ORIGINAL ARTICLE

Outcome of ilizarov fixator in tibial non-union

Muhammad Inam,[1] Mohammad Saeed,[2] Imran Khan,[3] Alamzeb Durrani,[4] Abdul Satar,[5] Mohammad Arif[6]

Abstract

Objectives: To evaluate the results of non-union of tibia treated with Ilizarov fixator.

Methods: The case series was conducted at Hayatabad Medical Complex, Peshawar, from January 2012 to April 2015, and comprised consecutive patients with non-union of the tibia. Patients of either gender, with complex non-union of the tibia from the age of 18 to 65 years were included, while patients with intra-articular fractures, vascular injury, smokers and steroid users were excluded. Outcome of the treatment was graded by using the scoring system of Association for the Study and Application of Methods of Ilizarov.

Results: There were 21 patients with a mean age of 40±13.89 years (range: 18-65 years). There were 7(33.3%) female and 14(66.6%) male patients. There were 14(66.6%) patients who had one previous surgery, 5(23.8%) had 2 surgeries and 2(9.5%) had 3. Bone results were excellent in 12(57.1%) patients, good in 6(28.6%) and fair in 3(14.3%). Functional results were excellent in 7(33.3%) patients, good in 9(42.9%), fair in 4(19%) and poor in 1(4.8%).

Conclusion: Ilizarov fixator gave good to excellent results in tibialnon-union, by eradicating the infection, filling the defect with bone transport, correcting the deformity and the limb length discrepancy.

Keywords: Non-unoin, Long bones, Tibia, Infection, Ilizarov, External fixator. (JPMA 65: S-94 (Suppl. 3); 2015)

Introduction

Ilizarov is a method which uses fine wires that are inserted percutaneously. Then these wires are attached and tensioned to provide a strong frame construct of ring fixator. The ring fixator, commonly known as Ilizarovapparatus, has a circular construction which provides far more structural support than the traditional monolateral external fixator.[1]

The Ilizarov apparatus is axially elastic and as the weight-bearing forces are directly applied to the bone ends, maintaining the weight-bearing function of the extremity actually becomes one of the prerequisites for the success of the method.[2] The cyclic axial telescoping mobility, not rigidity, at the non-union or fracture site is an important requirement for the formation of a reparative callus. Ilizarov experimentally showed that when gradual distraction tension stress is applied to the corticotomy site, the vascularity of the entire limb is increased, which in turn enhances the ability of the bone ends to unite.[3]

Most of the non-unions of long bones can be treated successfully by internal fixation and that is also for tibia. However, an infected non-union of the tibia can prove a difficult problem which can be complicated by bone loss, deformity or failure of previous internal fixation.[4] In such a difficult situation one has to choose between limb salvage and amputation.[5] The treatment of bone infections after internal fixation usually needs a variety of different surgeries such as removal of metalwork, radical bony debridement, deep tissue sampling, elimination of dead space and insertion of local antibiotic delivery systems. Then the bone is fixed externally with different surgical procedures like monolateral external fixator or ring fixator.[6]

This method is also useful for the fixation of compound fractures, segmental fractures, polytrauma, and segmental bone loss. The principle of controlled distraction at the fracture site stimulated not only the neovascularistion and new bone formation, but also regeneration of soft tissues andnerves.[7]

Ilizarovtechnique has many advantages likefixation of fractures and deformity correction can be done in same sittings; it can be used in both closed and open factures; bone transport/limb length discrepancy can be corrected; repeated surgeries can be avoided; distraction and minor adjustments in the alignment of bones do not require anaesthesia; it serves as important tool in infected non-unions and polytrama patients; and with the help of Ilizarov early ambulation of the patient is possible. Treatment with Ilizarov apparatus has been successful in managing most problems in these patients, but it is not a solution for each and every one patient.[7,8]

We planned the current study to evaluate the results of non-union of tibia treated with Ilizarov fixator.

[1,2,4-6]Department of Orthopedics and Spine Surgery, Hayatabad Medical Complex Peshawar, [3]Department of Orthopedic and Trauma, Gajju Khan Medical College Swabi.

Correspondence: Muhammad Inam. Email: dr_mohammadinam@yahoo.co.uk

Materials and Methods

The case series was conducted at the Department of Orthopaedics and Traumatology, Postgraduate Medical Institute, Hayatabad Medical Complex, Peshawar, from January 2012 to April 2015, and comprised consecutive patients with non-union of the tibia.

