

How to Cite:

Patra, G., Soni, S., Meher, B. K., & Dhone, P. G. (2022). Observation of role of orthofix limb reconstruction system in with non-union with bone loss shortening due to fresh fractures. *International Journal of Health Sciences*, 6(S4), 8891–8899. <https://doi.org/10.53730/ijhs.v6nS4.11152>

Observation of role of orthofix limb reconstruction system in with non-union with bone loss shortening due to fresh fractures

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Abstract---The nonunion can develop after an open fracture, after 10Us open reduction and internal fixation (ORIF), or as a sequela to chronic hematogenous osteomyelitis. The incidence also seems to be increasing especially in view of increasing high velocity trauma, which is usually treated by internal fixation. It is difficult to treat infected nonunion, because of the following reasons. Aim of the study is to observe the role of Orthofix limb reconstruction system as a treatment in non-union with bone loss with shortening due to fresh fractures. In the last twenty-five months we had the opportunity to treat thirteen cases of non-union and two cases of shortening With Limb reconstruction system. Out of thirteen patients eight patients had infected nonunion following open fracture and three patients had infected nonunion following previous surgeries with internal fixation for closed fractures and two patients had nonunion following treatment with traditional bone setters for closed fractures. Our follow up of cases varied from six to fifteen months. The results were divided into bony results and functional results, according to the classification of the ASAMI (Association for the study and application of the method of Ilizarov). ASAMI'S criteria were used to analyze the results in our study, as there were no specific criteria available in the

literature for assessing the results after treatment with Orthofix fixator. Union of the upper limb bones is not included in this classification.

Keywords---orthofix fixator, shortening, limb reconstruction.

Introduction

The nonunion can develop after an open fracture, after 1oUs open reduction and internal fixation (ORIF), or as a sequela to chronic hematogenous osteomyelitis.¹ The incidence also seems to be increasing especially in view of increasing high velocity trauma, which is usually treated by internal fixation.² It is difficult to treat infected nonunion, because of the following reasons.^{3,4}

- 1) Previous surgeries would have resulted in cicatrisation of the soft tissue with an avascular environment around the fracture site.⁵
- 2) The sinus tract leading to the fracture site usually indicating dead bone or sequestrum inside.⁵
- 3) Necrosis of bone near the nonunion site, to a considerable distance, due to thrombosis of blood vessels of Haversian canals⁶
- 4) Prolonged immobilization, multiple surgeries with fibrosis of the muscles leading to a stiff joint/fracture disease.⁷
- 5) The microorganism may develop resistance to the antibiotic therapy and poses a problem in controlling the infection.⁸

Sometimes a fresh fracture leads to bone loss which leads to shortening. There are various modalities of management for infected nonunion. In the past several authors who put their mind in solving this problem by many methods where in all the factors of nonunion like deformity, shortening, infection and abnormal mobility were managed.^{9,10} The cornerstones for successful bone healing are Biomechanical stability and biological vitality of the bone, as they provide an environment in which new bone can be formed. Aim of the study is to observe the role of Orthofix limb reconstruction system as a treatment in non-union with bone loss with shortening due to fresh fractures¹¹

Materials and Methods

The inclusion criteria for the study includes those with

1. Nonunion of long bones with major soft tissue defect.
2. Bone loss with shortening due to fractures.

The Exclusion criteria includes:

1. Intra-articular fractures.
2. Fractures with neuro-vascular deficit.

This was a prospective study conducted at MKCG Medical College Hospital which consists of 15 cases in the age range from 14 yrs. to 65 yrs. who were treated at

our institution from July 2010 to Aug 2012. Patients who were lost to follow up were not included in this study. Our institution approved our treatment protocols and all patients gave written informed consent There were Ten Males and Five Females in our study with male to female ratio of 2:1

Diagnosis was established in all patients by the history and physical examination and the investigations. A history was taken from the patient including the date of injury, the detail of original accident and subsequent treatment received.

