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Research Article

ROLE OF ILIZAROV'S METHOD IN THE TREATMENT OF HUMERAL SHAFT NONUNION: A PROSPECTIVE STUDY

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Abstract: ***Introduction:*** Nonunion of diaphyseal fractures of the humerus is a challenging orthopaedic condition, managed using several treatment methods such as plating with bone grafting, exchange nailing, fibular grafting and external fixation techniques. Among all the techniques, the Ilizarov ring fixation technique offers stable fixation, promotes bone healing and enables correction of deformity with early mobilization. We conducted a prospective study to evaluate the clinical and functional outcomes of Ilizarov ring fixation in the treatment of humeral shaft nonunion.**Methods:** Twenty five with diaphyseal fracture of the humerus were examined for shoulder movements, limb length discrepancy and deformity. Radiological assessment was carried out using standard anteroposterior and lateral radiographs to evaluate fracture alignment and angulation.**Results:** No cases were present with any infection or pain. Shoulder abduction of >150° was found in 4 cases, 160° in 6 cases, 165° in one case and 170° in 3 cases. This indicated that the final functional result was excellent in 13 cases out of 25 cases.**Conclusion**: Ilizarov ring fixation technique is the effective method for the treatment of humerus fractures with nonunion. They can be considered as a reliable and effective treatment in both infective and non-infective cases.

Keywords: Bone, fracture, Ilizarov ring fixation, humerus fractures, nonunion

INTRODUCTION

Humerus fractures are generally the common injuries encountered in orthopedic practice and represent a small but significant proportion of all skeletal fractures1. The management of humeral shaft structures may consist of non-operative approaches such as casting and bracing, or surgical procedures depending on the nature and severity of fracture2,3. Despite advances in this treatment methods, failure of fracture healing leading to nonunion remains an important complication. Nonunion of the humerus can greatly affect the limb function and quality of life (QoL) of patients, making its treatment more complex and demanding4. The challenges increases further if the cases are complicated with infections, particularly following previous operative intervention. Over the years, various surgical procedures have been utilized to achieve fracture union, including plate osteosynthesis with bone grafting, intramedullary fixation, and external fixation system5,6. Among these methods, the Ilizarov external fixator has garnered significant attention owing to its ability to provide stable fixation while also addressing infection and deformity correction simultaneously7-9. An additional advantage of this technique is that it often promotes bone healing without requiring extensive bone grafting procedures. Owing to these benefits, the Ilizarov method has become an effective option in difficult cases of humeral shaft nonunion. The present prospective study aims to assess the functional and radiological outcomes of patients with humeral diaphyseal nonunion managed using the Ilizarov technique.

MATERIALS AND METHODS

Study Design and Reporting Standards

This was a prospective study conducted at the Department of Orthopaedics in Sree Mookambika Institute of Medical Sciences, Kanyakumari. The study was conducted from Feb 2024 to May 2025. The study enrolled twenty five patients with diaphyseal fracture of the humerus. There were thirteen males and twelve females. Among the included patients, 9 had sustained open fractures at the time of the original injury and closed fractures were present in 16 cases. No evidence of infection was observed in any patient, and none reported pain during evaluation. Before surgery, all patients underwent a thorough assessment using both clinical examination and radiographic investigations.

Clinical examination included assessment of shoulder movements, limb length discrepancy and deformity. Radiological assessment was carried out using standard anteroposterior and lateral radiographs to evaluate fracture alignment and angulation. Final limb length discrepancy was categorized as 0 cm, 0.1–1.0 cm, 1.1–2.0 cm and 2.1–3.0 cm. Final angulation was measured in degrees and documented accordingly. Shoulder abduction was also measured and recorded during follow up.

Functional outcome was evaluated based on shoulder abduction, residual deformity and pain. The final functional result was graded as excellent when shoulder abduction was >150° with no significant restriction of movements and absence of pain. It was graded as good when shoulder abduction was >120° with mild restriction of movements and no pain. A fair result included shoulder abduction between 90°–120° with moderate restriction of movements, while shoulder abduction <90° with marked restriction of movements was considered a poor result. Final assessment was carried out at the end of follow up using both clinical examination and radiographic evaluation.

