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Infective Non Union of Tibia Treated With Ilizarov Ring Fixator: A Prospective Study

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Original Research Article

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Abstract: Infective nonunions of tibia are a surgical challenge in view of their compromised bone vascularity and are prone to limb shortening when treated by conventional methods. In this prospective case series done between July 2015 to June 2017, we treated 22 patients, reporting with infective non-union of tibia by the application of Ilizarov ring fixator. Surgical management of infective non-unions has drastically changed in the last two decades. The ring fixation device offers acute docking of the fracture non-union site and maintains compression, meanwhile any shortening that might have occurred due to either towards loss of communited fracture fragments or that lost during freshening of fracture non-union site can be addressed simultaneously by doing a corticotomy and bone transport simultaneously as the non-unions progresses successfully to union. An additional benefit of the ring fixation device used to treat these non-unions is that patients can resume ambulatory status as early as within 2 weeks from the date of surgery and can remain ambulant throughout the treatment time. If meticulous care of the pin tracts are taken care of, then ring fixation devices could be a gold standard in the treatment of infective non unions of tibia. The consolidation time in our series was anywhere between 6 months to 9 months depending upon the length of transport needed to compensate for limb shortening. All 22 cases went on to successful union. We had 40.5% of minor complications and 13.5 % of major complications. Hence our study concludes that the ilizarov ring fixator system is a versatile tool to surgically address infective tibial non- unions with or without bone length shortening. Subject to bone loss within 7.5cm.

Keywords: Infective non-union tibia, Ilizarov ring fixator, bone transport, distraction osteogenesis

INTRODUCTION

Open fractures of tibia have been becoming increasingly common due to RTA with the available modern operating facilities and the swift transfer of accident victims to tertiary trauma care centres. Many of these fractures are operated in the golden hour window [1] and after meticulous wound debridement internal fixation is opted for especially in type 1 and 2 Gustillo Anderson open fractures. Among these, very close to 16 to 22% [2] eventually end up as infective non-unions. Control of infection dictates implant exit. Now comes the dilemma as to how to stabilise these fractures and make them progress towards sound union. In cases involving fracture site communition there is an additional demand to compensate for the loss of limb length. It is in these challenging situations that the Ilizarov ring fixators provide for achieving both these goals simultaneously, with the additional benefit of making the patient quickly ambulant and help in maintaining the ambulatory status all throughout the treatment period [3].

Objectives

Evaluation of the efficacy of Ilizarov ring fixation device as a method of treatment for the management of infective non-union of tibia with or without segmental bone loss, subject to bone loss within 7.5cm.

MATERIAL AND METHODS

This is a prospective study of cases of infective non-unions of the tibia reporting at the casualty of Sree Balaji Medical College and Hospital, Chromepet from July 2015 to June 2017. Recruitment of cases stopped in June 2016, so that the follow up time is for a minimum period of 12 months. Hence the study lasted 2 years and the recruitment of patients lasted 12 months.

Inclusion criteria

- Both men and women were included in the study.

- Patients in age group 30 to 49 were included in this study.
- Bone loss of up to 7.5 cm alone were included in this study.

Exclusion criteria

- Patients not fulfilling the above inclusion criteria were excluded.
- Smokers and patients on blood thinning drugs were excluded.
- Tuberculous non-unions were excluded.

