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Role of external fixator in non union and lengthening of long bones

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ABSTRACT

Due to increasing number of high-energy traumatic events, the incidence of complex and compound fractures are also on the rise. Such fractures are often exposed to various environmental contaminants, Inadequate debridement and sometimes erroneous decision making leading to cases of infected nonunions. Eradication of infection in such cases and achieving union may sometimes lead to serious challenge to orthopaedic surgeons. Presence of comminution, bone gap or deformity can seriously complicate the situation. No definite surgical technique has been found to be full proof in dealing with these infected nonunion cases. In this scenario, the Orthofix rail fixator is emerging as a useful option for infected nonunions with deformity or gap nonunion.

Methods: Four cases of infected nonunions involving tibia (n=3), femur (n=1) were treated by Orthofix rail fixators after debridement of the infected nonunion site. Flap cover procedure was done as per necessity. Bone gaps and limb length discrepancies were dealt with bone transport or limb lengthening . Weight-bearing and removal of fixator was decided according to the radiological evidence of healing.

Results: All the nonunions and the regeneration sites healed uneventfully, although the union time was varied (range, 21-52 weeks). Commonest complication was pin-tract infection and pain.

Conclusions: Orthofix rail fixator is an excellent tool for management of infected nonunions which is easy to apply, comfortable for the patient with minimum complications and predictable as well as reproducible outcomes.

KEYWORDS Infected Bone, Nonunion, Bone transport, Limb lengthening, Fixator.

INTRODUCTION

Incidences of complex open injuries of the limbs are on the rise owing to the increased number of high energy vehicular accidents in recent times, which subsequently giving rise to more cases of infected non-unions.[1] Infected non-union of long bones are not only a source of functional disability but also can lead to economic and social hardship. Infected non-union has classically been defined as a state of non-union of fracture for at least six months with persistent infection at the fracture site. Infected non-union can result from various aetiologies, commonest being, open fractures, previous surgical procedures or as sequelae to osteomyelitis of bone. Infected non-unions have been the menace for Orthopaedic surgeons since decades, because of various factors, i.e. a) previous surgeries would have resulted in cicatrisation of the soft tissue with an avascular environment around the fracture site, b) chronic discharging sinus suggestive of pus collection and possible presence of sequestrum, c) necrosis of fracture ends near the non-union site up to variable lengths, due to thrombosis of vascular channels of the bones, d) prolonged immobilization, multiple surgeries with fibrosis of the muscles resulting in stiffness of adjacent joints, e) the microorganism may have developed resistance to multiple antibiotics, f) occurrence of limb length discrepancy and deformities, and g) variable degree of soft tissue loss or defects requiring multiple sessions of plastic surgical reconstructions.[2,3] Various researchers over the years have used many different approaches to deal with these complex problems. But, it has not been possible to address all the problems mentioned above by using any single technique. Therefore attempts are often made to follow a technique which can minimise the total number of additional surgical procedures, apart from being able to achieve union and controlling infection. External fixation devices which are compatible with "distraction osteogenesis" and gradual correction of deformities are gaining popularity in recent times in the management of infected nonunions.[4,5] External fixation device has shown great promise in such cases. In this study, we present our experience of treating infected non-unions of long bones by use of Orthofix external fixators with distraction osteogenesis.

METHODS

This study was prospectively conducted in the Department of Orthopaedics of Maharishi Markandeshwar Institute of Medical Sciences, Mullana, Ambala. A total number of 4 patients presented during this period with infected non-union of long bones like femur, tibia were included in the study. Among the study group 3 patients were males and 1 was female. Out of them, 3 were tibial and one case was femoral infected non-unions. All the patients were treated by external fixator of various dimensions and configurations. The patients were evaluated by routine blood investigations like complete blood counts, quantitative CRP and erythrocyte sedimentation rate. Swab samples were taken from the discharging sinuses for culture/ sensitivity and Gram staining. AP and lateral view radiographs of the affected limbs were taken to check for deformity, bone cavity, sequestrum, bone loss or comminution. Distal vascularity of the limbs and soft tissue as well as skin conditions was evaluated. Plastic reconstructive surgery opinion was sought for any possible need for soft tissue coverage surgery.

Fig 1: Preop xray of nonunion tibia

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Fig 2: Railfixator with removal of infected bone

Fig 3: removal of infected part

Fig 4: Showing fibrous union of tibia

Fig 5: Preop & Post op xray of femur

INCLUSION /EXCLUSION CRITERIA

Patients with radiological evidence of non-union and signs of infection at the nonunion site were included in the study. Patients those were excluded were non-unions of congenital aetiologies and pathological fractures due to non-infective causes or cases with radiological signs of progressing union.

RESULTS

All the 4 patients had good results. The average shortening was about 1cms. Average time taken to control the infection was 4 weeks ranging from 2 weeks to 10 weeks. Average time taken for the fracture to heal was 7 months ranging from 4 to 13 months. Femur took the shortest average time at 7 months to heal and tibia took 11 months on an average. The faster healing of femur was probably because of better vascularity due to good soft tissue coverage and tibia being subcutaneous bone at most of its length took longer time to heal as vascularity is low. There was 1 pin tract infections out of 4 patients and settled with local treatment and antibiotics

