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Original article

ILIZAROV BONE TRANSPORT AS A METHOD IN RECONSTRUCTING BONE DEFECT

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Abstract

In our study we reported 16 patients (12 males and 4 female) with age ranged from 18 to 55 years with average (31.3years old) and presented to academic level 1 trauma center during the period from January 2015 to January 2018 with infected non-union of tibia (10 cases), infected non-union of femur (5 cases), infected nonunion of radius and ulna (1 case).The infected fractures were treated by debridement including removal of implants and resection of sequestrated bone, and longitudinal bone transport using Ilizarov ring fixator after doing proximal or distal corticotomy. We evaluated the results of Ilizarov bone transport as a method of reconstructing bone defect. Infection was eradicated and union was achieved in all cases (100 %). Mean duration of treatment was 13 months. Both the bone and the soft tissues healed without further complications. Distraction osteogenesis performed with Ilizarov device is an excellent technique for bridging large infected post-traumatic bone defects of the long bones by resection of the infected segment, and gradual bone transport.

Keywords: *Ilizarov, Distraction osteogenesis, Infected non-union, Corticotomy.*

1. Introduction

Segmental defects of long bones are difficult to treat with conventional methods. The combination of local infection with bone defect exacerbates the problem and provides an even more negative prognosis [1]. Many authors believe that diaphyseal bone defects of the long bones smaller than 6 cm in Length can be managed with corticocancellous bone grafting [2] or non-vascularized fibular graft [3], provided the patient has an adequate soft tissue envelope. In case of soft tissue compromise, primary bone grafting is still the treatment of choice, combined with simultaneous soft tissue coverage [2]. Long bone defects greater than 6 cm can be managed with vascularized bone graft or bone transport using the Ilizarov external fixator [2, 4-6]. Ilizarov's technique of bone transport was viewed as an ideal solution for a large skeletal defect because **a)** a defect of virtually any size could be eliminated, **b)** rapid corticalisation of regenerate bone might. Shorten treatment time and eliminate the need for prolonged post treatment casting or bracing and **c)** no donor site morbidity would occur as the need for bone grafting had been eliminated [7].

We report our results with the Ilizarov method of bone transport to overcome bone defects of forearm bones due to infection.

2. Patients and Methods

This study was carried out in Sohag University Hospital during the period from January 2015 to January 2018. In this period, 16 patients (12 males & 4 females) with >6 cm of bone loss were managed by bone transport using the Ilizarov frame. The youngest patient was aged 18 years and the oldest was aged 55 years. Ten patients had a diaphyseal tibial defect, fig. (1), five had femoral defect, fig. (2), and one had radius and ulna defect, fig. (3). the smallest defect was 6 cm and the largest was 12 cm with a mean (10 cm). Frames were pre-assembled preoperatively. First the site of nonunion was exposed and any implant is removed and all unhealthy bone and any dead tissues were removed. Bone ends were refreshed (tapered sclerotic bone ends removed) and the medulla was opened by means of a drill bit. The frame was applied normally with the number of rings differing according to the bone for which it is applied (tibia 4 rings, femur 3 rings, and radius and ulna 3 rings), site of the lesion, and size of bone fragments. It was routine to use three wires in the most proximal ring and the most distal one. In the middle ring, we used two wires. After frame application and image check of the Alignment, a separate incision was used to perform the corticotomy for bone transport. One patient only had bifocal transport and all other patients had unifocal transport only. Wounds were then closed, a bulky dressing was used to compress the wound, and the limb was elevated. Patients were encouraged to mobilize with two crutches one day postoperatively (touchdown weight bearing) and instructed to elevate the leg while sitting or lying in bed. Transport started after 7 days. The transport rate was 0.25 mm every 6 hours. Patients were followed up in the outpatient clinic every two weeks to check and radiographs were taken every month to monitor the regeneration. The transfer rate was modified in some patients either because of slow regeneration or good quick bone formation. After reaching docking site, moving the ring continued for three or four days to compress the bone at this site. No patient needed bone graft at the docking site to speed up union. Follow-up then continued until at least two cortices were seen on radiographs then full weight bearing is allowed until complete healing occurs. The frame was then gradually removed to protect the bone.

