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Research Article

Management of complex non-union of shaft of tibia using Ilizarov technique and its functional outcome

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ABSTRACT

Background: Complex non-union shaft of tibia is challenging to treat and it needs coordinated multidisciplinary team work. Ilizarov ring fixator is mainly used as a salvage option in treatment of complex non-union. We studied retrospectively the functional and radiological outcome of 21 complex non-union shaft of tibia, treated by radical debridement, Ilizarov ring fixator with compression and distraction osteogenesis.
Methods: From 2008 to 2013, 21 cases of complex non-union shaft of tibia were included in our study. Eighteen patients were males and three patients were females with mean age of 37.5 years (19-56). The average number of surgeries before the index operation is 3.3 (1-5). Non-union was classified according to Paley's classification of non-union. All infected non unions were managed by radical debridement, fixed with Ilizarov ring fixator, monofocal / bifocal compression and distraction osteogenesis. The average duration of follow up is 45 months (30-70 months). The functional evaluation was done using ASAMI Scoring system, and bone union with serial radiographs.
Results: All patients had successful union. The mean time for union was 7 months (5-9 months). The mean time for fixator removal is 10 months (7-14 months). The mean amount of regenerate is 3 cm (2-4 cm).Two patients had re-fracture, which united successfully after reapplication of Ilizarov frame. The complications were pin tract infection (90 pins out of 220 pins), pin loosening, skin maceration, and limb oedema. Using the ASAMI (Association for the study and application of the methods of Ilizarov) scoring system we obtained 10 excellent, 8 good, 2 fair, 1 poor functional results.
Conclusions: The Ilizarov method is a viable option for complex non-union of shaft of tibia. The union was achieved successfully in all cases with good union and functional results, however, the results were compromised in cases, who underwent previous multiple surgeries before the index procedure. Thus the outcome can be improved if early osteosynthesis attempted with Ilizarov ring fixator in complex infective non unions.

Keywords: Ilizarov, Complex non-union, Distraction osteogenesis

INTRODUCTION

The The complex non-union is defined as an established non-union (of at least six months duration) with one or more of the following criteria, infection at the site of non-union, a bone defect of more than 4 cm (defect non-union), an attempt to achieve union that failed to heal after one supplementary intervention. The treatment of complex non-union is challenging and difficult. The success of treatment depends on radical debridement of infective non-union, stable fixation, and distraction osteogenesis. The radical debridement of the infective site eradicates infection more efficiently, and increases the vascularity at non-union site, however it creates bone defect. The bone defect can be due to bone loss at the time of initial injury, or during radical debridement, or both. The bone defect is filled by bone transport, as described by Ilizarov corticotomy and distraction

technique that forms new bone at the trailing end, also known as distraction osteogenesis. The prerequisite for achieving union and bone transport is a stable construct, which protects soft tissue, apart from providing stability. While the monolateral external fixator can provide adequate stability, the cantilever forces created while distraction leads to angulation, delayed degeneration of bone, and non-union at the distraction site. The Ilizarov ring fixator, on the other hand, provides multiplanar stability, helps in the correction of angulation, and rotation at the non-union site much effectively. However, the complications and the tedious process of application has been the main limiting factor. Thus, the Ilizarov is mostly used as salvage option in the treatment of complex non-union of tibia. We report our results using ASAMI scoring system on 21 cases of complex non-union of tibia.

METHODS

This study was done at MGMC & RI from January 2008 and December 2013, 55 patients were treated for non-union shaft of tibia. The patients who fulfilled the criteria for complex non-union were included in the study. Patients with intraarticular involvement and periarticular non-union were excluded from the study. Thus 21 patients were included in our study. The clinical details and radiographs were retrieved from medical records department. All patients had established infective non-union and failed surgical intervention. In addition, 12 patients also had bone loss with mean defect of 3 cm (2-5 cm). 18 patients were males, and 3 were females. The mean age of the patients were 37.5 (25-45). The average duration between injury and index surgery was 9 months (7-14 months). The average number of surgical intervention, including the soft tissue procedures, before the index surgery was 3.5 (2-5). The infection was active in 14 (5+9) patients with signs of purulent discharge, inflamed, indurated skin, and quiescent in 7 (4+3) defined as healed sinus (Table 1) with or without sequestrum in the radiograph and normal or elevated laboratory markers such as ESR and CRP.

Table 1: Types of infected non-union.

	Number of cases
A1, quiescent infection, defect <4 cm	4
A2, quiescent infection, defect >4 cm	3
B1, actively discharging sinus, defect <4 cm	5
B2, actively discharging sinus, defect >4 cm	9

According to Gustilo Anderson classification[1] for open injuries, 5 patients had grade II, 10 patients had grade III A, 4 patients had grade III B and 2 patients had closed injury. The mechanism of the initial injury was road traffic accident in all the patients.

