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ORIGINAL ARTICLE

Role of the Ilizarov External Ring Fixator in Gap Non-Union and Bone Loss Management

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ABSTRACT

Background: Several surgical techniques are available to address segmental long-bone defects. Each technique has its own advantages and limitations. The Ilizarov bone plasty is a vital method for infected nonunion and compensating bone loss which has gained widespread popularity within the last few decades.
Objective: To determine the role of the Ilizarov external ring fixator in gap non-union and bone loss management.
Study Design: Observational study
Place and Duration of Study: Department of Orthopaedics Unit-1, Chandka Medical College, SMBBU, Larkana from 1st October 2023 to 30th September 2024.
Methodology: Sixty patients suffering from extensive tibial defects of more than ten centimetres were enrolled. The patients requiring bone gap union and bone loss management were included.
Results: There were 43 males and 17 females with mean age 20.8±11.2. The mean bone defect value was 13.2±0.9 and anatomical shortening was 6.5± 0.8cm. The mean restoration of lower leg length was significantly higher as 88.8 ± 2.5%. The complications associated with the Ilizarov external ring fixator included highest presentation of skin inflammation up to 23.8% followed by recurrence of equinus in 18.3% and ankle stiffness presented in 11.6%.
Conclusion: The Ilizarov external ring fixator has an efficient role in gap non-union and bone loss management.
Keywords: Ilizarov, Management, Complications, Bone defects, Fixator.

INTRODUCTION

Segmental long-bone defects are a significant concern in orthopedic surgery, often arising from severe trauma, infection, or tumor resection.[1] These defects can have a profound impact on a patient's quality of life, leading to chronic pain, limited mobility, and long-term disability. Segmental long bone defects can have devastating consequences if left untreated or mismanaged.[2] Effective management treatment and therapy of long-bone defects is crucial to promote optimal recovery and prevent further complications.[3]

Several surgical techniques are available to address segmental long-bone defects. Each technique has its own advantages and limitations.[4] Autogenous bone grafts, for instance, are suitable for small defects, on the other hand, free vascularized grafts and distraction osteogenesis are more effective for larger defects.[5] Another contemporary approach is the induced membrane technique which has shown promising results. Nonetheless, selecting the most suitable technique depends on a range of clinical factors,

including patient comorbidities, the location and size of the defect, and soft tissue condition.[6] The Ilizarov method, developed by G.A. Ilizarov, has revolutionized the field of reconstruction surgery and bone lengthening. The Ilizarov bone plasty is a vital method for infected nonunion and compensating bone loss which has gained widespread popularity within the last few decades.[7]

As orthopedic surgery continues to evolve, advances in technology and technique hold promise for improved treatment outcomes.[8] Ongoing research and development are essential in addressing the complexities of segmental long bone defects. By exploring new techniques, instrumentation, and biomaterials, orthopedic surgeons can provide more effective and personalized treatment options for patients, ultimately improving their quality of life and functional outcomes.[9,10] This study is specifically designed to determine the role of the Ilizarov external ring fixator in gap non-union and bone loss management

MATERIALS AND METHODS

This observational study was carried out at Department of Orthopaedics Unit-1, Chandka Medical College, SMBBU, Larkana from 1st October 20223 to 30th September 2024 and 60 patients suffering from extensive tibial defects of more than 7 centimetre were enrolled. It was ensured that patient's personal information was only used for research purpose and kept confidential else wise. The patients requiring bone gap union and bone loss management were included. While patients under year 1 or suffering from bone necrosis, autoimmune disorders/infections and malignancy were excluded. The sample size was generated using sample size calculator wherein the calculations were built on 80% power of test, 95% confidence of interval, 5% margin of error and 29%.[11] The patients were followed by double osteotomy of the tibia. Either one fragmentation lengthening was performed through bifocal proximal fragment distraction or and bifocal distal-fragment distraction was conducted. The longitudinal-stretching was also performing on fixator rods for minimizing anatomical related shortening. A well-structured questionnaire was generated for documenting all the important information. The data was entered and analyzed through SPSS version 26.0.

RESULTS

There were 43 males and 17 females. The mean age of the patients was 20.8±11.2 years and majority of the patients were young adults (Table 1). The bone defect presented as the bone defect with a mean value of 13.2±0.9 while anatomical shortening, was observed as 6.5± 0.8cm (Table 2).

