary nailing in the patients with pin site infection and we should think an alternative treatment in Gustilo Type III injuries.

However there are some study shows that the use of pinless external fixator in spite of threaded pins, for primary stabilization of open tibial shaft fracture, facilitates further management and decreases the rate of infection after intramedullary nailing as seen with the use of pin fixators.

CONCLUSION:

On the basis of the high incidence of complications in both the present series and the few reports in the literature, we concluded that alternative treatment options should be carefully considered before electing this sequential method of fixation.



Fig 1.



Fig 2

Table 1- Details Of The Different Series In The Literature.

	Gustilo II, IIIa,b fractures (number)	Duration of external fixation (days)	Safe Interval (days)	Pin-track infection (%)	Deep infection (%)	Healing time (wk)	Nonunion (%)
McGraw et al ¹	7/16	59.5	16	42.8	28.5	13.6	57.1
Maurer et al ²⁰	20/24	52.1	73	25.0	20.0	-	-
Johnson et al ⁶	7/13	84.0	14	28.5	0.0	11.6	0.0
Blaich et al ⁴	34/41	17.0	9	5.0	5.0	-	5.0
Wheelerwright and Court-Brown ¹⁰	10/21	57.4	12	33.3	4.8	27.5	0.0
Siebenrock et al ¹²	24/135	44.8	6	8.3	0.0	21.5	4.1
Bemat et al ¹¹	10/21	185.0	0 ^a	9.5	0.0	19.5	-
Antich et al (present series)	17/17	27.0	10	20.5	5.8	26.0	5.8

^a not as an established protocol
[†] at the same surgery stage

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