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Original Research Article

Treatment Outcome of Nonunion Fracture of Long Bone through Limb Reconstruction System

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Abstract

Background and Aim: "Established when a minimum of 9 months" is how non-union is defined. Three months have passed since the fracture first became injured, and nonunion has occurred. The study's objective was to evaluate the results of the limb reconstruction system's use in treating infected long bone nonunion both prospectively and retroactively in order to determine the system's true utility.

Materials and Method: This study, which was done retrospectively at General Hospital and its affiliated medical college, involved 60 patients who were treated at our facility and ranged in age from 24 to 75 years old (with a mean age of 43 years).

Results: 60 cases of infected non-union using limb reconstruction system over the past three years were included in the study. Of the 60 patients, 22 patients acquired infected nonunion after prior implant procedures for closed fractures, while 38 patients developed infected nonunion following open fracture. Our case follow-up ranged from six to twenty-four months.

Conclusion: In the current trial, we were able to reach an 80% success rate, providing the majority of our patients with positive, optimistic outcomes. Thus, we draw the conclusion that the Indian adaptation of the Limb Reconstruction System is an efficient and practical method for the treatment of infected long bone nonunion. This can also be utilised to simultaneously fix limb length disparities that may develop during treatment.

Keywords: Long bone, Nonunion, Limb reconstruction, Fracture, Docking

Introduction

The growing incidence of high velocity road traffic accident has lead to increased number of complex compound injuries, which subsequently gave rise to the greater number of incidence of complex nonunions. These patients are usually operated upon several times for stabilization (and healing) or to eradicate infection, which in turn produces scarring of the soft tissues and devitalization of any surviving bone [1,2].

"Established when a minimum of 9 months" is how non-union is defined. Three months have passed since the fracture first became injured, and nonunion has occurred. Until clinical or radiographic evidence indicates that healing

has stopped and that union is highly implausible, nonunion is diagnosed. Long bone fractures should not be regarded as non-union for at least six months after the accident since union takes longer, especially after some local difficulties. Systemic and local factors are believed to play a role in the development of delayed union and nonunion, even though the precise causes are unknown [3,4].

Hak et al. [5] reported that the success of exchange reamed intramedullary nailing of femoral shaft nonunions and delayed unions was adversely affected by tobacco usage. It has been demonstrated that smokers' blood oxygen levels are lower, which slows the healing of wounds.

These patients' bone and soft tissue recovery will be improved once they stop smoking. Nonsteroidal anti-inflammatory medicines (NSAIDs) have also been shown in numerous animal experiments to reduce fracture healing [6].

The cornerstone of bone healing is biomechanical stability and biological vitality of the bone because they create an environment in which new bone can be xator is regarded to have developed. External xation in infected nonunion, per the AO manual. For concern of infection persistence or recurrence, the normal technique is postponed in cases of infected nonunion [7].

The standard method of fixation in infected nonunion, according to the AO manual, is an external fixator. For concern of infection persistence or recurrence, internal fixation is postponed in cases of infected nonunion [8]. A unilateral external fixator system is the limb reconstruction system. LRS is a desirable alternative for skeletal stabilisation due to frequent consequences such infection, bone gap, shortening of limbs, deformity, and soft tissue issues with atrophic non-union [9,10]. The study's objective was to evaluate the results of the limb reconstruction system's use in treating infected long bone nonunion both prospectively and retroactively in order to determine the system's true utility.

Material and Methods

This study, which was done retrospectively at General Hospital and its affiliated medical college, involved 60 patients who were treated at our facility and ranged in age from 24 to 75 years old (with a mean age of 43 years). Patients that were unreachable were excluded from this investigation.. The institute ethical committee was informed about the study and ethical clearance certificate was obtained prior to the start of the study. The included patients were informed about the study and the written informed consent was obtained prior to the inclusion in the study.