There were 15 patients treated with external fixation initially, 4 fractures treated initially by plating, and 2 with intra- medullary nailing. 15 patients had soft tissue procedure with 10 patients having local rotation flap, 3 patients split skin transfer, and 2 patients free flap. Despite being warned that smoking might delay bone union, 6 of 20 patients continued to smoke and 2 were addicted to alcohol and required detoxification on admission.

All the patients underwent radical debridement at the infective non-union site. The fracture site is acutely docked or acutely shortened without compremising distal vascularity. A bifocal compression distraction technique[2] (compression for nonunion with distraction at the corticotomy) was used in 16 patients. Out of 16 patients, 13 patients had acute docking, and 3 patients acute shortening followed by gradual compression at the fracture site. Monofocal compression and distraction was used in 5 non-unions. Bone grafting was used in 3 patients at the docking site. The corticotomy was done simultaneously in 12 patients and as second procedure in 4 patients after average of 4 days. The distraction at corticotomy started after five days. Patient hospitalized for average of 10 days (7-14 days). The distraction is done at the rate of 1 mm per day. The distraction is stopped if one of the following such as expected limb length, vascular or neural compromise, and contracture of the adjacent joint occurs. The Ilizarov ring fixator was maintained for twice the period of distraction, to consolidate the union. The amount of distraction and bone formation were assessed with follow up radiographs in anteroposterior and lateral views once in two weeks during distraction. Once the union is consolidated, the dynamisation is done for two weeks with patient allowed full weight bearing. The fixator was removed if the patient was able to walk without pain.[3]

At final follow-up we assessed the patients for gait, limb-length discrepancy and range of movement of the adjacent joints. Functional and radiological outcomes were assessed using the Association for the Study and Application of Methods of Ilizarov (ASAMI) criteria described by Paley et al. In order to assess patient satisfaction, we used a visual analogue scale from 0 to 100, with 0 being completely unsatisfied and 100 being completely satisfied. This method was used by Sanders et al.[4] Our definition of union was the presence of bridging trabeculae on three cortices, absence of pain on dynamisation.

RESULTS

All patients came for regular follow up. The mean follow up time is 36 months (26-70 months). All 21 patients had successful union. The average time for successful union is 7 months (5-9 months). The average distraction at corticotomy is 1.1 cm/month. The average duration of consolidation period is 8 months (7-9 months). The average duration for frame removal is 12 months (8-14 months) in bifocal compression distraction and 6 months (5-9 months) in monofocal compression distraction. The

bone union and functional results are assessed at final follow up using ASAMI scoring system (Table 2). The mean satisfaction score on a numerical scale from 0 to 100 was 85. Only 12 patients were able to return to work, 3 patients modified the occupation, and 6 patients failed to return to work.

Table 2: Association for the study and application of the methods of Ilizarov (ASAMI) scoring system.

ASAMI scoring system		
Bone results		
Excellent	Union, no infection, deformity <7°, limb-length discrepancy <2.5 cm	15
Good	Union + any two of the following: absence of infection, <7° deformity and limb-length inequality of <2.5 cm	2
Fair	Union + only one of the following: absence of infection, deformity <7° and limb-length inequality < 2.5 cm	2
Poor	Nonunion/re-fracture/union + infection + deformity >7° + limb-length inequality >2.5 cm	1
Functional results		
Excellent	Active, no limp, minimum stiffness (loss of <15° knee extension/<15° dorsiflexion of ankle), no reflex sympathetic dystrophy (RSD), insignificant pain	13
Good	Active, with one or two of the following: limp, stiffness, RSD, significant pain	1
Fair	Active, with three or all of the following: limp, stiffness, RSD, significant pain	0
Poor	Inactive (unemployment or inability to return to daily activities because of injury)	1
Failures	Amputation	0

Every patient had pin tract infection of which 8 patients were taken for debridement. All patients were put in course of antibiotics and Staphylococcus aureus was the commonest infecting organism.[5]

Table 3: Complications of our treatment.

	Number of cases
Problems	
Poor regenerate	2
Pin tract infection	All patients
Obstacles	
Infection needing change of frame	0
Wire breakage	0
Re-fracture	2
Fracture of regenerate	1
True complications	
Chronic osteomyelitis	1
Deep venous thrombosis	0
Persistent infection of pin tracts	2

One patient had refracture within two months after removal of frame and the Ilizarov ring is reapplied. All fracture showed both radiological and clinical union. Secondary bone grafting was done on 4 patients.

We classified the adverse effects of our treatment as problems and complication and were tabulated above (Table 3).

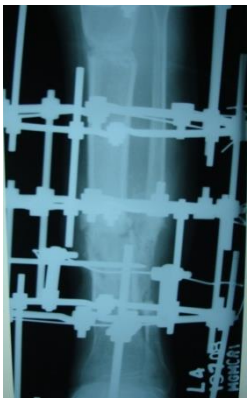

Figure 1: With fixator.