Operative Management

In the elected infective non-unions of tibia, the pus discharge from the sinuses, if any was sent for culture and sensitivity and appropriate parenteral antibiotics were initiated. Dressing was done daily with silver stream solution (containing colloidal silver ions) for 2 to 3 weeks. After the discharge had minimised, the patient was taken up for operation. The patient was given suitable anaesthesia. Antiseptic painting and draping of the affected limb was done. Debridement of the non-union site was done after removal of any previously secured hardware. The curetted material was sent for culture and sensitivity. At the non-union site, nibbling of the fracture ends was done until fresh bleeding was encountered [4]. The medullary canals were thoroughly curetted. An autoclaved reconstructed Ilizarov ring frame was used. The number of rings was decided preoperatively based on the fracture site and the site of proposed corticotomy. The frame was free between the internal part of the ring and the soft tissues circumferentially over the bulkiest part of the leg [5]. The limb was laid in the centre of the construct. The proximal and distal most rings were kept parallel to knee and ankle joint line [6]. The wires were first passed proximally fixing proximal ring to the limb. With the help of the dynamometric tensioner, appropriate tensioning was done [7]. Then, the distal most rings were fixed to the limb just proximal to the ankle joint line. Depending upon whether or not there exists an element of limb shortening an appropriate level in the upper tibial metaphysis was chosen for subperiosteal corticotomy[8]. Thereafter, based on the fracture position full rings were fixed in between the proximal and the distal most rings keeping the level of anatomical cuts in mind. No wire was passed through the fibula in these rings. Tensioning was done for all wires. Schanz pin, if required were fixed with the posts attached to the ring [8]. A stab incision was made and drilling was done. A hybrid construct was mostly preferred. Half Schanz pin was inserted with the help of a T-handle manually. We agree with Schwartzman *et al.,* [9] that fibular osteotomy is always needed when lengthening of the limb is planned or compression of the non-union is to be achieved. Conversely, an intact fibula definitely contributes to the stability of the non-union. The fracture site was docked and compressed. Sterile pin-skin interface dressing was done with povidone iodine. Distal limb vascularity was checked, post operatively in all cases.

Postop Protocol

All patients were put on injectable cefotaxime plus sulbactam antibiotics for a period of 5 days. Depending upon pain tolerability of the patient and whether or not corticotomy was done, analgesia was achieved either with paracetamol infusion or any other injectable NSAIDS. Knee and ankle mobilisation was encouraged from day 1. Weight bearing was initiated between day 5 to day 14. In patients in whom corticotomy was done, distraction was initiated from day 3 to day 5[10]. Distraction was done by 90 degrees every 4 hours starting at 6.00 am in the morning till 10.00 pm at night in 4 instalments, such that by the end of a day we achieved distraction by 360 degrees rotationally, which translates to a distraction of 1mm at the corticotomy site linearly. Suture removal was done on day 14. Pin tract dressings are done on a daily basis with povidone iodine and sterillium. During the patient's hospital stay, patients are tutored to carry out the distraction with the spanner themselves and also to cater for the pin tract dressing. They are usually discharged after suture removal and are seen as out patients on a weekly basis for the first four weeks and thereafter at fortnightly intervals. Distraction of the corticotomy site is stopped once the desired loss of bone length is restored. X rays are taken at monthly intervals and radiological signs of bone healing and consolidation of the distracted bone segment are recorded the quality of bone regenerate on X-rays was assessed on the basis of Fernandez Esteve., grading [11].

Grade I empty space between two fragments without radiopacity.
Grade II presence of cloud of bony callus.
Grade III presence of periosteal bridge in at least one diaphyseal wall in every X-ray projection.
Grade IV presence of periosteal bridge in both diaphyseal walls in every X-ray projection.
Grade V structural callus is seen.

During the entire course of this treatment patient was kept ambulant with full weight bearing. On the event of any discharge from the pin tract, patient was admitted and processed for infected pin removal and exchange of pin at the same sitting, which usually is carried out under local anaesthesia. Once there are satisfactory radiological signs of bony union, the ring fixator with its pins are removed and a PTB cast is applied[12]. This cast protection is usually maintained for six to eight weeks.