In our study, the male to female ratio was 6:1, with 52 men and 8 women participating. The AO Classification was used to categorise these diseased nonunions. According to this classification in our investigation, we had

1. Infected quiescent non- draining nonunion – 12 cases
2. Infected active non-draining nonunion – 12 cases
3. Infected draining nonunion –36 cases.

Patients were classified as non-draining if their wounds had not discharged for three months (Quiescent). Local symptoms and indicators of infection, such as increased warmth, redness, sinus pain, fever, etc. 26 patients had infected femoral nonunion, while 34 patients had infected tibial nonunion. Of the 26 femur cases, 10 patients experienced infected nonunion following ORIF with a nail or plate for closed fractures, 8 patients experienced infected nonunion following open fractures and subsequent native treatment, and 8 patients experienced infected nonunion following treatment of an open fracture with an AO external fixator system. 8 patients had infected nonunion following ORIF for a closed fracture, 18 patients had infected nonunion following an open fracture, and 12 patients had infected nonunion following a closed fracture. A

minimum of 5 months and a maximum of 18 months were included in our follow-up period. In total, 18 of the 60 patients in Toto had infected nonunion as a result of prior operations. In 12 cases, ineffective treatment of the open fracture by native bone setters led to infected nonunion; in 4 other cases, infected nonunion followed cast immobilisation for Grade 1 open fractures; and in 26 cases, infected nonunion followed initial external fixator treatment of Grade IIIb open fractures.

Investigations such as erythrocyte sedimentation, total and differential white blood cell count, pus culture sensitivity, and standard AP, LATERAL X-rays were used to establish the diagnosis. A patient's history is obtained, including the injury's date, the specifics of the initial accident, and the treatments that followed. Measurements of limb length, joint range of motion, neuromuscular state, and distal vascularity received particular emphasis.

Results

60 cases of infected non-union using limb reconstruction system over the past three years were included in the study. Of the 60 patients, 22 patients acquired infected nonunion after prior implant procedures for closed fractures, while 38 patients developed infected nonunion following open fracture. Our case follow-up ranged from six to twenty-four months.

There were 3 to 7 months of union time. With the exception of 12 patients who had multiple sinus tracts, all cases in whom the sinus tracts were cleaned showed a tendency toward union. In terms of moving the bones, this series had no problems. In each case, the consolidation period was significantly delayed. In 24 of the 60 cases, a pin tract infection was present.

Split skin graft cover was supplied in 6 cases for wound dehiscence throughout the postoperative phase. In two cases, pin loosening and tract infection occurred during the transportation portion of the bone lengthening treatment, necessitating pin revision. There were no infections at the corticotomy site in any of the subjects.

The final result of the osteotomy's healing was adequate in each of the 36 cases following a period of waiting for consolidation to take place. Modified shoes with raised heels and soles were used to treat cases where there was a limb length disparity in the lower limb of up to 2.5 cm. Using the ASAMI categorization, the results were separated into bone outcomes and functional results. As there were no defined criteria available in the literature for evaluating the results following treatment with a Limb reconstruction system fixator, ASAMI'S criteria were employed to examine the results in our study.

Functional Results:

The functional results were

1. A clinically detectable
2. Stiffness of the knee or ankle of knee extension or more than 15 degrees of dorsiflexion of ankle compared to the normal limb.
3. Soft tissue
4. Pain that reduce
5. Loss of activity

Functional results: Limp, Equinis, ankle rigidity, soft tissue deformity, pain & inactivity

Excellent -active + no other

Good -active + 1 or 2

Fair - active + 3 or 4

Poor - inactive irrespective of whether other criteria were applicable.

According to these criteria the functional result was

Excellent - 20 cases

Good - 14 cases

Fair - 16 cases

Poor - 10 cases.

