

Management of Infected Nonunion of Long Bones, A Case Series

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ABSTRACT

Objective: To evaluate the management of long bones infected nonunion.

Methods: This retrospective study was conducted between July 2014 and July 2017. Inclusion criteria was to include all cases of infected nonunion of long bones with no evidence of union within six to eight months, irrespective of loss of bone. All patients were thoroughly investigated and evaluated clinically, labs and X-rays. All patients were assessed by the Association for the Study and Application of Methods of Ilizarov (ASAMI) criteria for radiological and functional outcomes.

Results: In this study, Twenty cases of infected nonunion (tibia 14, and femur 6) were used. There were 14 males and 6 female subjects, for whom the average age was 35 ± 6.21 SD (range 18-52). 15 patients had open fracture while 5 patients were post internal fixation. Infection was eradicated and the union was achieved in all cases. The average time to union was a mean of 10 ± 1.1 SD months, ranging from 8 to 12 months). The follow up was a mean of 18 months (range 16-20 months). In case of tibia and femur as per the ASAMI score, radiological results were excellent in 14/20 (70%) and good in 4/20 (20%), 2/20 (10%) showed fair results and no patient had poor result. Functional outcomes were excellent in 13/20 (65%) subjects, 5/17 (25%) were rated as good, and 2/20 (10%) as fair. Union was achieved in all three cases of humerus.

Conclusion: Infected non-unions pose challenge to both patient and surgeon. Ilizarov fixator gave good and excellent results in complex non-union of long bones by eradicating infection, filling the defect with bone transport and correcting the deformity.

Key words: Long bones, Infected nonunion, Ilizarov

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INTRODUCTION

Long bones with infected nonunion of fractures are not only complicated surgical problems with a high morbidity but also chronic and occasionally worst conditions for the patients. Nonunion of long bones functionally leads to instability. Patients with nonunion can also suffer economic hardship and loss of self-esteem. Due to increased presentation of high velocity trauma that is more frequently treated with internal fixation the incidence seems to be increasing [1,2,3,4,5,6].

Orthopaedic Surgeons find the management of infected nonunion as perhaps one of the most challenging complication of long bone healing [7,8,9]. In clinical practice, nonunion of long bones due to

infection are prevalent. Along with persisting infection, soft tissue and bony loss, deformity, limb length discrepancy and joint stiffness and coexisting the problems usually complicate the nonunion [10,11]. According to Gustilo [12], due to cicatrization and scarring, resistance developing to causative microbes, repetitive surgeries, immobilization of adjacent joints, presence or absence of a gap nonunion and fracture site avascularity are factors supplementary to infected nonunion. Unfavorable environment is created by infection, which when associated with mechanical instability which hampers fracture healing [13].

Infected nonunion may be defined as a failure of union along with persisting infection of site of fracture for six- eight months [14]. The union seems less likely to occur without active intervention. Experts have proposed several different surgical treatment options including extensive debridement with or without bone graft [15], antibiotic-impregnated cement beads [8], free-tissue transfer [16], and Ilizarov methods [17]. Traditionally, two staged procedure is followed for

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treatment of infected nonunion. In first stage, infected nonunion is converted to an aseptic nonunion by debridement and possible insertion of cement bead impregnated with antibiotics along with systemic (IV or oral) antibiotics. Subsequently, stability is achieved either by internal or external fixation and bone graft coming in the second stage [18].

The Ilizarov external fixator has been established as an effective treatment for providing stability to a fracture nonunion while debridement and other interventions can be undertaken for control of infection [17]. In this study, we assessed utility of Ilizarov external fixator as a primary surgery in tibia and femur and two stage procedure (extensive debridement, cement beads placement and later on internal fixation) in humerus in infected non-union of long bones management in terms of union rates, control of infection and associated complications.

