How to Cite:
Patra, G., Soren, S., Prusty, A., & Dhone, P. G. (2022). Observation of role of orthofix limb reconstruction system in with non-union with major soft tissue defect. *International Journal of Health Sciences*, *6*(S6), 6528–6537.
https://doi.org/10.53730/ijhs.v6nS6.11151

Observation of role of orthofix limb reconstruction system in with non-union with major soft tissue defect

Gopabandhu Patra
Assistant Professor, Department of Orthopaedics, Bhima Bhoi Medical college, Balangir, Odisha, India,767001

Surai Soren
Associate Professor, Department of Orthopaedics, Government Medical college, Keonjhar, Odisha, India

Alok Prusty
Assistant Professor, Department of Orthopaedics, Government Medical college, Keonjhar, Odisha, India

Pravin G. Dhone*
Professor & Head, Department of Pharmacology, RSDKS GMC, Ambikapur
*Corresponding author

Abstract---Soft tissue loss with multiple sinuses, osteomyelitis, osteoporosis, complex deformities with limb length inequality, stiffness of the adjacent joints and multi drug resistant infection all complicate treatment and recovery. Aim of the study is to observe the role of Orthofix limb reconstruction system as a treatment in non-union with bone loss and major soft tissue defect due to fresh fractures. 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.

Keywords---orthofix, non-union, infection, Limb.

Introduction

Soft tissue loss with multiple sinuses, osteomyelitis, osteoporosis, complex deformities with limb length inequality, stiffness of the adjacent joints and multi drug resistant infection all complicate treatment and recovery.[1,2] These factors make an unfavorable environment for fracture union. Even after prolonged treatment and repeated surgeries to correct the problem, the outcome is unsure

and many need amputation at the end.[3] Hence the treatment of all these problems i.e. non-union with soft tissue loss, shortening or lengthening of limb due to fresh fractures are associated with a formidable challenge to the orthopaedic surgeon.[4,5] Aim of the study is to observe the role of Orthofix limb reconstruction system as a treatment in non-union with bone loss and major soft tissue defect due to fresh fractures[6,7]

Materials and Methods

Proforma

- Name
- Age
- Sex .
- In-Patient No.
- Mode of injury
- Side of injury
- Dominant side
- Type of nonunion
- Associated injury
- Associated complications
- Date of injury
- Date of surgery
- Post-operative complication
- Date of mobilization
- Date of suture removal
- Date of fixator removal

Inclusion criteria

The inclusion criteria for the study includes those with:

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

Exclusion criteria

The Exclusion criteria includes:

- Intra-articular fractures.
- 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 yTs 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:

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

The condition of soft tissue surrounding the non-union site is of paramount importance, because the presence of a cicatrix, a draining sinus or a thin and un-yielding soft tissue will certainly limit or redirect the surgical methods to be used. 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.

Observations and Results

Table 3.1
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 3.2
Distribution of various type of non-unions in various bone
(N-13)

BONE	DRAINING NONUNION		NON DRAINING NONUNION	
	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 2.3 Sex Distribution
(n=15)

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

Table 3. 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 4. 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 4.6 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

Union time ranged from six to nine months (Average 8.2 months). The Sinus tracts got cleared in all cases. No case had any difficulty in the series as far as transportation of bone was concerned. However, there was considerable delay in the consolidation of bone in all cases. There was infection of pin tract in nine cases out of total fifteen cases (60%) which were subsided after systemic or oral antibiotics. we observed wound dehiscence in six cases during the post-operative period which required split skin grafting. The length of bone gap after debridement was from 2.5 to 7 cms.(Average 3.5 cms) Distraction was carried on fora period of minimum 35 days to a maximum of 80 days. There was no

neurological or vascular injury as a result of instrumentation. Bone healing index was (days of fixator use/centimetres of length gain) 69.1 days/cm. 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 analyse 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:

- Union
- Infection
- Deformity
- 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:

- A noteworthy limp
- 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)
- Soft tissue sympathetic dystrophy
- Pain that reduced activity or disturbed sleep and
- Inactivity (unemployment or an inability to return to daily activities because of injury)

Functional results- limp, equines, 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 humours, 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 instrumentation.

Discussion

All over the globe, in the recent past, a tremendous interest has been shown in distraction osteosynthesis. The clinical fact that distraction can produce new bone formation was showed as early as 1900 by Codivilla. The effect of rhythmical distraction which generates new bone formation was enlightened by Ilizarov from 1951 onwards. The effect of osteotomy on increased vascularity of the whole limb as well as the fixator in the fracture site was still under study. The distraction on tensile force at the osteotomy site, the lining cells covering the bone ends are able to differentiate into osteogenic and chondrogenic cells under an adequate stimulus and environment. This type of osteosynthesis even called as "intramembranous ossification" of lizarov. This type of regeneration of bone can be obtained by an appropriate distraction rate. This rate appears to be critical in the new bone formation and maintenance of adequate blood supply. In the present study, Limb Reconstruction System was used and appropriate rhythmical distraction was done. Maximum number of cases showed good periosteal tube of new bone formation.