Patients of either gender, with complex non-union of the tibia of age 18 years or more were included, while patients with intra-articular fractures, vascular injury, smokers and steroid users were excluded. Thorough clinical history was obtained, complete physical examination was performed and investigations were carried out. All the patients were counselled about their conditions which necessitated an urgency of the surgical procedure they had to undergo. Informed consent was taken from all patients.

The patients had preoperative full-length radiographs of the affected leg for assessment of the level and type of fracture non-union, plane of deformity, bone quality and presence of sequestrum. Culture swabs from draining sinuses and open wounds were carried out in all patients.

The initial metalwork was removed and the bone ends were debrided and 2 (1 for microbiology + 1 for histology) deep tissue samples were taken. These samples comprised any soft tissue and bone from the non-union site and were subsequently sent for culture. The frame was then applied with transosseous wires and half-pins to preserve the anatomical axis and avoid any additional soft tissue damage. The frames were extended to the foot to minimise equinus deformity where necessary. Osteotomy was done in the same setting. Postoperatively, the patients were empirically started on linzolid and cefoperazone + sulbactam and were encouraged to bear weight with the aid of crutches. The antibiotics were continued till the result of culture sensitivity report. Physiotherapy within comfort with specific reference to joint mobilisation and oedema control was attempted in all patients.

After the application of each fixator, radiographs were taken and patient was discharged on the second postoperative day. Physical therapy was continued throughout the treatment. Patient was educated regarding bone transport and pin-site care and advised to change dressings daily.

Follow-up protocol was 2-4 weeks depending upon the procedure according to Association for the Study and Application of Methods of Ilizarov (ASAMI) criteria (Table 1) for at least 9 months. The fracture union, complications and functional recoveries were also recorded during follow-up. The criteria for union were the presence of bridging trabeculae on at least three cortices radiologically and absence of pain and no movement at fracture site clinically.

Outcome of the treatment was graded by using ASAMI score7. Data thus collected with the help of proforma and was analysed using SPSS 17.

Results

There were 21 patients with a mean age of 40±13.89 years (range: 18-65 years). There were 7(33.3%) female and 14(66.6%) male patients. The number of previous operations ranged from 1 to 3. There were 14(66.6%) patients who had one previous surgery, 5(23.8%) had 2 surgeries and 2(9.5%) had 3 surgeries (Table-2).

Previous operations done were Intramedullarly locking nail in 4(19%), Locking Plate in 2(9.5%), Dynamic Compression Plate (DCP) in 1(4.8%), Monolateral External Fixator in 7(33.3%), Monolateral External fixator+Intramedullary locking nail in 3(14.3%), Monolatral external fixator+DCP in 2(9.5%), Monolateral

Table-1: ASAMI scoring system

Bone Results	
Excellent	Union, no infection, deformity <7, limb-length discrepancy <2.5 cm,
Good	Union + any two of the following: Absence of infection, <7 deformity and limb-length inequality of <2.5 cm.
Fair	Union + only one of the following: Absence of infection, deformity <7 and limb-length inequality <2.5 cm.
Poor	Non-union/re-fracture/union + infection + deformity >7 + limb-length inequality >2.5 cm.
Functional Results	
Excellent	Active, no limp, minimum stiffness (loss of <15 knee extension/<15 dorsiflexion of ankle), no reflex sympathetic dystrophy (RSD), 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).

Table-2: Number of Previous Operations.

Valid	Frequency	Percent	Valid Percent	Cumulative Percent
1	14	66.7	66.7	66.7
2	5	23.8	23.8	90.5
3	2	9.5	9.5	100.0
Total	21	100.0	100.0	

Table-3: Previous surgeries.

	Frequency	Percent	Valid Percent	Cumulative Percent
Intramedullarly locking nail	4	19.0	19.0	19.0
Locking Plate	2	9.5	9.5	28.6
Dynamic Compression Plate	1	4.8	4.8	33.3
Monolateral External Fixator	7	33.3	33.3	66.7
Monolateral External fixator, Intramedullary locking nail	3	14.3	14.3	81.0
Monolatral external fixator, Dynamic compression plate,	2	9.5	9.5	90.5
Monolateral External Fixator, Dynamic compression plate, Monolateral External fixator	2	9.5	9.5	100.0
Total	21	100.0	100.0	

