

ORIGINAL ARTICLE

COMPARISON OF EARLY MANAGEMENT OF COMPOUND GRADE 2 AND 3A (GUSTILO-ANDERSON) FRACTURES OF TIBIA SHAFT USING PRIMARY INTRAMEDULLARY NAILING AND PLACEMENT OF ANTIBIOTIC BONE-CEMENT BEADS, WITH THAT OF EXTERNAL FIXATOR APPLICATION

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ABSTRACT

Introduction: Compound fractures of tibia have been conventionally managed by debridement and external fixation, followed by intra medullary nailing or Ilizarov technique after few months. Definitive surgery is delayed in the early stages, as it may cause infections and additional soft tissue damage. But external fixators have their own set of complications. Hence a technique of antibiotic coated intramedullary nail (locked or unlocked) has been advocated.

Methodology: Total 30 patients with grade 2 & 3 A (Gustilo-Anderson) compound tibia fractures were selected for the study. Group 1 was operated with antibiotic coated intramedullary nails. Group 2 was operated with external fixators application and later with intra medullary nailing.

Results: The infection rate after nailing was 6.67% in group 1 (1out of 15) and 40% (6 out of 15) in group 2 (p=0.02 i.e. statistically significant).The timing to healing (cortical bridging) was 4.5 months (2 - 8.5months) in group 1 and 7.5 (3-18) months in group 2. (p=0.02i.e. statistically significant).The overall complication rate was 60% (9/15 cases) for group 2 and 26.67% (4/15 cases) for group 1 (p=0.03 i.e. statistically significant).Results of primary nailing with antibiotic impregnated cement are superior to delayed nailing after initial external fixation.

Conclusion: Primary nailing with antibiotic impregnated cement method is biologically active with greater advantages compared with existing methods of treatment in grade 2 & 3A compound tibia fractures. Clinical results are better with a lower infection rate and a less hospital stay.

Keywords: Compound Fractures, Tibial shaft, Intramedullary Nailing, Antibiotic Bone-cement Beads

INTRODUCTION

Compound tibia fractures comprise 25% of tibia fractures and are on rise due to high energy trauma due to road traffic accident, industrialization etc. These fractures are managed conventionally by emergency debridement and application of external fixation devices, followed by a definitive treatment after soft tissue healing, that may take a few weeks to months.^{1,2} A technique of antibiotic coated intramedullary nailing (locked or unlocked) has also been advocated and practiced at some centers, though it requires under-sizing of the nail by 2 mm or so.³

Microbial contamination during compound injuries is mostly by gram negative rods and gram positive

staphylococci and sometimes the MRSA. Topical therapy by incorporating heat resistant antibiotic in polymethacrylate cement, which is then placed in wound, is becoming popular. There is extensive literature about debridement within 24 hours for compound tibia fractures and is very effective to reduce the rate of infection.^{1,4,5,6}

There is also extensive literature available that primary nailing in compound tibia fracture within 24 hours is effective in many patients for early fracture healing.^{7,8,9,10} Negative pressure system such as Vacuum Assisted Closure (VAC) prevents desiccation of cortical bone and has also been recommended.¹¹ Risk of reoperation is 18% in unreamed nailing alone, along with risk of non union and deep infection.⁹ Theoretically, reaming of the medullary canal and placement

of large nail will give better biomechanical stability. However concern is about deterioration of endosteal blood supply from reaming. There are many studies which compared reamed and unreamed nails and formed no statistical difference with regards to time to union, rate of union, infection and frequency of implant breakage (nail).^{9,12} Most surgeons feel immediate intramedullary nailing poses an increased risk of septic complication and delayed nailing after external fixation could decrease this risk. There are many studies which show plating has higher failure rate and complications in compound tibia fractures and hence should not be done.^{10,13,14}

Ilizarov ring fixation though proven useful, has many disadvantages like steep learning curve and are heavy implants, and so are reserved for non-unions or malunions, rather than primary fixation. Hence nailing remains only viable option with or without antibiotic cement, primary or delayed (after external fixator application). Antibiotic cement decreases local infection but the application of cement decreases the diameter of nail. Hence we preferred antibiotic beads over antibiotic impregnated nail. We wanted single surgery as far as possible, and hence did not do external fixation prior to nailing. That is why we decided to do primary unreamed intramedullary nailing with antibiotic beads for compound tibia 2,3A fractures.