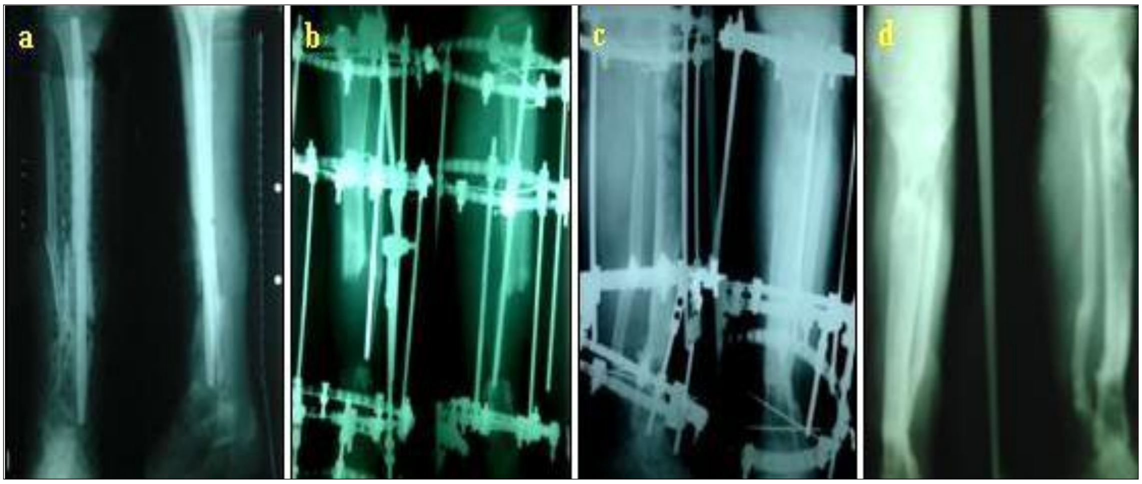

Figure (1) Shows infected nonunion of the right tibia **a.** after previous internal fixation in a male patient, **b.** after sequestrectomy and frame application, **c.** after end of transport a waiting consolidation, **d.** after consolidation and frame removal.

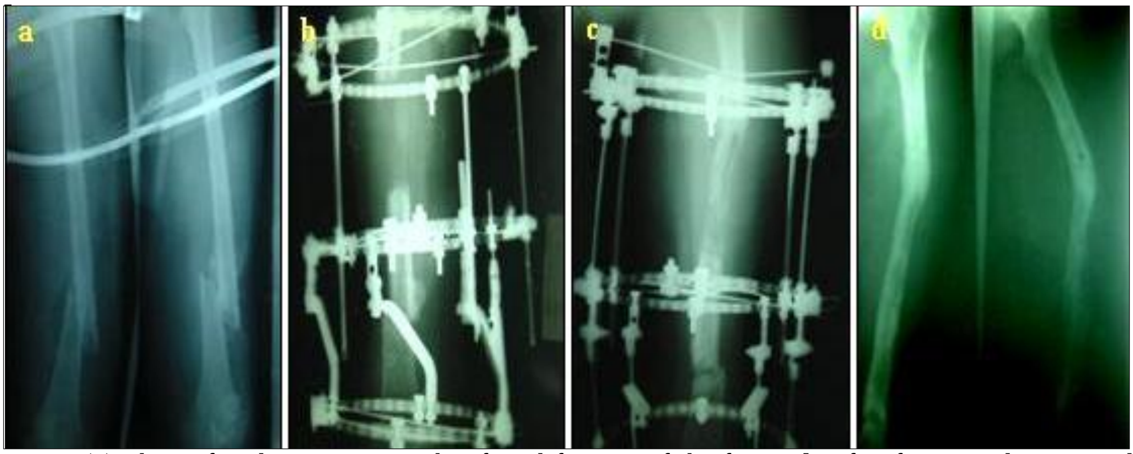

Figure (2) Shows female patient **a.** with infected fracture of the femur, **b.** after frame application and bone transport, **c.** end of transport awaiting consolidation, **d.** after consolidation and frame removal.