On presentation, the Following were evaluated:

1. limb length measurements,
2. Range of motion of the joint,
3. Condition of skin and vascularity,
4. co-existing ligamentous instabilities and
5. General medical condition.

Preoperative radiographs of the affected extremity were taken. Anteroposterior and lateral X rays were taken and detailed evaluation were made. These infected nonunion were classified as per the AO classification. In our study, according to this classification we had

Infected quiescent non- draining nonunion..... 4 cases

Infected active non-draining nonunion..... 1 cases

Infected draining nonunion.....8 cases

Shortening of lower limb 2 cases

Patients with wounds that had no discharge for 3 months were labeled as non-draining (Quiescent). Infection was evident Ocal Symptoms and signs like increase warmth, redness, sinus, fever, etc. Four patients had nonunion of femur, eight patients had nonunion of tibia and one patient had nonunion of humors. Two Patients had deformity of lower limb with shortening. Of the Four cases of femur, two had nonunion after ORIF with nail/plate fixation for closed fractures, One had nonunion which occurred after open fractures and subsequent native treatment, and One had nonunion following treatment of open fracture with AO external fixator system.

Observations and Results

Table-1 Distribution of Nonunion in Various Bones in Our Study
(n-13)

Distribution of nonunion	No. Of Cases	Percentage
Femur	04	30.70
Tibia	08	61.50
Humerus	01	7.80

Table -2 Distribution of Various Type of Non-Unions in Various Bone
(N-13)

BONE	DRAINING NONUNION	NON-DRAINING NONUNION
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	No. of Case	Percentage	No. of Case	Percentage
Femur	2	15.38	2	15.38
Tebia	6	46.15	2	15.38
Humerus	0	0.00	1	7.69
Total	8	61.54	5	38.46

Table-3 Sex Distribution
(n=15)

Sex	No. of case	Percentage
Male	10	66.66
Female	5	33.33
Total	15	100.00

Table-4 Distribution according to side of affection
(N-15)

Side	No. of case	Percentage
Left	5	33.33
Right	10	66.66
Total	15	100.00

Table-5 Previous Treatment Received By The Patient
(n=13)

Nonunion	Total	Ext. fixation	Plating	Nailing	POP Cast	Native treatment
Femur	4	1(7.69%)	-	2 (15.38)	-	1(7.69%)
Tibia	8	6(46.15%)	-	-	-	2 (15.38%)
Humerus	1	-	1(7.69%)	-	-	-

Table-6 Age Distribution
(n=15)

Age group In yrs.	No. of Cases	Percentage
10-19 Yrs	1	7.69
20-29 Yrs	4	30.77
30-39 Yrs	5	38.46
40-49 Yrs	4	30.77
Above 50 yrs	1	7.69
Total	15	100.00

Results

In the last twenty-five months we had the opportunity to treat thirteen cases of non-union and two cases of shortening With Limb reconstruction system. Out of thirteen patients eight patients had infected nonunion following open fracture and three patients had infected nonunion following previous surgeries with internal fixation for closed fractures and two patients had nonunion following treatment

with traditional bone setters for closed fractures. Our follow up of cases varied from six to fifteen months.

The results were divided into bony results and functional results, according to the classification of the ASAMI (Association for the study and application of the method of Ilizarov). ASAMI'S criteria were used to analyze the results in our study, as there were no specific criteria available in the literature for assessing the results after treatment with Orthofix fixator. Union of the upper limb bones is not included in this classification.

Bone Results

The bone results were determined according to ASAMI'S criteria as follows:

1. Union
2. Infection
3. Deformity
4. Leg length discrepancy

The fracture was considered to be united when it appeared SO roentgenographically, when there was no motion at the site of the nonunion after loosening all nuts in the apparatus and the patient was able to walk without pain and had a feeling of solidity of the limb. According to the protocol of the ASAMI, a bone result cannot be graded excellent unless union was achieved without the use of the bone graft.

Bone union results

E-Excellent: Union + No Infection+ Deformity<2.5cms.

G-Good Union+any TWO of the above factors.