The instrumentation did not cause any neurological or vascular Injury

Table 1: Distribution of Cases in Femur and Tibia

Infected nonunion	Total	POP	External fixation	Plating	Nailing
Femur	26	0	8	6	12
Tibia	34	8	12	6	8

Discussion

Controlling the infection and achieving a healed, aligned, and drainage-free limb—which is functionally superior to amputation and artificial prosthesis fitting—are the main objectives of treating infected nonunion. Ten factors are taken into account in long bone repair, including

1. Patient's age,
2. Metabolic status,
3. Mobility of the foot and ankle,
4. Intact neuro-vascular structures and
5. Patient and attenders reassurance & rehabilitation.

Bony debridement must be performed up to any detected punctate bleeding spots. Bony alignment is obtained by compression at the fracture site after the non-union site is removed [11]. Reconstruction is mostly determined by

1. Surgeon's ability to restore a functional limb
2. Duration of treatment,
3. Anticipated residual disability.

Bony union cannot occur without complete wound debridement and removal of nonviable bone and soft tissue. Two patients who received ilizarov therapy for persistent infection also required recurrent debridement and corticotomy surgery for bone lengthening.

For the treatment to be effective, the patient must also comply and comprehend their issues, how long the fixator must be worn, and any complications.

By explaining the procedure ahead of time, the patient needs to feel more at ease. In elective reconstruction, the patient may be more willing to embrace their technique than if it were being forced upon them [12].

The general health of the patient must be improved through a healthy diet, regular exercise, and support for quitting smoking. In patients with infected nonunion, distraction osteogenesis is associated with a noticeable improvement in the blood supply, and adequate vascularization is required to achieve bone repair. Before surgery, adequate preoperative planning is required. Similar to other series, skeletal findings were superior to functional results. A good functional outcome is not always guaranteed by excellent bone results [13].

In 48 of 60 patients, the nonunion site healed, which is close to the 86.7% bone union rate in the Eduardo Garcia et al. [14]. study from 2004. In his research, Antonio Biasibetti [15] had a 93% success rate. Angular abnormalities of 10 to 15 degrees are well tolerated, according to Merchant and Dietz's findings from a long-term study of tibial fractures. A difference in leg length of up to 2.5 cm does not require treatment, and a tilt of 5 to 6 degrees is normal.

In the study by Gopal.S et al. [16], pin tract infection was reported in twenty out of 38 cases (53%), which is equivalent to the 12-out-of-30 instances (40%), when it occurred. 30% of pin tract infections were reported in another study by J.R. Coll. As a result, our study's rate of pin tract infection remained high.

Lower limb length disparity was better restored as a result of bone translocation. Two level corticotomies can be used to treat larger bone abnormalities. We only have single level corticotomy experience. Some patients with lower limb shortening of more than 1 cm refused to have their limbs lengthened, even if it was planned when there was evidence of

union at the nonunion location. In our study, the mean difference in limb length was 4 cm.

In a study of 52 cases of infected nonunion conducted by Eduardo et al. Bone grafts can be added, after infection settles at the nonunion site. Graft can also be added to their generate site if progression towards consolidation is slow as quoted in the literature. The Limb reconstruction system is a telescopic device that can be locked for rigid fixation or unlocked to permit load sharing.

Even though the cost of the fixator is high, the patients because of the following reasons accept it: Light weight, patient friendly, day to-day activities can be done easily, Since the pins are unilateral it is much more comfortable for the patients, hence joint mobilization can be done with ease. Being rigid, early weight bearing can be allowed with the device. Patient can readily lengthen.

Furthermore, it is comfortable to do plastic surgical treatments including skin grafting, fascio-cutaneous flaps, and cross-leg flaps. Once the patients have learned how to distract themselves, it is encouraged that they return for a review once every 15 days to gauge the length gained and the quality of the regeneration. Furthermore, if the device is undamaged, the fixator can be utilised on a different patient.The system's high price, inability to treat infected nonunion with extreme deformity, and need for stability so close to a joint—for which the Ilizarov fixator could be a better choice—are some of its drawbacks. The adoption of the Indian version of the Limb reconstruction method has effectively managed the cost factor. The Ilizarov ring fixator is more complicated to use, but the LRS is easier for patients to wear.