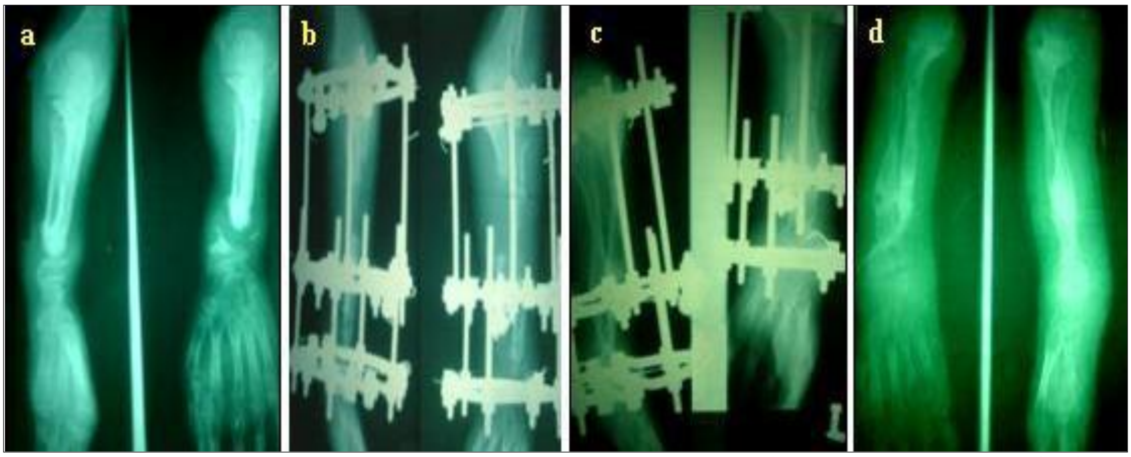

Figure (3) Shows male patient **a.** with post-traumatic bone loss of radius and ulna, **b.** afterframe application and bone transport, **c.** unifocal transport, **d.** after frame removal.

3. Results

Postoperative follow-up of each patient was at least 24 to 30 months with a mean 26 months. There were no intraoperative complications, neither complication in the early Postoperative period (a month after the surgery). The Ilizarov frame was placed for transport and until bone was solid for an average of 12 months (range: 10-18 months). External fixator index ranged from 22 to 37 days/cm (average 28.5 days/cm). No patient needed bone graft at the docking site for delayed union. Two patients needed open reduction and removal of interposed soft tissue. No patient had equines deformity at the time of frame removal. Ten patient had limited knee flexion which improved by physiotherapy Seven patients had pin track infection which responded well to daily dressing and proper antibiotic according to culture and sensitivity. Although we presented only light patients we are proud to highlight the absence of the most common and certainly the most difficult complications to resolve such as deep infections, nerve and vascular injuries. There were no recurrences of infection. All patients were able to return to their previous jobs.

4. Discussion

Massive bone defects represent a challenge to the orthopedic surgeon. Numerous techniques have been used to fill these defects including autologous cancellous bone graft [8], allograft [9], ipsilateral vascularized fibular transport [10], bone transport [8], and free vascularized fibular graft [11]. Autologous bone graft is good for small defects, but when the defect is large, more than one site may be used to harvest the graft, which adds to the morbidity of the patient. Allograft has its limitations (preparation and preservation) and its problems, and vascularized free fibular transfer is a demanding technique. Bone transport to fill massive gaps is reliable, but has the disadvantage of having the frame on for long periods. It needs close follow-up to monitor the bone ingrowth, joint mobility, and any pin tract infection, loosening, or breakage. Physiotherapy during and after transport until the frame is removed and the patient is back to normal activity is of paramount importance [11]. Cierny and Zorn [11] compared the results of treating segmental tibial defects using Ilizarov bone transport and massive autologous Bone graft, and the results were in favor of the Ilizarov method. Song et al [8] compared the results of bone transport and vascularized bone graft in femoral defects and it was better in the bone transport group. Different types of external fixators can be used for bone transport. Experimental and clinical experience showed that the most versatile system to be the ring fixator with half-pin modifications. It can transmit gradual mechanical forces and movements of bone in any plane (frontal, sagittal, or transverse) or any direction (axial, angular, translational, rotational, or any combination) at an unlimited number of treatment sites, and it has the potential to cross and protect active joints. Wires attached to the frame under tension, which can achieve stiffness equivalent to those of the much larger diameter half-pins, exhibit unique self-tensioning effects that may facilitate load sharing with the supported bone either in distraction or in compression modes. As the use of half pins results in half the number of sites of soft-tissue transfixion, they can decrease the number of pin-related and soft-tissue complications and can potentially improve the comfort of the patient and the tolerance to treatment [12]. In our study, the external fixator index was 28.5 day/cm and is shorter than most studies. This is possibly due to the relatively young age of our patients (average age is 31.3 years). In our study, we achieved union, normal lower extremity alignment, and limb length equalization in all patients, at the end of treatment. Moreover, we obtained 85% excellent and 15% good results in terms of bone scores and 80% excellent, 15% good, and 5% fair results for functional scores.

5. Conclusion

Bone transport using the Ilizarov frame can be effective in filling massive bone defects where other methods, like bone graft, used to fill these defects are inadequate and are highly demanding with high complication rates including micro vascular fibular graft.

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