DISCUSSION

The management of infected non-union has remained a constant challenge. The associated factors like delayed presentation, bone defects or gaps, shortening, deformities and poor soft tissue conditions complicate the treatment further as presented in Figure 4.[6] Treatment recommendations for non-union of long bones range from non-invasive and semi-invasive methods to extensive surgical interventions. The non-invasive methods include electric stimulation, low-intensity pulsed ultrasound and extracorporeal shock wave therapy etc.[7,8] The various surgical methods include bone marrow injection, autologous bone grafting, fixations using intramedullary, extramedullary and external fixation devices.[11-16] But the presence of infection at the fracture site changes the scenario significantly and forces alterations in the management protocols. Use of the otherwise popular technique of non-vascularized corticocancellous bone grafts becomes unpredictable in presence of active infections. Internal fixation methods usually require extensive surgical procedures and the implants themselves may behave like foreign bodies in an infected surrounding and may further help colonization of the pathogens. Although these internal fixation methods are known to be useful in cases of aseptic non-union, they do not address problems like infection, shortening and bone loss. Moreover, the condition of the soft tissues may further limit the scope of large surgical exposures.[17-18] On the other hand, the advantages of an external fixator are that, it provides stable fixation staying away from the site of trauma or infection; it can be used as a minimally invasive method and there is no need of too much dissection through the already traumatized soft tissues apart from the debridement. At the same time, by using the modern external fixators problems such as shortening and deformity can also be addressed simultaneously. The patient can be mobilised early, which will act as a physiological stimulus for bone healing. The Ilizarov ring fixator has proven to be a useful method to treat infected non-union cases. But it requires a long learning curve, expertise and is technically a demanding surgery. Although Ilizarov is a multi-planar strong and stable assembly, it may be quite cumbersome an apparatus for both the doctor and the patient alike. On the other hand the Orthofix railfixator is a simple, unilateral assembly with excellent strength and rigidity. It is less cumbersome, quicker to apply and better tolerated by the patient. Progressive correction of the deformity and shortening is possible at the same time by this instrument.[3-5,19,20] The overall goal in the reconstruction of an infected nonunion of long bone involves more than control of infection and includes creation of a healed, aligned and drainage free limb which is functionally better than a amputated and prosthetic fitted limb. Several factors must be considered in reconstruction of bone including the patient's age, socioeconomic status, metabolic status, mobility of the knee, foot and ankle, integrity of neurovascular structures and also the patient's motivation. The extent of bony debridement is defined by the appearance of punctate bleeding points at bone ends. The non-union site must be resected as it is better to substitute a biologically poor atrophic bone area with two bone surfaces of good quality modelled in such a way so as to allow easy stabilization and compression. The decision to proceed with the reconstruction is based on not only the surgeon's ability to restore a functional limb but also the duration anticipated for treatment and the anticipated residual disability. Thorough wound debridement and removal of the bone and soft tissues with doubtful vascularity is necessary for achieving bone healing and eradication of infection. In elective situations the patients can be made to meet other patients who have undergone this process, have preoperative counselling and voluntarily elect this treatment protocol. Patients are more likely to accept these techniques better when they have chosen it as an elective reconstruction rather than when it is inflicted up on them. In the recent past, a tremendous interest has been generated in the method of distraction osteogenesis. The clinical fact that distraction can produce new bone formation was showed as early as in 1900 by Codivilla. The effect of rhythmical distraction resulting in new bone formation was enlightened by Ilizarov from 1951 onwards. The positive effect of corticotomy on the vascularity of the whole limb has also been a matter of interest since decades. The effect of corticotomy on the healing of bone is also explained by intact intramedullary blood supply by microangiographic studies. By the distraction force at

the corticotomy site, the lining cells covering the bone ends are able to differentiate into osteogenic and chondrogenic cells under adequate stimulus and environment; this type of osteosynthesis has been termed as "intramembranous ossification of Ilizarov".[21]The percentage of the patients in which union occurred and the time to union are the most important measures of biomechanical adequacy of the surgery. De Bastiani et al treated 50 cases of non-union or delayed union (16 femurs, 29 tibias, one humerus and one radius) with a dynamic external fixator.[6] A healing rate of 94% was reported, which was similar to the findings of the present study (100%). Marsh et al however, reported a lower healing rate (80%).[16] Most fractures in their series were 7–24 months old while, in our study, presenting time was 6-11 months. Hashmi et al treated 110 long bone segments (60 tibias, 38 femurs and 12 humerus) with a mono-lateral fixator. There were 61 mono-focal and 49 bifocal procedures. Bone grafting was done in 71 cases in their series. The mean time to bone union was 12.6 months. The mean healing time in the bone lengthening group was 14 months (range 9–25 months) and in the non-lengthening group it was 12 months (range 3.5–64 months). The success rate in terms of clinical and radiological healing with initial fixation was 90%. The mean length gain was 4.5 cm (range 1.5–12 cm).[20] Our study reinforce the utility of Orthofix railfixator in terms of union, limb-length equalisation, deformity correction and resolving of infection. The orthofix railfixator is a telescopic device that can be locked for rigid fixation or unlocked to permit load sharing. As the pins are unilateral it is comfortable for the patients and joint mobilization can be done with ease. Being rigid, early weight bearing can be allowed with the device in place. Patient himself can carry out day to day lengthening or transport with little training. Another advantage of railfixator is the fact that, it does not interfere with plastic surgical soft-tissue procedures like cross leg flaps, free vascularised flaps, fascio-cutaneous flaps or skin grafting etc. The commonest complication encountered in this series was pin-tract infection which is in accordance with many previous studies. The other disadvantages include the high cost of the system, inability to use the apparatus for correction of gross deformities, in severe osteoporosis, stabilization very close to a joint, for which Ilizarov fixator could be a better option. This study has weaknesses like small patient population, short duartion of follow-up and absence of a control or comparison group. The railfixator is a reasonably simple instrument with less learning curve and patients themselves can do distractions once explained; it is also well tolerated by the patients for long durations. It is a strong and stable assembly in spite of being uniplanar, the results of treatment of infected nonunion by Orthofix railfixator is quite satisfactory and also reproducible.

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Ethical approval: The study was approved by the institutional ethics committee

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