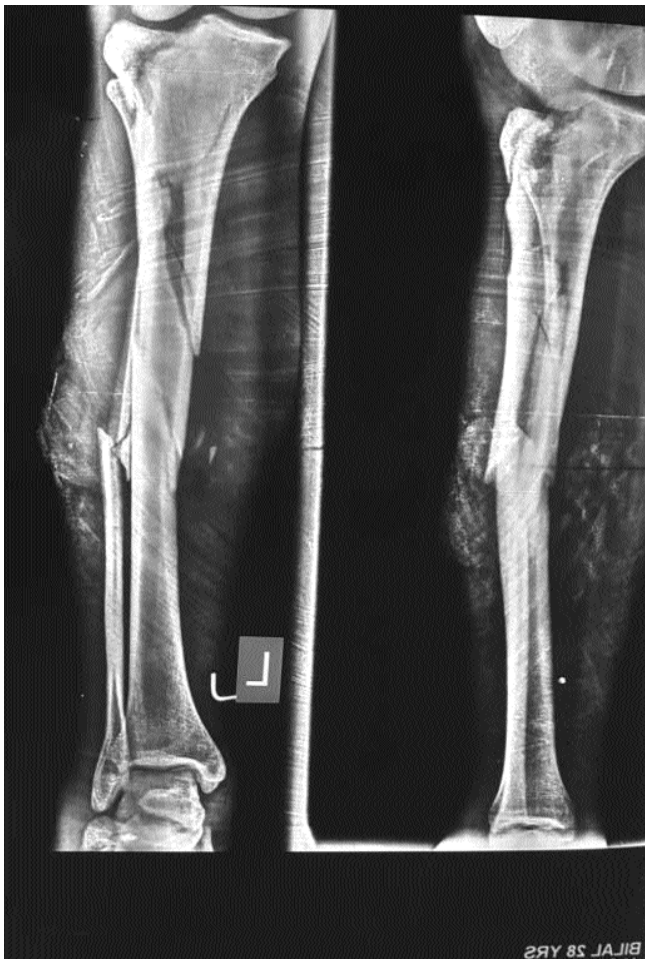

Figure-1: Comminuted fracture tibia with plateau fracture.

Figure-2: After applying Monolateral Ex-Fixator.

External Fixator+DCP+Monolateral External fixator in 2(9.5%) patients. Nine (42.9%) were close fracture while the remaining 12(57.1%) were open fractures (Table-3).

In 4(19%) patients it was the upper one-third of tibia that had the fracture, in 9(42.9%) middle one-third and in 8(38.1%) patients it was the lower one-third of tibia.

Segment transport was done in 12(57.1%) patients and compression/distraction was done in 16(76.2%). After doing osteotomy in the same setting of application of Ilizarov fixator, the patient was instructed on first postoperative day for transport of the segment. Segment transport was done by rotating the nuts of the

Table-6: Comparision of different national and international studies.

	Our study	Paley et al[13]	Dendrinos et al[14]	Magadum et al[15]	Farmanullah et al[16]	Kumar et al[8]	Vigneset al	Khan et al[17]	Madhusudan et al[18]
Bone Results (In Percent)									
Excellent	57.1	60.87	50	76	58.9	79	60	93.7	22
Good	28.6	26.09	29	20	20.7	11	30	6.2	36.34
Fair	14.3	8.7	3.6	0	13.8	0	10	0	22
Poor	0	4.35	17.4	4	8.6	10	0	0	18.18
Functional Results (In Percent)									
Excellent	33.3	64	25	60	56.9	40	50	81	5.56
Good	42.9	28	39.2	32	31.1	50	40	18.7	22.22
Fair	19	4	14.13	4	6.9	0	10	0	33.33
Poor	1	4	2.15	4	5.1	10	0	0	38.89