METHODOLOGY

The present study was a prospective cohort studies from 2012 to 2014. Total 30 patients with Grade 2&Grade 3A Gustilo Anderson compound fractures of Tibial shaft which came to different hospitals in Pune district attended by 2 surgeons were selected for study. Patients with segmental fractures, fractures with significant bone loss, grade 3B & C tibia fracture, degloving injuries and patients with life threatening injuries were excluded from the study.

Permission was obtained from ethical committee of the institutional to conduct the study. Informed written consent of all the participants were obtained before enrollment. Those who were not willing to give written consent were not included in the study.

Group 1: Patients were operated under suitable anesthesia after being made hemodynamically stable. After debridement, intramedullary nail (V-nail or interlocking nail) of appropriate size was selected. Unreamed nailing procedure was performed as recommended using medial para-patellar approach. Antibiotic

otic mixed polymethacrylate cement beads were prepared over thin stainless steel wire during the surgery and inserted through the wound. Due to wound size limitations most often only single beads chain of 3-5 beads could be inserted. One end of bead chain was kept out of wound for easy identification and removal after 6-8weeks. Antibiotics commonly used were Vancomycin 2gm or Gentamicin 320mg. After insertion of bead chain, wound closure was done. Post-operatively, patients were given limb elevation, IV antibiotics, and intravenous fluids for about 5 days. Suture removal was done after 12-14 days. Some patients in whom locking was not done were given above knee slab for about 6 weeks. Patients were mobilized on crutches but not allowed to bear weight till radiological signs of union were seen on X-ray. Patients were followed up for 1 year with 2 monthly X-rays.

Group 2: After debridement of the compound fractures, external fixator was applied and repeated dressings and IV antibiotics were given for about 12-14 days. After the wounds were healthy or healed, delayed intramedullary nailing was done. No beads were used as wound almost healed them.

Both groups of patients were given prophylactic antibiotics for 5 days and we're discharged between 6 to 12th days after nailing. Weight bearing was permitted with crutches after X-rays showed signs of healing.

RESULTS

There were total 30 patients enrolled in the study and out of which 15 were included in Group 1 and 15 were included in Group 2. Mean age of patients of group 1 was 47 years (18-74 yrs). And of group 2 was 40 years (22-77yrs). In group 1 there were 13 male and 2 female patients and in group 2 there were 10 male and 5 female. This difference was not statistically significant (p=0.10)

The mean follow up was 2.1 yrs (4 months to 2 yrs) for group 1, and 2.4 yrs (5 months to 4 yrs) for group 2 (p=0.19). The infection rate after nailing was 6.67% in group 1 (1out of 15) and 40% (6 out of 15) in group 2. This difference was statistically significant (p=0.02). The average time to heal (cortical bridging) was 4.5 months (2-8.5 months) in group 1 and 7.5 (3-18) months in group 2. (p=0.02 i.e. statistically significant). The overall complication rate was 60% for group 2 and 26.67% for group 1. This difference was statistically significant (p=0.03).

Table 1: Post operational condition of patients

Variable	Group 1	Group 2	p-Value
Infection Rate	1 (6.67%)	6 (40%)	0.02
Average time to heal	4.5 months	7.5 months	0.02
Overall complication rate	4 (26.67%)	9 (60%)	0.03

Table 2: Different types of Complications in both the groups

Complications	Group 1 (n=15) (%)	Group 2 (n=15) (%)
Non union	1 (6.67)	0
Nail Infection	1 (6.67)	6 (40.0)
Nail Breakage	1 (6.67)	1 (6.67)
Fat embolism	1 (6.67)	0
Knee stiffness	0	2 (13.33)
Total	4 (26.67)	9 (60.0)

Table 2 shows difference complications in both groups. In group 1, total 4 (26.67%) patients got complications. There was one case of each of non union, nail infection, nail breakage and patient developed fat embolism. Nonunion patient had to undergo Pheister grafting and cast. One nail breakage patient had to undergo nailing again with wider interlocked nail. Fat embolism patient was managed by medical treatment. Nail infection in one patient decreased after nail removal after healing of fracture (till then patient was on antibiotics).