The unilateral fixator application learning curve is less challenging than the Ilizarov fixator application learning curve.

Conclusion

We were able to give the majority of our patients good, optimistic results in the current trial, with a success rate of 80%. Thus, we draw the conclusion that the Indian adaptation of the Limb Reconstruction System is an efficient and practical method for the treatment of infected long bone nonunion. This can also be utilised to simultaneously fix limb length disparities that may develop during treatment.

References

1. Agnihotri A., Galfat D., Agnihotri D. J. J. O. M., Surgery O. Incidence and pattern of maxillofacial trauma due to road traffic accidents: a prospective study. 2014; 13: 184-188.
2. Pathak S., Jindal A., Verma A., Mahen A. J. M. J. A. F. I. An epidemiological study of road traffic accident cases admitted in a tertiary care hospital. 2014; 70: 32-35.
3. Thomas J. D., Kehoe J. L. Bone nonunion. In StatPearls [Internet]; StatPearls Publishing, 2021.
4. Wang C.J., Chen H.S., Chen C.E., Yang K. D. J. C. O., Research R. Treatment of nonunions of long bone fractures with shock waves. 2001; 387: 95-101.
5. Hak D. J., Lee S. S., Goulet J. A. J. J. O. O. T. Success of exchange reamed intramedullary nailing for femoral shaft nonunion or delayed union. 2000; 14:178-182.
6. Kovacevic D., Rodeo S. A. J. C. O. Research R. Biological augmentation of rotator cuff tendon repair. 2008; 466: 622-633.
7. Foster A. L., Moriarty T. F., Zalavras C., Morgenstern M., Jaiprakash A., Crawford R., Burch M.A., Boot W., Tetsworth K., Miclau T.J.I. The influence of biomechanical stability on bone healing and fracture-related infection: the legacy of Stephan Perren. 2021; 52:43-52.
8. Chahar H. S., Gupta M., Kumar V., Yadav R., Patel J., Pal C. P. J. J. O. O. C. R. Prospective evaluation of role of limb reconstruction system (rail external fixator) in open fractures and infected non-union of femur. 2021;11: 5.

9. Ingle M. V., Gade S. D., Koichade M. R. J. I. J. O. O. Study of limb reconstruction system in infected and gap nonunion: At tertiary care centre. 2020: 6: 1316-1326.
10. Sarmiento A., Latta L. Closed functional treatment of fractures; Springer Science & Business Media, 2012.
11. Patra S. R., Kisan D., Madharia D., Panigrahi N. K., Samant S., Manoj M., Shiv A., Das L. K. J. I. J. O. R. I. O. P. S. I. J. R. O., et al. Management of infected non-unions of long bones using limb reconstruction system (LRS) fixator. 2017; 3: 213-219.
12. Mears S. C., Kates S. L. J. G. O. S.; rehabilitation. A guide to improving the care of patients with fragility fractures, edition 2. 2015; 6:58-120.
13. Zheng L. W., Ma L., Cheung L. K. J. B. Changes in blood perfusion and bone healing induced by nicotine during distraction osteogenesis.2008;43:355-361.
14. Garcia-Cimbrelo E., Martí-González J. C. J. C. O., Research R. Circular external fixation in tibial nonunions. 2004, 419, 65-70.
15. Biasibetti A., Aloj D., Di Gregorio G., Massè A., Salomone C. J. I. Mechanical and biological treatment of long bone non-unions. 2005; 36: S45-S50.
16. Gopal S., Majumder S., Batchelor A., Knight S., De Boer P., Smith R. J. T. J. O. B., Volume J. S. B. Fix and flap: the radical orthopaedic and plastic treatment of severe open fractures of the tibia. 2000; 82: 959-966.