F-Fair : Union+ any ONE of the above factors.

P-Poor No union/Refracture/none of the above factors.

According to these criteria the bone result in our study was Excellent-01 cases, Good -08 cases, Fair - 02 cases, Poor-02 cases.

Functional Results

The functional results were based on five criteria

1. A noteworthy limp
2. Stiffness of either the knee or ankle (loss of more than 15 degrees of full extension of the knee or of 15 degrees of dorsiflexion of the ankle in comparison with the normal contra lateral side)
3. Soft tissue sympathetic dystrophy
4. Pain that reduced activity or disturbed sleep and
5. Inactivity (unemployment or an inability to return to daily activities because of injury)

Functional results- limp, equinus, 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 : 04 case
 Good : 07 cases
 Fair : 01 cases
 Poor : 02 cases.

The functional results of the upper limb were determined by assessing pain, shoulder and elbow range of movements and strength. In the cases of infected nonunion of humerus, at follow up there was no pain/limitation of movements of elbow or shoulder and the strength was adequate. There was no neurological or vascular injury as a result of instrumentatio

Discussion

The decision to proceed with the reconstruction is based on not only the surgeon's ability to restore a functional limb but also the duration anticipated for treatment and the anticipated residual disability. Through wound debridement and removable of the doubtful bone and soft tissues to keep the area totally devoid of non-viable tissue is essential for achieving bony union.

The patient must be cooperative and understand the length of time the frame has to be worn and complications requiring pin revision are a probability. In elective situations the patients can be made to meet other patients who have gone through this process, have preoperative teaching and elect this treatment protocol. Patients may accept these techniques better when they have chosen it as an elective reconstruction rather than when it is inflicted on them. Patients require adequate nutrition, exercise, and encouragement to stop smoking. Although distraction osteogenesis is associated with marked improvement of the blood supply, good Vascularization is necessary to obtain bone healing, especially in patients.

With infected non-union it is necessary to plan the procedure adequately before the surgery. As in other series functional results were inferior to bony results. An excellent bone results does not guarantee a good functional result. As to the nine cases where there was rigidity of ankle/knee, it must be noted that six were preexistent and three were post treatment. The functional result is affected by the condition of the nerves, muscles, vessels, joints, and to a lesser extent bone.

The nonunion site united in all but 1 cases out of 13, which is comparable to the study conducted by Eduardo Garcia et al in 2004 wherein the bony union result was 86.7%. Antonio Biasibetti in his study had a success rate of 93%. Infected nonunion of humerus are rare yet challenging problem to treat. In our study 1 patients with infected nonunion of humerus were treated with hardware removal,

debridement and stabilization in compression with external fixator. The resultant shortening, was accepted. There was evidence of good bony union in an average of 8.2 months (range 6 to 9 months), which is comparable to the study by Gualdrini et al, where the reported union time was 5.5 months. In another study conducted by Biasibetti. A et al the union time was months. Since the nonunion was in the diaphyseal region in both the cases, and because of the co-operative mobilization exercises carried out by the patients there was not much of impairment of range of movements in shoulder/elbow joints for both the cases. The results were excellent for both functional aspect as well as bony union. In long-term study of tibial fractures, Merchant and Dietz determined that angular deformities of 10 to 15 degrees are well tolerated. Leg length discrepancy of up to 2.5 cms does not require any treatment, 5 to 6 degrees of tilt is acceptable. Likewise, minimal translation in the mechanical axis is acceptable. (Range of acceptability unknown) Pin tract infection occurred in 09 out of 15 cases (60%), which is comparable to the study conducted by Gopal.S et al, where the reported pin tract infection was in ten out of 19 cases (53%). In another study by J.R Coll the reported pin tract infection was 30%.

Conclusion

The method of treatment of infected non-union by the Limb Reconstruction System with a predictable healing of nonunion and control of infection is well shown in this study. Though there are some complications with this method, it can be overcome by careful preoperative planning, appropriate surgical techniques and adequate follow-up, which will definitely make this method a very successful one.

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