Case illustration1

Fig-1: After plate exit and debridement with antibiotics beads in situ

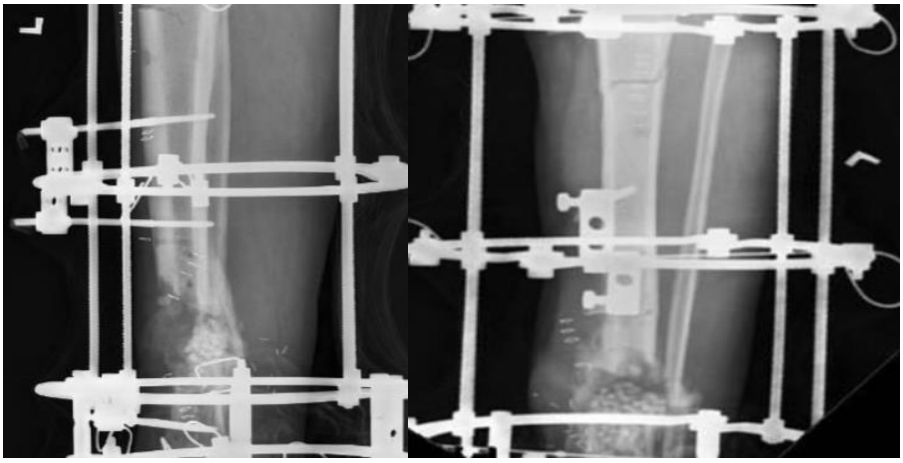

Fig-2: After exit of antibiotic beads and fixation with Ilizarov ring fixator with proximal tibial corticotomy

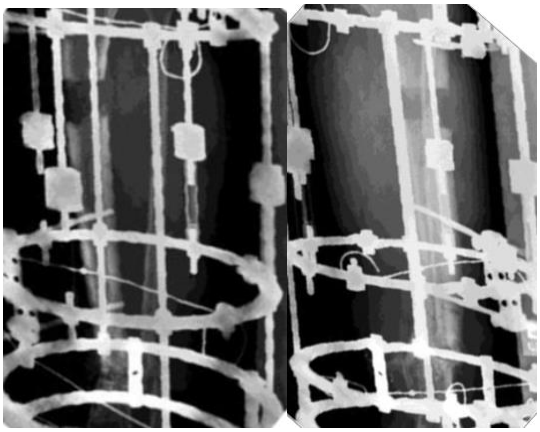

Fig-3: Showing impaction at fracture site and desired lengthening at corticotomy site at 6 months.

Fig-4: Bony consolidation achieved at the end of 12 months of follow up.

Case illustration 2

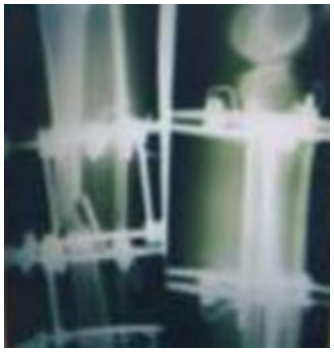

Fig-5: Showing infective non-union

Fig-6: Showing fracture consolidation at 6 months.

Case illustration 3

Fig-7: Showing implant failure with infective non-union

Fig-8: Progress of union at 6 months

Fig-9: Consolidation achieved at 9 months.

RESULTS

In the 12 months of recruitment we could enroll 22 patients who satisfied our inclusion criteria. Of these 22 patients, there were 14 (64 %) males and 8 (36 %) females. The majority of the patients were in the age group of 40-44 (32 %) followed closely by patients in the age group 35-39 (27 %). The average duration of the treatment ranged from 6 to 9 months in the male category and 6.5-10 months in the female category. The average duration for consolidation was 9 to 12 months in the male category and 9.5 to 12 months in the female category. Pin tract inflammation was the most common complication and was graded according to Dahl's grading [13] and dealt with accordingly:

Grade I normal pin site.
Grade II inflamed.
Grade III inflamed with serous discharge.
Grade IV inflamed with purulent discharge.
Grade V inflamed with osteolysis.
Grade VI inflamed with ring sequestrum.

For grades II and III local care was sufficient and for grade IV systemic antibiotics (Linezolid and Dalacin – c) were given. For grade V we resorted to changing the wire. We did not encounter any case of grade VI inflammation. 9 (40.5 %) of patients had minor complications like pin tract infection and pin loosening. 3 (13.5 %) of patients had major complications which required pin removal and exchange pinning at an alternate site. None had developed osteomyelitis like major complications. All cases went in for sound union. Our outcomes let to the logical conclusions that in carefully selected cases and under scrupulous medical supervision the Ilizarov ring fixator is an excellent choice for treating infective non-union of tibia with reasonable bone defect (within 7.5cm).