The effect of osteotomy on the healing of bone was also explained by intact intramedullary blood supply by microangiographic studies. It is experimentally proved by Drey et al that there is no difference in regeneration to the healing sequence, in rhythmic distraction either after corticotomy or after osteotomy. The microangiographic study is essential at this juncture to prove that there is intact medullary tube after osteotomy in this series. The corticotomy was advised by Prof.llizarov mostly in the metaphyseal region, where as in the present series, it has been done in the most of cases in the diaphyseal region, which may be called in other words as "callostasis" or callus distraction. Callostasis was usually done after a lag period of 2 weeks in adults and 10 days in children. In the present study, there was a considerable delay in the consolidation phase of many cases,

which may be shortened in time by bone grafting and plating at the osteotomy site as advised by Jeorge Alenso, who also used a similar A0/ASIF tubular fixation in the segmental defect.

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.

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.

References

1. Ali F. Saleh M Injury. 2002 Mar; 33(2): 127-34
2. Aronson J. Good, B.Stewart et al. Preliminary studies of mineralization during distraction, Osteogenesis Clinic Ortho., 250, 43-49, 1990.
3. AS.A.M.IGroup: operative principles of lizarov.1991. Pg 42-52
4. Babulkar S, Pande K, Babulkar S. Clin Orthop Relat Res. 2005 Feb431): 50-6-Non-union of Diaphysis of long bones.
5. Behrens F, Searls K: External fixation of the tibia, Basic concepts J Bone and Joint Surg Br. 1986 Mar; 68 (2): 246-54.
6. Biasibetti A, Aloj D: Mechanical and biological treatment of kong bone nonunion: Injury.2005 Nov; 36 Suppl 4:S45-50.
7. Cadivilla The Orthopaedic Clinics of North America, Vol.21, No.4, Oct. 1990 by Vladimir Sachwartsman.
8. Campbell's operative orthopaedics 10 th edition vol.3 pg. 2706-2714
9. Cattaneo R, Catagni M, Johnson EE. The treatment of infected nonunions and segmental defects of the tibia by the methods of lizarov. Clin Orthop. 1992 Jul; (280):
10. Chanchit Sangkaew Injury.2005 Jan: 36(1) 185-93-Distraction osteogenesis using a conventional external fixator. A novel technique.

11. Chantelot C, Robert G; Role of external fixators for the treatment of humeral fractures; report of 23 cases treated with orthofix external fixators: Chir Main. 2002 Mar; 21 (2):134-9
12. Chao EY, Hein TJ: Mechanical performance of the standard orthofix external fixator. Orthopedics 1988 Jul; 11 (7): 1057-69.
13. Chapman's orthopaedic surgery 3 rd editiorn; 2001:Chapter 26.
14. Charles T. Price: Unilateral fixators and mechanical axis realignment. Orthopedic clinics of North America: vol.25.No.3.,July, 1994.
15. Chatziyiannakis AA, Nonunion of tibial fractures treated with external fixation. Acta Orthop Scand Supp. 1997 Oct; 275:77-9.
16. Chir Main. 2002 Mar; 21(2): 1M-9-Role of lixternal fixator in the treatment of humeral fractures
17. Dendrinos G.K, S. Kontos Use of the Ilizarov technique for treatment of nonunion of the tibia associated with infection. JBJS Vol 77-A, No. 6, June 1995.
18. Donnan LT, Saleh M, Rigby AS: JBJS Br. 2003 Mar; 85{2): 254-60.
19. dukewyeh.GJ, Sperlingl.W, Results of treatment of infected Humeral Nonunions: The Mayo clinic experience. CORR No.414, Pp.25-30, 2003
20. Dwijaya, A., & Atmaja, M. H. S. (2022). Clinical and imaging findings of klippel-trenaunay syndrome: A case report. International Journal of Health & Medical Sciences, 5(1), 145-149. https://doi.org/10.21744/ijhms.v5n1.1860
21. Eduardo Garcia-Cimbrelo et al; Circular external fixation in tibial nonunions. Clin orthop. No.419, Feb 2004
22. Franco ML, Lodovico RB, Piergiulio: Bio mechanical factors in designing screws for the Orthofix system Clinical Orthopaedics and related research No.308, pp 63-67:1994
23. Gopal.S, S.Majumder; The radical orthopaedic and plastic treatment of severe open fractures of the tibia: JBJS Vol 82-B, No.7 sep 2000.
24. Green SA, Moore TA, Spohn PJ: Orthopedics. 1988 Aug: 11 (8):1149-57.
25. Guadrini G, Pascarella R, Colozza A, Stagni C:Infected nonunion of the humerus. Chir Degli Organi Di Movi 85:251-255, 2000
26. Guidera KJ, Hess WE, Highhouse KP, Ogden JA.Extremity lengthening: results and complications Pediatr orthop. 1991 Jan-Feb
27. Hashmi MA, Ali A: Management of nonunion with monolateral 20 external fixation. Injury. 2001 Dec; 32 Suppl 4:SD304.
28. Hessmann M, Mattens M, Use of unilateral external fixator in fracture treatment: experience in 50 patients: Unfallchirurg.1994 Oct; 97(10): 511-7.
29. Jain AK, Sinha S: Infected nonunion of long bones. CORR 2005 Feb(431): 57-65.
30. Jorge F. Alonso M.D. and Pietro Regazzoni The Orthopaedic Clinics of North America, Vol.21, No.4, Oct.1990 by Vladimir Sachwartsman.
31. Judelreatment of non-unions. General Principles. Operative Orthopaedics by Michael W. Chapman.
32. Keating JF, Gardener E, Management of tibial fractures with the orthofix dynamic external fixator; J R Coll Surg Edinb.1991 Aug; 36(4): 267
33. Keith A.Mayo and Stephen K.Benirschke, OCNA, 21/4, 1990.
34. Kelly PJ: Infected nonunion of the femur and tibia. Orthop clin North Am. 1984 July; 15(3): 481-90.
35. Kim NH, Hahn SB, The orthofix external fixator for the fracture of long bones;Int. Orthop.1994 Feb; 18(1): 42-6