METHOD

This retrospective study was conducted retrospectively upon cases between July 2014 and July 2017. Inclusion criteria was infected nonunion for 9 months with no evidence of union, with or without bone loss. All included patients were thoroughly investigated and evaluated both clinically labs (CBC, ESR, CRP and S. albumin, Ca Vit D) to assess nutritional status, and radiologically Xray. All cases had established non-union with evidence of infection for the last 9 months. A diagnosis of non-union was made by physical signs of fracture site tenderness, movements at fracture site and radiologically by either no progressive evidence of bone healing for last 3 months or no bony union at a total of nine months. A nonunion was labeled infected, when either patient complained of discharge from pariety of affected bone or there was a discharging sinus on examination. It was further confirmed by elevated inflammatory markers i.e WBC counts, ESR and quantitative CRP. Plain radiographs were also scrutinized for sclerosed, necrotic bone, i.e sequestrum. All included patients underwent baseline investigations for anesthesia fitness. All patients had history of previous surgery either debridement, implant removal, internal fixation or external. Five patients had hypertension and 3 had diabetes mellitus. Six patients were Ex-smoker. All cases of tibia and femur were primarily treated with debridement and Ilizarov external fixation. In cases of humerus first

removal of implant with extensive debridement and interim application cement beads followed by definitive stabilization.

Operative procedure

Patients were operated under spinal anesthesia. In first step thorough debridement and excision of atrophic bone was done, followed by chipping technique via osteotome at nonunion site if required, An ring external fixation with appropriate sized or suitable configuration was used to as per Ilizarov method in compression mode. Post operatively patients were given IV antibiotics in accordance with C/S results for 6 weeks. Post-operative weight bearing started as tolerated with range of motion exercises. Patients were followed up with one month interval and radiographs were taken to check for healing. One each visit infection markers ESR and CRP were regularly checked. Once union At least 3 cortices showing signs of union (callus formation) on plain radiograph and clinically no discharge and pain achieved Ilizarov external fixator removed and brace given for 3 weeks. All patients were evaluated using ASAMI scoring system [5] bone/Radiological results and functional results.

RESULTS

Twenty cases of long bone infected nonunion (tibia 14 cases, and femur 6 cases) were included in our study. 14 males and 6 female patients were including with a mean age was 35 ± 6.21 SD (range 18-52). Infected nonunion were found in open fractures in 16 patients and post internal fixation 4 patients. two tibia, and 2 femur were post internal fixation. Diaphyseal nonunion in 15 patients while 5 were metaphyseal. Bone grafting was done in 8 patients.

Infection eradication with union was achieved in all cases. Union time was a mean of 10 months, ranging from 8-12 months. The average follow-up was 18 months ± 2 , ranging from 16-20 months. As per the ASAMI score, radiological results were excellent in 14/20 (70%) and good in 4/20 (20%), 2/20 (10%) showed fair results and no patient had poor result. Functional outcomes were excellent in 13/20 (65%) subjects, 5/17 (25%) were rated as good, and 2/20 (10%) as fair. Union was achieved in all three cases of humerus. Complications such as infected Pin tracts were seen in four patients who improved with regular dressing. Three patients had pin loosening that were

exchanged. No patient had neurovascular complication after MUA and physiotherapy. while two patients had knee stiffness which improved

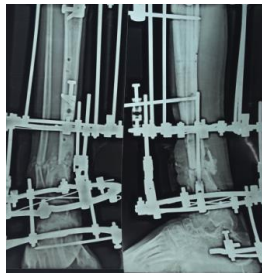
Table 1: Asami Scoring System [5]

| ASAMI SCORING SYSTEM | |
|-----------------------------------|---|
| Bone/ Radiological Results | |
| Excellent | Union, no infection, deformity<7°, limb length discrepancy<2.5 cm |
| Good | Union + any two of the following: no infection, deformity<7°, limb length discrepancy<2.5 cm |
| Fair | Union +only one of the following: no infection, deformity<7°, limb length discrepancy<2.5 cm |
| Poor | Non-union / re-fracture / union + infection + deformity>7° + limb length discrepancy>2.5 cm |
| Functional Results | |
| Excellent | Active, no limp, minimum stiffness (loss of <15°knee extension/<15° dorsiflexion of ankle), no reflex sympathetic dystrophy, insignificant pain |
| Good | Active with one or two of the following: Limp, stiffness, RSD, significant pain. |
| Fair | Active with three or all of the following: Limp, stiffness, RSD, significant pain |
| Poor | Inactive (unemployment or inability to return to daily activities because of injury) |
| Failure | Amputation |

