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Comparison of flexible intramedullary nailing with external fixation in compound tibial shaft fractures

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Abstract
Aim: This study compared the results of flexible intramedullary nailingusing Ender nails (EN) with those of external fixation (EF) in compound tibial shaft fractures.
Materials and Methods: Twenty-eight patient with tibial shaft fractures were evaluated in thestudy. The patient ages ranged from12 to 40 years, and the average period of follow-up was 24 months. Fifteen patients underwent flexible intramedullary nailing using Ender nails and thirteen patients underwent external fixation. The outcomes were assessed based on the clinical and radiology findings.
Result: Bone union was achieved in all cases, and no patients sustained a complication that was expected to cause disability. For EN union occurred at an average of 12 weeks (10-14 weeks). For EF, union was observed at an average of 16 weeks (14-18 weeks). EN group, one patient suffered proximal pin migration. In the EF group, three patients had a pin site infection and loosening.
Conclusion: The EN and EF groups showed similar results at the last follow up. However, in the EF group, refracture, pin site infection, and angular deformity were some of the possible complications during the healing process. EN is recommended for grade I & II tibia fractures, not require secondary operative treatment, stable as it is intramedullary implant.

Keywords: Compound tibial shaft fracture, enders nail, external fixation

Introduction
Compound fracture of tibia is quite common fracture. As tibia has less muscle envelope so it is prone to get open fracture. It has been traditionally treated with irrigation, thorough debridement antibiotic coverage and fracture fixation. Recently, various treatments have been chosen according to the patient's age, associated injury, location of the fracture, degree of soft tissue injury, or the experience of the surgeon the use of firm internal fixation has become the standard of treatment. External fixation (EF) and flexible intramedullary nailing have been used to treat the fracture.We report the treatment results as well as the advantages and disadvantages of 15 cases of EN and 13 cases of EF for compound tibia shaft fracture.

Materials and Methods
This study involved 28 patient with an compound tibial shaft fracture between the ages of 12 and 40 years, who were treated either with EN or EF. Fracture were classified according to Gustillo and Anderson Classification.

Type	Characteristics
1	Open fracture with a wound < 1 cm
2	Open fracture with a wound < 1 cm without extensive soft tissue damade
3	Open fracture wih extensive soft tissue damage
3a	3 with adequate soft tissue damage
3b	3 with soft tissue loss and periosteal stripping and bone exposure
3c	3 with arterial injury needing repair

The operations were performed on a fracture table under spinal anaesthesia with fluoroscopic control.

Firstly the wound was thoroughly irrigated and debrided and Ender nail was inserted at the level of tibial tubrostity on the lateral side and then on the medial side of the tibia. With bone awl Cortex was perforated and the tip of the enders nail was negotiated and with gentle hammering nail was inserted. under fluoroscopic guidance, reduced fracture was confirmed and nail was driven past the fracture. Care was taken to form spindle at the fracture site. As Enders nail is malleable and curved it is easily inserted into the medullary canal. On the same way the opposite nail was inserted on the medial side of the cortex at the same level.

External Fixator, was applied in the cases which presented with compound tibia fracture. Through irrigation and debridement of wound was done followed by external fixator application. Two pin proximal and two pin distal to fracture site was applied, end to end apposition was done, fracture aligned followed by connecting rod application. Regular antiseptic dressing of compound fracture site and pin insertion site was done separately at regular interval. With progress of time when wound got healed & fracture seemed to be uniting. We left the external fixator as such for 3 months. But in cases where wound healing was good but fracture site was not uniting secondary operative procedure was planned and performed.

Records of the time from injury to union, reduction failure, angular deformity, infection, and refracture were carefully made.

Results

Bone union was achieved in all cases, and no patients sustained a complication that was expected to cause disability. For EN, union occurred at an average of 12 weeks (10-14 weeks). For EF, union was observed at an average of 16 weeks (14-18 weeks).

In the EN group, one lateral nail migrated proximally which was removed at 4 weeks but there were no complications such as infection, reduction loss, or bursitis on the nail insertion site. In the EF group, 3 patients had a pin site infection and pin loosening, which was treated with antibiotics and healed after removing the device at the time of union.

In EN one patient had coronal plane angulation ＞10 on the follow-up. Therefore, correction was made, followed by application of PTB cast. The flexible intra-modularly nail was removed at an average of 18 months (18-24 months) after surgery and the external fixators were removed after an average of 12 weeks (14-16 weeks). There was coronal plane angular deformity ＞15 in the EF Group. However, this has no observable effect on the final outcome.

Three patient had limitations of knee or ankle motion, or a limping gate. On the radiograph, no patient had a shortening of the injured side.