36. Kousik D.Markel Fitzgerald and Manual L.Brown. Scintigraphic evaluation in musculo skeletal sepesic, Ortho. Clinic of North America, Vol.15, No.3, July 1984.
37. Lavm , Renzi Brivio l, Treatment of nonunion of the humerus using the orthotis tivator: Injury.2001 Dec; 12 Suppl 4:S35-10.
38. LJ. Prokuski, J.L. Marsh The role of bone transport OCNA; Vol. 25:No.4: Oct. 1994.
39. Magyar G. Hydroxyapatite coating of threaded pins enhances fixation JBJS Br. 1997 May; 79(3): 487-9.
40. Mahaluxmivala J, Nadarajah R: Injury 2005 May; 36(5): 662-8.
41. Manual on the AO/ ASIF tubular external fixator: 1985 edition.
42. Melender HM, Colon C: Clinical Orthopaclics and related research. Treatment of open tibial fractures with the orthofix fixator; 1989 Apr; No.241. pp.224-30.
43. Merchant T, Dietz F: Journal of bone and joint surgery71 |A: 599-606, 1989.\
44. Muharrem Inan et al; Treatment of femoral nonunion by cyclic compression and distraction CORR No. 436, pp. 222-228, 2005.
45. Ong CT, Choon DS, The treatment of open tibial fractures and of tibial nonunion with a novel external fixator:Injury.2002 Nov; 33(9):
46. Orthopaedics and related research: No.414, pp.25-30, 2003.
47. Paley D, Catagni MA, Argnani F, Villa A, Benedetti GB, Cattaneo R. Ilizarov treatment of tibial nonunions with bone loss. Clin Orthop. 1989 Apr:(241):146-65.
48. Panagiotis M: Classification of nonunion. Injury. 2005 Nov; 36 Suppl . 4:530-7.
49. Patzakis MJ, Results of bone grafting for infected tibial nonunion: CORR 1995 Jun;(315): 192-8.
50. Price CT, Mann]W. experience with the orthofix device for limb lengthening: Orthop clin North Am. 1991 Oct; 22(1): 651-61.
51. Ralston 1:1Orthop Trauma. 1990; 4(4): 419-57.
52. Rockwood and Groen's 5th edition vol.1 pg.231-43
53. Romen Gristllo, Stuart, A. Green and Thomas A.Dlabal. The open bone 8ratt for septic non union., Clinic Ortho., 180, 117 - 124. Nov.1983. 1. Prokuski LJ, Marsh JL. Segmental bone deficiency after acute trauma: The role of bone transport. Orthop Clin North Am. 1994 Oct; 25(4): 753- 63.
54. Ruedi T.P, W.M Murphy AO Principles of fracture management, 2000.
55. Shaw DL, Lawton JO: Clinical results and cost effectiveness of external fixation JR Coll Surg Edinb. 1995 Oct; 40(5): 344-6.
56. Suryasa, I. W., Rodríguez-Gámez, M., & Koldoris, T. (2021). Get vaccinated when it is your turn and follow the local guidelines. *International Journal of Health Sciences*, *5*(3), x-xv. https://doi.org/10.53730/ijhs.v5n3.2938
57. Thomas P. Ruedi, William M. Murphy: AO principles of fracture management; pg 765-77
58. Toh CL, Jupiter JB: The infected nonunion of the tibia. Clin Orthop Relat Res. 1995 Jun:(315): 176-91.
59. Ueng SW, Wei FC, Shih CH: Management of femoral diaphyseal infected nonunion J Trauma. 1999 Jan; 46(1): 97-103.
60. Websites- www.othofix.com, www.pubmed.com, www.jbjs.org

61. Zachee B, Roosen P: The dynamic axial fixator in fractures of the tibia 59. and femur. A retrospective study in 98 patients: Acta orthop.Belg.1991; 57(3): 266-71