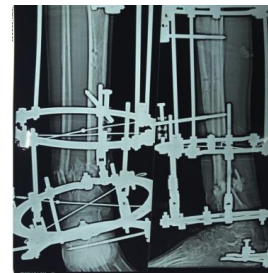
Case # 1



A: Pre-Operative



B & C: Post-Operative



D: Follow Up

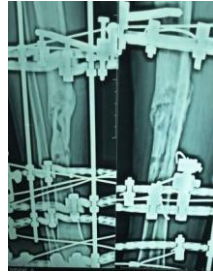


E: After Ilizarov removal

Case# 2



Pre-operative



Post-operative



Follow Up



Case # 3



Pre-operative



Post-operative



Follow Up



DISCUSSION

Mostly cases of long bone infected nonunion are due to surgical infection or open fractures. Managing resistant infection often requires the combination of local and systemic treatments. The ultimate aims of treatment are eradication of infection, prevention of recurrence, and normal limb function restoration. The literature stresses upon the importance of extensive surgical debridement to get rid of these infections. Rate of recurrence and reoperation is higher with only surgical debridement and systemic antibiotics without adding local antibiotics. Multiple surgeries further worsen the already damaged condition of soft tissue and blood supply makes it difficult for antibiotics to penetrate [19].

The treatment modalities in an established infected nonunion of long bones are thorough debridement along with skeletal stabilization, use of antibiotic coated nail, antibiotic beads along with nail/plate, open cancellous bone grafting, an antibiotic impregnated, osteoconductive, bioabsorbable bone substitute, ring/rail fixator and excision of infected segment followed by distraction osteogenesis to fill the gap [5].

We studied 20 cases of infected nonunion, union was achieved in all and infection control rate was 100%. Chen *et al* [20]. and Babhulkar and Pande [22], using a 2-stage procedure, reported complete eradication of infection and a 100 percent union in their study. Twenty cases of infected nonunion were studied by Thonse and Conway [21] with bony defects. 95% rate of control of infection was seen in their study whereby antibiotic-infused cement nails were used in 2 of their cases while the rest underwent a secondary procedure

Struijset al noted that one stage debridement and Ilizarov frame bone transport resulted in union in 70%-100% of cases across various studies with the rate of persistent infections being 0% to 55% with no fresh evidence of progress of healing [23]. In a study by Pande H [24], they achieved union in 94.4% cases and the rate of persistent infection was 5.6% (1 patient out of 18; the patient who required eventual amputation).

Comparing our results with the Ilizarov method using the ASAMI criteria of evaluation, our radiological results were found to be excellent, good and fair in 70%, 18% and 12% cases respectively and no patient had poor result. Functionally 65% patient's results

were excellent, 23% good, and 12% were found fair. In a similar study conducted by Sala F et al [25], bone results were reported as 83.3%, 16.7% 0% 0%; excellent, good, fair, and poor respectively and functional results, excellent in 50%, good in 42%, and fair in 8%. In another study by Muhammad Shoaib Khan in terms of outcome, 29(64.44%) patients had excellent bone results, 9(20%) had good results, 2(4.44%) had fair results and 5(11.1%) had poor bone results. There were 32(71.11%) patients with excellent functional result, 8(17.77%) good, 2(4.44%) fair and 3(6.66%) patients had poor results [28]. Patil S reported 42% excellent 34% good 10% fair and 14% poor in radiology and 44%, 44%, 6% and 6% excellent, good, fair, and poor functional results respectively [26]. In a study by Chattopadhyay P [27] bone score results where 50% were classed as excellent, 33% as good and 17% as fair. Functionally, 17% was graded as excellent, 50% as good, and 33% as fair.

Four out of 17(23%) patients treated with Ilizarov had pin tract infections, in contrast to a study by Pande H who reported 38% pin tract infection in his similar study [24]. Apart from infections, we observed knee stiffness in 2 patients in our series who had supra condyle fractures were treated with Ilizarov. They improved with manipulation under anesthesia and regular physiotherapy.

CONCLUSION


Infected nonunion pose challenge to both patient and surgeon. Ilizarov fixator gave good and excellent results in complex non-union of long bones by eradicating the infection, filling the defect with bone transport, and correcting the deformity.

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AUTHORSHIP AND CONTRIBUTION DECLARATION

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