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

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***Abstract*---**The concept of Bifocal osteos1ynthesis is distraction at the Osteotomy site and compression at the non-union site with rhythmical distraction leads on the neo-osteogenesis and consolidation of cortectomy site. Transporting a segment of bone increases the vascularity of the fracture ends. Once the vascularity of the fracture ends increases, the infection will be eradicated and there will be healing of non-union. Daring transportation phase for bone lengthening their Wet pin tract infection and loosening in two cases for which pin Tension was done. ln all cases, neither there was infection at the Corticectomy site nor at the distraction sites. After a period of Waiting for consolidation to occur, the final result of the healing of the osteotomy was adequate in all cases. The cases (seven) with limb length discrepancy up to 2.5 cms in lower limb managed with modified footwear with heel and sole raise. One case of femur nonunion had angular deformity of 15 degrees. Six cases had knee stiffness; three cases had ankle stiffness. There was no neurological or vascular injury as a result of instrumentation. Bone healing index was (days of fixator use/centimeters of length gain) 69.1 days/cm.

***Keywords*---**Bone healing index, lower limb, fixator.

1. Introduction

The concept of Bifocal osteos1ynthesis is distraction at the Osteotomy site and compression at the non-union site with rhythmical distraction leads on the neo-osteogenesis and consolidation of corticotomy site.[1,2] Transporting a segment of bone increases the vascularity of the fracture ends. Once the vascularity of the fracture ends increases, the infection will be eradicated and there will be healing of non-union. Non-union with frequent association of infection, bone defect, limb shortening, deformity and soft tissue problems with atrophy of bone ends Limb Reconstruction System is an ideal choice to correct all these problems. [3,4,5] Hence, we have decided to study the effect of segmental transport in the management of infected non-union of long bones and shortening of long bones by Ilizarov's concept using the Limb Reconstruction System[6]. Aim of the study is to observe the role of Orthofix limb reconstruction system as a treatment in non-union with bone lengthening due to fresh fracture[7,8]

2. Materials and Methods

2.1 Inclusion criteria
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.

2.2 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 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:

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.

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.
Nonunion resulted from previous surgeries in ten cases and in One case nonunion resulted after cast immobilization for Grade 1 open fracture (Gustillo Anderson classification) and in Two cases non-union resulted after cast immobilization for closed fractures.
Deformity with shortening resulted in two cases due to multiple surgeries due to old compound fractures of both bones of leg.
diagnosis was established by history, physical examination investigations like erythrocyte sedimentation rate, total and ditterential white blood cell count, pus culture sensitively and standard A LATERAL X-rays. History was taken from the taint including the date of injury, detail of original accident and Subsequent treatment. Special attention was focused on limb length measurements, range of motion of the joints, 1neuromuscular status and distal vascularity.

3. 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	
	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

4. Results

During transportation phase for bone lengthening their Wet pin tract infection and loosening in two cases for which pin Tension was done. ln all cases, neither there was infection at the Corticectomy site nor at the distraction sites. After a period of Waiting for consolidation to occur, the final result of the healing of the osteotomy was adequate in all cases. The cases (seven) with limb length discrepancy up to 2.5 cms in lower limb managed with modified footwear with heel and sole raise. One case of femur nonunion had angular deformity of 15 degrees. Six cases had knee stiffness; three cases had ankle stiffness. There was no neurological or vascular injury as a result of instrumentation. Bone healing index was (days of fixator use/centimeters 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 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.

4.1 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.

4.2 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.

4.3 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, 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 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 instrumentation.

5. Discussion

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 overall goal in the reconstruction of an infected un united long bone fracture involves more than control of infection and includes creation of a healed aligned and drainage free limb which is functionally better than that which could have been achieved by amputation and prosthetic fitting. Several factors must be considered in reconstruction of bone including the agent s age, metabolic status, mobility of the foot and ankle, integrity ot neuro-vascular structures and importantly the patient's motivation. The extent of bony debridement is defined by the presence of punctate bleeding points observed. The non union site must be respected as it is better to substitute a poorly biological atrophic bone area with two bone surfaces of good quality modeled in such a way as to allow for easy stabilization under compression.

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 Bone healing index (BHI) in our study was 69.1days/em, which is high when compared with that reported in the literature. Various studies and their reported BH: Aldegheri described 270 lengthening with a mean BHI of 39 days/cm, Spanish study of 261 lengthening had a lowest BHI of 28 days/cm, Noonan et al reported BHI of 49 days/cm. The high BHI may be ascertained to poor nutritional status of ours patients due to poor economic status.

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. This is 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 themselves can lengthen very easily. More over plastic surgery procedures like cross leg flap, Fascio-cutaneous flap and skin grafting can be done comfortably. Once the patients have been taught about how to do distraction, they ae advised to come for review once in 15 days to assess the length gained and also to assess the quality of the regenerate. Moreover, the fixator (other than the tapered half pins) can be reused tor another patient provided there is no damage to the apparatus.

6. 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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