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Original Research Article.

A Prospective Study on Use of Ilizarov Ring Fixator in Management of Nonunion of Long Bone

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ABSTRACT

Introduction: The aim of treatment of non-union is to achieve a stable union without residual infection, deformities or shortening. The various techniques that are used in the treatment of non-union have all produced inconsistent results. The principle of Ilizarov method along with the technique of bone transport allows the orthopaedic surgeon unprecedented control over osteogenesis, radical debridement of infected bone and soft tissue while maintaining stability and allows simultaneous correction of deformity and limb length discrepancy.

Objective: To evaluate the effectiveness of Ilizarov's principles and methods in the treatment of non-union.

Materials and Methods: This prospective study was conducted in the Department of Orthopaedics, orthopedics ward of S. K. Hospital, Sikar. 25 cases of non-union of tibia, humerus and femur were included in the study. The bone result and functional result of these patients after Ilizarov technique was assessed.

Results: Of the 25 cases included in the study, 96 % were non-union of tibia, 76% were compound fractures and 72 % were infected at the commencement of treatment. At the last follow up, 96 % cases did not require any assistive device for ambulation.

Conclusion: The use of Ilizarov principle and methods in our study of 25 cases of non-union with complications like infection, shortening, deformity, and soft tissue loss has given excellent results.

Keywords: Non-Union, Ilizarov Technique, Fracture.

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INTRODUCTION

Non-union of bones is a challenging problem that frequently taxes the ingenuity of the orthopaedic surgeon. Since by definition , non-union can only be diagnosed when at least six months have elapsed since the fracture and when there is evidence that union will not take place , infection under these conditions tend to become chronic often with organisms resistant to most antibiotics. Infected non-union bring together problems of resistant bone infection and loss of stability of bone. The classical modalities of treatment of infected

non-union ranges from prolonged immobilisation, aggressive surgical debridement followed by extensive re-construction using bone grafts and microvascular tissue transfer techniques to electrical stimulation.[1] These techniques have had variable rates of success and include multiple extensive procedures, prolonged hospitalisation, limited ability to correct limb length discrepancy and lack of early functional rehabilitation.[2]

Professor Gavril Abramovich Ilizarov from the Siberian town of Kurgan in Russia in 1950, developed a circular external skeletal fixator which employed the principle of distraction osteogenesis to attain union, correct deformities and eradicate infection in infected non-union. Application of Ilizarov technique to the treatment of non-union depends on the type of non-union hypertrophic or atrophic, extent of infection and condition of soft tissues. The main surgical principle in the management of diaphyseal bone infection is thorough debridement of all non-viable tissues. Such debridement often result in a large bone and soft tissue defect creating a formidable situation to overcome with standard grafting and stabilisation technique.[3,4] The application of the principle of distraction osteogenesis allows bone to be regenerated between bone ends and to stretch it in any direction and length to accomplish lengthening, gap reconstruction and correction of deformity in any plane. The Ilizarov technique allows radical, circumferential debridement more than is possible by

conventional techniques. This is possible due to the unique technique of bone transport involving gradual transport of an intercalary segment of bone through the limb while simultaneously lengthening the corticotomy gap and closing the skeletal defect.[5,6]

MATERIALS AND METHODS

This prospective study was conducted in the Department of Orthopaedics, orthopedics ward of S. K. Hospital, Sikar. 25 cases of non-union of tibia, humerus and femur were included in the study. All patients had received unsuccessful treatment for their fractures before the Ilizarov technique was applied. The results were divided in to bone result and functional result. For bone result, the criteria evaluated were union, infection, deformity and limb length discrepancy. For functional results the criteria evaluated were significant limp, equinus rigidity of ankle, soft tissue dystrophy, pain and inactivity.

Table 1: Classification of non-union

Type		n	%
A	A(less than 1 cm bone loss)	10	40
	A1 (lax)	6	24
	A2-1 (stiff, no deformity)	0	0
	A2-2 (fixed deformity)	4	16
B	B (more than 1 cm bone loss)	15	60
	B1 (bony defect, no shortening)	0	0
	B2 (shortening, no defect)	7	28
	B3 (bony defect and shortening)	8	32

Table 2: Status after follow up

Modality		n	%
Union	Yes	24	96
	No	1	4
Infection	Yes	2	8
	No	23	92
Limb length discrepancy	Yes	2	8
	No	23	92
Radiological union	Yes	24	96
	No	1	4
Residual bone deformity	Yes	8	32
	No	17	68

Table 3: Final Result Grading

Bone Result		
Grade	n	%
Excellent	10	40
Good	8	32
Fair	6	24
Poor	1	4
Functional Result		
Grade	n	%
Excellent	14	56
Good	8	32
Fair	2	8
Poor	1	4

Table 4: Duration of treatment, final status of union and infection and percentage of failure