Fig 1: Grade I compound tibia fracture treated with EN (enders nail)

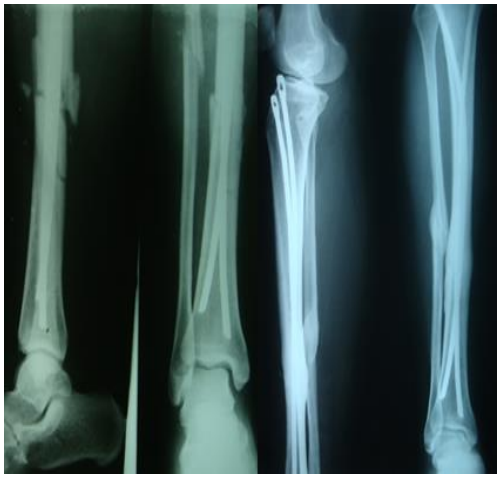

Fig 2: Grade II compound tibia fracture treated with EN(enders nail)

Fig 3: Grade III compound tibia fracture treated with EF (external fixator)

Fig 4: Grade III compound tibia fracture treated with EF (external fixator)

Discussion

In this study, tibial shaft fractures associated with head injuries, multiple fractures, were excluded, and only compound tibial shaft fractures were examined. EF involves no soft tissue dissection and leaves little scarring, and is easy to remove. The disadvantages are the presence of an external device that causes apprehension in the patient and a high rate of pin-track infections. The possibility of re-fracture, delayed union, or overgrowth are also some of the reported disadvantages [1, 2, 5, 6, 12]. Aron-son and Tursky [1] reported the results of EF in 44 tibia fractures. They achieved bone union over an average of 16 weeks, a 10 % rate of pin-track infections, and 5.8 mm of overgrowth. Kim *et al*. [12] reported that they required an average of 16 weeks for bone union and noted 4.8 mm of overgrowth and 2 cases of refracture. In this study, bone union took an average of 18 weeks, and in the 3 cases (23%) with a pin track infection. It was assumed that the insufficient dynamization of the external fixator might have shielded the fracture site from the forces necessary to

encourage sufficient callus formation, which led to refracture after removing the device.

EN allows the early recovery of knee joint motion and weight bearing. In addition, it pre-serves the circulation around the fracture site, which promotes bone union because it works as an internal splint to maintain the length and alignment of the tibia. However, migration of the nail, skin irritation, and bursitis over the insertion site are some of the complications reported [2, 3, 7, 8, 10, 11, 13, 15]. Flynn *et al.* [8] reported that full weight bearing without a brace was possible within an average of 16 weeks using FN but irritation of the soft tissue by a prominent nail tip occurred in 4 cases, and refracture after premature of the nail occurred in one case. However, there was no significant leg-length discrepancy >1 cm or angular deformity >5. Yun *et al.* [15] reported that full weight bearing without a brace was possible within an average of 16 weeks Five cases showed an angular deformity >5 and 2 cases showed leg length discrepancy >1 cm. One fixation failure and one deep soft tissue infection at the entry point of the nail were some complications.

Similarly, in our study, full weight bearing without plaster was possible within an average of 20 weeks. One case of nail migration occurred but there was no infection, fixation failure, angular deformity, or soft tissue irritation occurred. In the last follow up radiographs, 4.2 mm of overgrowth was shown but did not affect the gait, and no angular deformity >5 was observed. In previous studies, weight bearing was begun early. However, in this study partial weight bearing was started after callus formation on the radiograph and full weight bearing was started after bone union, which is believed to have prevented the angular de-formity. In addition, the tip of the nail was close enough to the cortex so as not to irritate the surrounding soft tissues.

Bar-On *et al.* [2] reported that in the EN group, the parents' satisfaction with the treatment was much greater and full weight bearing was possible earlier than in the EF group. In addition, in the EF group, refracture, pin site infection, quadriceps atrophy and angular deformity were some of the complications encountered. In this study, there were no significant differences between the two groups in the last follow up but similar complications to those reported elsewhere occurred in the EF group during the process.

Conclusion

In this study tibia shaft fractures were treated with either EF or FIN with Ender nails in patient between 12 and 40 years. The FIN and EF groups showed similar results at the last follow up. However, in the EF group, refracture, pin site infection, and angular defor-mity were some of the possible complications during the healing process.

FIN is recommended for grade I & II tibia fractures, not require secondary operative treatetment, stable as it is intramedullary implant, high change of union micromotionposssibe at fracture site better wound care and EF is better for grade III compound injury, but may require the secondary operative procedure, wound care is combersonme and difficult, unstable implant high chance of pin tract infection, losing so there is high chance of implant failure.

Thus FIN better for grade I & II while EF better for grade III compound tibia fracture.

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