Figure 2: After fixator removal.

Figure 3: Clinical picture.

DISCUSSION

Management of tibial non-union has been described by various authors and it is agreed that various approaches

have been adopted by the orthopaedic surgeons for such challenging issue under the medical ethics and as per needs of the patients concerned. There are different types of fixators used for bone transport to fill the bony defects. Ilizarov fixator is most commonly used for bone transport. All patients referred to us were infected non-union of tibia after initial treatment by either plates or nails. All patients underwent atleast 4 surgeries before the application of Ilizarov ring.

In the study by Paley D et al.,[6] cases of tibial non-union were treated with Ilizarov fixators which shows excellent bone results in 18 cases, good in 5 and fair in 2 based on union, persistent infection in 3 cases, deformity in 4 and limb shortening in 1 case. Functional results were excellent in 16 cases, good in 7, fair in 1 and poor in 1 based on return to daily activities, limp in 4 cases, equinus in 5 cases, dystrophy in 4 cases, pain in 4 cases and amputation for neurogenic pain in 1 case. In another study 11 on 17 patients with tibial pseudoarthrosis, 14 cases had full union, 1 patient was still using orthosis and 3 patients were in need of re-operation with bone transplantation. Mean time of treatment was 5.2 months (2-11.5 months) while the overall treatment time was 9.8 months (3-19 months). In this study the Ilizarov method of treatment of pseudoarthrosis had a good stimulation of healing but experience with fixator system and aggressive treatment of various minor complications are essential for successful outcome. Our study shows comparable results with international literature.[7-9]

In this study all patients had infected non-union of shaft of tibia due to either compound wound or by infection followed by the primary fixation. Patients with infected wound and soft tissue and bone loss were treated with flap cover and corticotomy with distraction done respectively. Our success in the eradication of chronic infection, with no recurrences after a median follow-up of 25 months, is very satisfactory. We believe that this was because we were able to apply the basic surgical principle of the treatment of infection by the excision of all unhealthy tissue. Some required excision of a segment of bone which was then regrown from regions of good vascularity, avoiding the use of avascular cancellous graft. Five of our 21 cases underwent segmental excisions of a median length of 5 cm. It is possible that such radical treatment excised some bone unnecessarily, but we had no failures and consider that the risk was justified. We believe that early selection of cases and prompt treatment will help in acceptable results and return to their occupation.

CONCLUSION

The method of radical debridement and distraction osteogenesis using Ilizarov ring external fixator is used to treat complex non-union of shaft of tibia as a salvage option when all the other methods were unsuccessful. Though the bony union is achieved in most of these patients with satisfactory functional results, it can still be further better if debridement and distraction osteogenesis is used after early failed attempts at union. To finalize, we conclude that Ilizarov external fixation is a useful method with several advantages and certain set-backs in treatment of tibial septic non-unions, especially in high-energy trauma where other methods of treatment had failed.

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Ethical approval: Not required

REFERENCES

1. Gustilo RB, Mendoza RM, Williams DN. Problems in the management of type III (severe) open fractures: a new classification of type III open fractures. J Trauma. 1984;24:742-6.
2. Ilizarov G. The tension-stress effect on the genesis and growth of tissues. Clin Orthop Relat Res. 1989;239:263-85.
3. Tilkeridis K, Owen AJ, Royston SL, Dennison MG, Vinsent M, Vashista G. The Ilizarov method for the treatment of segmental tibial fractures. Injury Extra. 2009;40:228.
4. Stanley L. Chapman, Robert N. Jamison, Steven H. Sanders. Treatment helpfulness questionnaire: a measure of patient satisfaction with treatment modalities provided in chronic pain management programs. Elsevier. 1996;68:349-61.
5. Sian PS, Britten S, Duffield B. The care of pinsites with external fixation. J Bone Joint Surg [Br]. 2006;88-B:558.
6. Paley D. Problems, obstacles and complications of limb lengthening by the Ilizarov technique. Clin Orthop Relat Res. 1990;250:81-104.
7. Schwartsman V, Martin SN, Ronquist RA, Schwartsman R. Tibial fractures: the Ilizarov alternative. Clin Orthop Relat Res. 1992;278:207-16.
8. Oztürkmen Y, Karamehmetoğlu M, Karadeniz H, Azboy I, Canikliogl M. Acute treatment of segmental tibial fractures with the Ilizarov method. Injury. 2009;40:321-6.
9. Tilkeridis K, Owen AJ, Royston SL, Dennison MG, Vinsent M, Vashista G. The Ilizarov method for the treatment of segmental tibial fractures. Injury Extra. 2009;40:228.

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