Study	Duration of Treatment	Final Status		Percentage of Failure
		Union	Infection	
Stewart Green (8)	41 weeks 1 day	94%	5.8%	5.8%
Vla dimir Schwartzman (8)	32 weeks 1 day	100%	Nil	Nil
Present Study	27 weeks 1 day	95%	8%	4%

RESULTS

Out of the 25 cases of non-union included in the study, 19 cases (76%) were non-union of tibia, 3 (12%) were non-union of femur and 3 cases (12%) were non-union of humerus. The age of the patients ranged from 16 to 66 years. Maximum number of patients were in the 31 – 40 year age group (30%). All patients had received unsuccessful treatment for their fracture before the Ilizarov technique was applied. 9 cases (36%) were treated by internal fixation, 12 (48%) by external fixation and 4 cases (16%) were treated by plaster of Paris immobilisation alone before application of Ilizarov technique. The duration of disability ranged from 12 weeks to 9 years before application of Ilizarov apparatus. Out of the 25 cases, 19 (76%) were compound fractures out of which 10 (40%) were grade 2 and 9 (36%) were grade 3 according to Gustilo grading. 18 cases (72%) were infected at the commencement of treatment.

Non-union was classified based on the Ilizarov system of classification.[7] The average time in the Ilizarov apparatus was 28 weeks for tibia, 31 weeks for femur and 17 weeks for humerus. Union was attained in all except one patient. The failure occurred in a case of Type 3 compound fracture both bone leg lower one third which had been previously treated by an external fixator and cross leg flap cover. Duration of follow up of the patients ranged from 3 months to 2 years. At the last follow up 24 /25 cases did not require any assistive device for ambulation. All patients except the failed one had returned to full-fledged daily activities. Two patients had length discrepancy less than 2 cm which was acceptable to the patient.22 patients developed pin track infection at some time during the treatment. 12 patients developed grade 2 pin track infection which was successfully treated by antibiotics. Two patients developed grade 3 pin site infection and the wire was removed and fresh wire inserted. At the time of last follow up, there were no cases of ring sequestrum. Premature consolidation occurred in two patients. The consolidation was broken by accelerated distraction in one patient and by closed rotational osteoclasis in the other. Delayed consolidation occurred in four cases with poor bone formation. The rate of distraction was reduced and later bone formation was adequate. None of the patients developed any neuro-vascular complications. At the time of commencement of treatment, 18 patients had equinus deformity of the ankle and stiffness of the knee due to immobilisation in plaster of paris casts or external fixators. All of them improved with ambulation and eight cases required a metatarsal pin to correct

the equines deformity. At the final follow up, there was less than 15 degree residual equinus contracture.

Final result grading was done based on a total of 9 parameters which include clinical radiological and functional assessment of the patient, some of which are subjective and depends on the patients assessment

DISCUSSION

In this series of 25 patients, road traffic accidents accounted for 84 percent of the injuries and 12 percent were due to domestic accidents and falls which is comparable to other studies.[8] The mean age of patients in this series was 32.56 years and the duration of disability before application of Ilizarov fixator was 100 weeks and 4 days. Stewart Green et al reported a mean age of 33 years and duration of disability was 128 weeks 4 days.[9] In this study classification of nonunion according Weber and Cech and Dror Paley et al was applied. It was found that the classification of nonunion after adequate debridement or bone resection was more relevant to the treatment strategy than classification prior to debridement. There were 10 cases classified as Dror Paley Type A which was treated by monofocal compression osteosynthesis. 15 cases were classified as Dror Paley Type B with a bone defect of more than one centimeter before and following debridement and were treated by corticotomy and bifocal osteosynthesis. Trifocalosteo synthesis was not employed in our study. In this study bone grafting was used in selected cases of atrophic nonunion where the non-union site was opened in an effort to augment union and reduce the duration of treatment. Vladimir Schwartzman recommends bone graft to augment union in selected cases only.[8]

After follow up it was noted that ankle movements never returned to normal while knee movements gradually recovered within 2 to 3 months. This was probably due to soft tissue contracture following prolonged immobilisation prior to treatment and poor compliance with weight bearing and physiotherapy. The soft tissue healing was notably accelerated by the increased vascularity in the limb. Soft tissue defects which were left open quickly granulated and skin cover was obtained without skin grafting in all cases. Draining sinuses healed spontaneously on the application of the apparatus and restoration of stability. The stability provided by a properly applied Ilizarov frame is excellent and aids union.

CONCLUSION

Non-union presents a therapeutic challenge to the orthopaedic surgeon. When traditional methods of managing these non-unions fail, this study shows that the Ilizarov technique provides excellent results for majority of the patients. The Ilizarov technique allows early function of the limb resulting in adequate stimulus for soft tissue and bone healing. Proper selection of patients by avoiding extremes of age, and assessing compliance by the patient is essential for the successful application of the Ilizarov technique. Proper understanding of the biological and biomechanical principles of the Ilizarov method and there careful application gives excellent results in almost all cases of nonunion.

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