Table-1: SEX WISE DISTRIBUTION

Sex	No: of patients	% age of patients
Male	14	64
Female	8	36
Total	22	100

Table-2: Age distribution

AGE GROUP	SEX		TOTAL	% age of patients
	MALE	FEMALE		
30-34	3	2	5	22
35-39	4	2	6	27
40-44	5	2	7	32
45-49	2	2	4	19
TOTAL	14	8	22	100

Table 3: Treatment duration table

SEX	BONE DEFECT /SHORTENING IN CM	"n"	DURATION OF TREATMENT IN MONTHS (UNION TIME)	DURATION OF CONSOLIDATION IN MONTHS
MALE	1 -3	3	6	9
	3-5	4	7	10
	5-7.5	7	9	12
FEMALE	1-3	2	6.5	9.5
	3-5	2	8	11
	5-7.5	4	9	12

Table -4: Complication table

TYPE	DESCRIPTION	"n"	% age of patients
MINOR	PIN LOOSENING	4	18
	PIN TRACT INFECTION	5	22.5
MAJOR	PIN REMOVAL OR EXCHANGE	3	13.5
	FIXATOR REMOVAL	0	0
TOTAL		12	54

DISCUSSION

External fixation has been the skeletal stabilization of choice with lowest reported deep sepsis as highlighted by Dervin *et al*., [14] and Keeling *et al*, [15]. Ilizarov is a complex technique requiring lot of resources and time and it also has numerous complications [16]. This concept has greatly changed now with the advent of better operating theatres, availability of higher antibiotics and modification of the Ilizarov to make it a hybrid construct with half pins with short threads which have greatly improved the stability of the ring fixation devices. In the present study there was a preponderance of male patients over female in the ratio 7:4. This compares well with the study done by Laishram Singh *et al.*, and Shtarker H *et al.*, [6]. The age group 35 to 44 constituted 59% of the infective non-unions cases of tibia. In our study all patients were made ambulant within 2 weeks with full weight bearing. This is comparable to that of Dagher and Ronkoz., [7] who reported that partial weight bearing was begun within 1st week of operation and full weight bearing after 2 to 3 weeks. In our study the ring fixator was removed at an average of 22 weeks (ranging from 14-28 weeks), which is about 4 to 6 weeks more than that of Shtarker *et al.* [6] who removed at an average of 16 weeks (ranging from 11-21 weeks). In our study the union time was 28 weeks (ranging from 24 to 36 weeks), which is again about 7.5 weeks greater than that reported by Shtarker *et al.*, [6] 21.5 weeks (ranging from 17.5 to 25.5 weeks). It was observed that in the male category bone defects in the range of 5 to 7.5 cm took the longest duration of treatment of 9 months and a further period of 3 months for the bone to consolidate. For the female category, for the same bone defect the treatment duration and time for bone consolidation were exactly the same. However, in the bone defects ranging from 1 to 3 cm and 3 to 5 cm, the duration of treatment and consolidation were lower by about 4 weeks in the male category as compared to the female, for the same length of bone defect. Minor complications continue to plague this fixator device system (40.5%) and in order that any of them don't progress to the level of major complications, it requires that the patient on the fixator is seen by the operating surgeon at least once in 2 weeks, so that minor complications are remedied at the earliest. This fixator device is not a "fix it and forget it" type. Therefore, patient compliance is of paramount importance and its significance should be made to be understood, prior to embarking on this prolonged treatment program. The fact that the patient is ambulant throughout the treatment period is a great morale booster for the patient, who can look after his primary activities of daily living.

The application of the methods of Ilizarov including distraction osteogenesis offers a sound alternative towards treatment of infective non-unions of tibia. Ilizarov circular frame osteogenesis allows resection of the infected bone area, repair of the bone defect and stabilization of the bone to consolidation, while maintaining or restoring the length of the limb as desired. Joint function in the involved extremity is encouraged during the period, as the apparatus enables functional loading within a fortnight of application of the apparatus. The aim of a successful Ilizarov treatment for non-union is not just to achieve healing of the non-union, but also to achieve a leg with minimal deformities, shortening or infection with near normal range of motion and near normal strength of the bone and soft tissues. The Ilizarov frame construct is very resilient to torsion and bending forces but translates its

axial loading towards the fracture site micro-motion and thus stimulates bone healing.

CONCLUSION

In the age group of 30 to 49 years, for cases of infective tibial non-unions, Ilizarov ring fixator device is a desirable treatment option. With refining of the surgical skills of the surgeon and patience and co-operation from the patients, rewards with desirable results in these types of cases.

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