The total treatment period in days was much less with reduced mean bone gradual transport value as well. The mean restoration of lower leg length was significantly higher as 88.8 ± 2.5%. There were 20 cases with residual anatomical leg discrepancy (Table 3).

The complications associated with the Ilizarov external ring fixator included highest presentation of skin inflammation up to 23.8% followed by recurrence of equinus in 18.3% and ankle stiffness presented in 11.6%. The infection of bone was only presented in 1 case out of the total 60 cases (Table 4).

Table 1: Gender and age distribution of patients (n=60)

Variable	No.	%
Gender		
Male	43	71.6
Female	17	28.3
Age (years)		
< 18	11	18.3
18 – 40	40	66.6
> 40	9	15

Table 2: Anatomical shortening of the patients (n=60)

Parameter	Mean±SD
Anatomical shortening (cm)	6.5± 0.8
Bone defect	13.2±0.9
Fragment ends shape, congruent	17/60

Table 3: Treatment and restoration period of patients (n=60)

Parameters	Mean±SD
Total treatment period (days)	287.0±14.3
Mean bone gradual transport (days)	97.8±5.8
Distraction for tibial fragment separation/correction (days)	84.5±22.8
Time of mean fixation (days)	169.9±12.5
Bone defect-filling (cm)	11.3±0.8
Mean restoration of length of lower leg (%)	88.8±2.5
Residual anatomical leg discrepancy cases (≥3 cm)	20

Table 4: The rate of complication among cases managed by Ilizarov external ring fixator

Complications		No. (%)
Pin tract infection (n=21)	Skin inflammation (Grade 1)	5 (23.8%)
	Infection of adjacent tissues (Grade 2)	2 (9.5%)
	Infection of bone (Grade 3)	1 (4.76%)
Ankle stiffness		7 (11.65)
Knee stiffness		3 (5%)
Breaking of wire		3 (5%)
Recurrence Equinus		11 (18.3%)

DISCUSSION

The treatment and management of segmental long bone defects remains a significant challenge in contemporary

orthopaedics.[11] These are the consequences of the severity of high-energy trauma, traffic accidents, and military activities Choosing the suitable surgical technique depends on various clinical factors, such as patient comorbidities, soft-tissue condition, and defect size.[11-13] Extensive research is required to focus on addressing the limitations of current techniques and exploring new approaches to improve treatment outcomes. The Ilizarov method is a commonly used technique for reconstructing bones, especially in cases of nonunion and defects. This approach utilizes a circular external fixator to harness the body's natural bone growth processes. The Ilizarov method stimulates the formation of new bone tissue, facilitating the bridging of bone gaps and promoting union by applying controlled distraction and axial forces.[14,15]

Bone loss accompanying non-union significantly complicates the healing process, giving a substantial challenge. The Ilizarov frame has proven instrumental in addressing gap non-unions through bone transport.[16] The outcome of bone transport to alternative methods, consistently highlighting the superiority of the Ilizarov approach. Studies have also employed acute shortening in cases with bone gaps less than 4 cm.[17] This strategy yielded a reduced external fixator index, averaging 1.71 months/cm, and consequently minimized associated complications. By facilitating immediate docking of bone ends after resection, acute shortening enhanced apposition, increased bone viability, and ultimately improved the chances of successful union.[18]

The excellent bony results were observed in 90% of patients, while 93% demonstrated excellent functional results. These outcomes surpass those reported in previous studies, which achieved 50% excellent functional results and 28.5% good results.[19,20] Another study also reported union rates ranging from 70% to 100% after debridement and Ilizarov frame-assisted bone transport. Our findings suggest that a ring Ilizarov fixator frame may be a viable and effective option for managing infected or gap non-union of the tibia.[21]

CONCLUSION

The Ilizarov external ring fixator has an efficient role inin gap non-union and bone loss management with minimal risk of complications.

DECLARATION

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Authors Contribution
Each author of this article fulfilled following Criteria of Authorship:

1. Conception and design of or acquisition of data or analysis and interpretation of data.
2. Drafting the manuscript or revising it critically for important intellectual content.
3. Final approval of the version for publication.

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Competing interests
The authors declare that the research was conducted in the absence of any commercial or fnancial relationships that could be construed as a potential confict of interest.

Conflict of interest
The authors declared no conflict of interest.

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