In group 2, there were total 9 (60%) got complications. Two patients had knee stiffness, six had nail infections and one had nail breakage. One nail breakage was managed by revision nailing. 4 cases of nail infection required antibiotics cement beads and or antibiotic impregnated cement nails. 2 cases could be managed by antibiotics for 8-10 months followed by nail removal after fracture healing. However one patient had chronic fistulae formation and refused further surgery.

A new method of treatment is used which biologically active with greater advantages compared with existing methods of treatment. Clinical results are excellent with a lower infection rate with less hospital stay and treatment costs. Antibiotic impregnated cement beads as compared to group in which delayed nailing was done after initial external fixation ($p=0.02$) significantly. Time to healing was less in primary nailing with beads group than delayed nailing group. ($p<0.02$) Overall complication rate was significantly less in primary nailing with beads group as compared to delayed nailing group ($p=0.03$). Lower hospital stays obvious as there is no delay in nailing in primary compared to delayed nailing group. This brings down treatment cost.

DISCUSSION

It has been estimated that more than 4.5 million open tibia fractures occur per year in India.² These fractures have significant morbidity, as the potential for contamination is high. Gustilo classification has been most widely used. Infection risk has been reported to be 0-2% for type 1 and 2-10% for type-

2fractures & 10-50% for type 3 fractures.^{14,15} With systemic antibiotics given within 3hrs of injury, risk of infection decreases 6-fold. With the propensity for gram positive infections, IV Cephalosporins are preferred. However for Type 3 fractures, additional coverage for gram negative organisms and anaerobic organisms is advised. General consensus is to maintain antibiotic coverage until wound is closed. Open fractures should be taken up for surgery on emergency basis using appropriate surgical judgment.⁷ Surgical intervention with irrigation and meticulous debridement of injury decreases contamination and infection.¹⁶ Recent studies have shown that open fractures are often contaminated with nosocomial organisms (I.e. pseudomonas) and that early closure may help prevent these infection.^{7,15} Early stabilization of open fractures provide length, alignment, and rotation restoration which prevents further damage from mobile fracture fragments. This decreases soft tissue dead space and infection. The surgeon has many choices for fixation including external fixation, intramedullary nails and plates. There are many studies which shows plating has higher failure rate and complication in compound tibia fracture.¹³ Hence we preferred to carry out study with external fixator and intramedullary nail only. However there are many studies which show external fixation alone has high failure rate as regards union and hence is often used only as temporary fixation device for wound management.^{13,10,17,18} Hence delayed nailing after initial external fixation is often employed and literature studies shows that infection in compound fracture tibia nailing can be brought down after initial external fixation. Ilizarov fixation can be used as definitive fixation but is cumbersome, heavy, has a steep learning curve and is commonly used for malunion or nonunion cases.¹⁹ Considering these literature studies we carried out comparative studies between delayed nailing after external fixation and primary nailing. To decrease infection we decided to use local antibiotic delivery system of heat stable antibiotic polymethacrylate beads with primary nailing. We prepared the beads intra operatively over 24 number of stainless steel wires, and inserted it through fractures wound. We prepared Vancomycin plus Gentamicin beads and retained it in autoclaved container in aseptic environment for use in few other cases. Hence we could use prepared beads from 40gm cement, 2gm Vancomycin, 320 mg Gentamicin in almost 5 compound fractures on an average. Hence this treatment becomes economical also. As reamed nailing has increased infection chances in compound fractures we preferred unreamed nailing. Antibiotic cement coated nails are usually made with 8-10 mm diameter and don't have adequate resistance to fatigue and bending forces. Also cement around such nails is prone to decoupling and jamming during insertion and extraction. Hence we did not use them and went ahead with beads as they were economical also. Newer an-

tibiotic delivery system like bioabsorbable calcium sulfate / phosphate is costly and we did not use them.

CONCLUSION

Results of primary nailing with antibiotic impregnated cement beads are superior to delayed nailing after initial external fixation. Hence this method of treatment is biologically active with greater advantages compared with existing methods of treatment in grade 2,3A compound tibia fractures clinical results are excellent with a lower infection rate may less hospital stay.

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