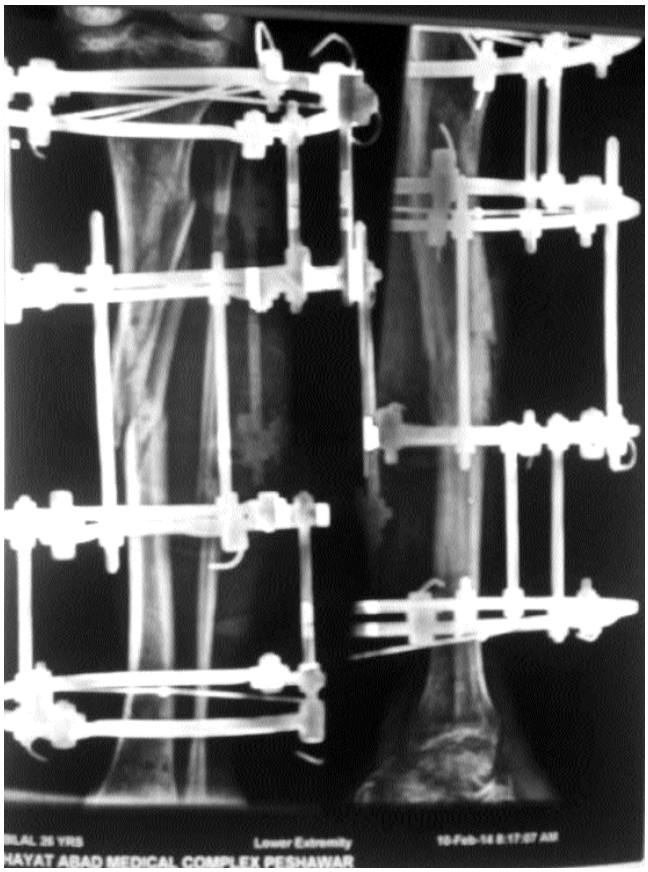

Figure-3: After applying Ilizarov.

Figure-4: After removal of Ilizarov.

osteomatised segment qurter turn each six hours per day, after 15days of surgery, till the segment reached the other segment.

Four (19%) patients had one or more wire-site infection, while in 1(4.8%) patient one wire was broken. Two (8.5%) patients had loosening of the pins, and 1(4.8%) patient had chronic osteomylitis.

At final follow-up, the bone results were excellent in 12(57.1%) patients, good in 6(28.6%) and fair in 3(14.3%) (Table-4).

Functional results were excellent in 7(33.3%) patients, good in 9(42.9%), fair in 4(19%)and poor in 1(4.8%) (Table 5) (Figure-1-4).

Table-4: Bone Results.

	Frequency	Percent	Valid Percent	Cumulative Percent
Excellent	12	57.1	57.1	57.1
Fair	3	14.3	14.3	71.4
Good	6	28.6	28.6	100.0
Total	21	100.0	100.0	

Table-5: Functional Results.

	Frequency	Percent	Valid Percent	Cumulative Percent
Excellent	7	33.3	33.3	33.3
Fair	4	19.0	19.0	52.4
Good	9	42.9	42.9	95.2
Poor	1	4.8	4.8	100.0
Total	21	100.0	100.0	

Twenty (95.2%) patients healed successfully without any complication, while 1(4.8%) patient had shortening of 3 centimetres, deformity and infection, and the mean time to union was 8 months (range:4 to 12).

Discussion

Long-standing infected non-union and gap non-union is difficult to treat and is a challenging problem for orthopaedic surgeons. It usually leads to residual deformity, persistent infection and contracture that leads to a useless limb.[9] Many methods have been employed to treat this situation. All have improved results, but none has been able to solve this clinical situation fully.[10] The Ilizarov ring fixator gives an option of compression, distraction and bone transport, and is effective in the treatment of infected non-union of the tibia where other types of treatment have failed. Weight-bearing and functioning of the joints while on the treatment is an advantage that cannot be matched by any other technique.[11,12]

A study[13] on tibial non-union treated with Ilizarov fixators showed excellent bone results in 60.87% cases, good in 26.09%, fair in 8.7%and poor in 4.35% cases. Functional results were excellent in 64% cases, good in 28%, fair in 4% and poor in 4%cases.

Farmanullah et al[16] studies 58 patients with tibialnon-union and 38 (65.5%) of them had infected non-union while 20 (34.5%) had clean non-union. Bone results were excellent in 33(58.9%), good in 12(20.7%), fair in 8(13.8%) and poor in 5(8.6%) patients. Clinical result was excellent in 33 (56.9%), good in 18(31.1%), fair in 4(6.9%) and poor in 3(5.1%) patients.[16]

In almost all our patients at the time of frame removal and subsequent follow-up, infection had been eliminated. As we followed up our patients for 9 months, only one patient had chronic osteomylitis that was treated with no discharge, but there is possibility of a flare up which cannot exclude the absence of recurrence of infection. It is a good result in ASAMI criterion. In this study, bone results were better than the functional results. One thing is very clear that excellent bone results do not necessarily guarantee good functional results. The functional result is affected by many other factors like conditions of the muscles, vessels and the joints.

If we compare our study with national and international studies (Table-6), the results are almost the same which shows that union was achieved at the non-union site in almost all patients by the end of the treatment. The patients were performing their normal daily life activities which were not possible before the operation.

The main limitation of the study was the small number of patients. Only those patients were included in the study who had completed follow-up.

Conclusion

Ilizarov fixator gave good and excellent results in complex non-union of long bones by eradicating the infection, filling the defect with bone transport, correcting the deformity and the limb length discrepancy.

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