RESULTS

A total of 25 patients with humeral shaft fractures were included in the study. There were thirteen males and twelve females. Among the included patients, 9 had sustained open fractures at the time of the original injury and closed fractures were present in 16 cases. No evidence of infection was observed in any patient, and none reported pain during evaluation (Figure 1).

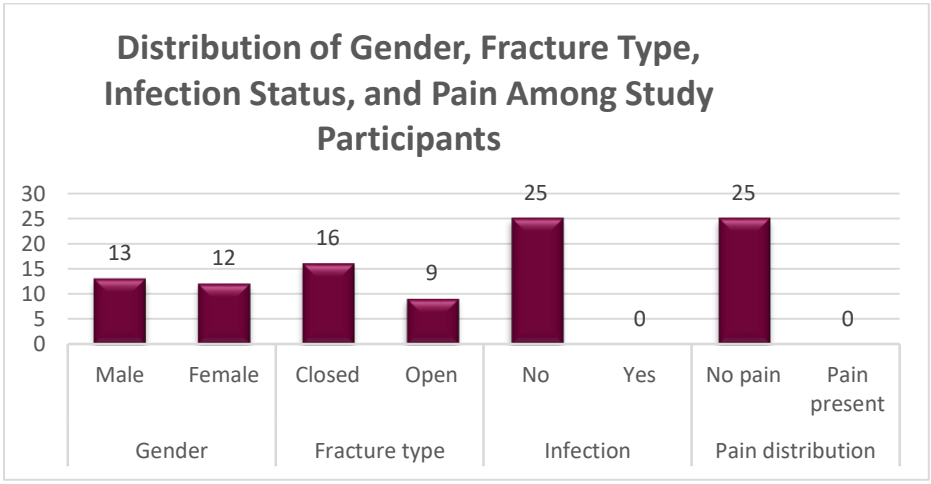

Figure 1: Distribution of Gender, Fracture Type, Infection Status, and Pain Among Study Participants

Final limb length discrepancy, final angulation distribution, and shoulder abduction is shown in Table 1, 2, and 3 respectively. The final functional result was graded as excellent when shoulder abduction was >150°, with no significant restriction of movements and absence of pain. It was graded as good when shoulder abduction was >120° with mild restriction of movements and no pain. A fair result was considered when shoulder abduction ranged between 90°–120° with moderate restriction of movements. Shoulder abduction <90° with marked restriction of movements was considered a poor result. Final assessment was carried out clinically and radiologically at the end of follow up.

Final LLD Category	Frequency	Correct Percentage
0 cm	10	40%
0.1–1.0 cm	2	8%
1.1–2.0 cm	6	24%
2.1–3.0 cm	7	28%
Total	25	100%

Table 1: Final limb length discrepancy (LLD)

Final Angulation	Frequency	Correct Percentage
0°	4	16%
2°	5	20%
3°	1	4%
4°	4	16%
5°	8	32%
6°	3	12%
Total	25	100%

Table 2: Final angulation distribution

Shoulder Abduction	Frequency	Correct Percentage
100°	1	4%
130°	3	12%
135°	3	12%
140°	1	4%
150°	3	12%
155°	4	16%
160°	6	24%
165°	1	4%
170°	3	12%
Total	25	100%

Table 3: Shoulder abduction distribution

DISCUSSION

Fractures involving the shaft of the humerus are commonly treated without surgery, and satisfactory healing is achieved in the majority of patients. However, a small proportion of cases may progress to nonunion despite appropriate treatment, irrespective of whether conservative or operative methods are used[10-15]. Several factors contribute to the development of nonunion, including infection, inadequate stability at the fracture site, excessive distraction, inappropriate implant selection, compromised blood supply due to soft tissue damage, osteoporosis, and bone loss[11-13]. Humeral nonunions may generally present either as hypertrophic or atrophic types, with or without associated infection[16,17]. Hypertrophic nonunion generally highlights insufficient mechanical stability, whereas atrophic nonunion is more commonly related to impaired biological healing potential. Infected nonunion is more frequently observed following surgical intervention and in open fractures. Although exchange intramedullary nailing has shown good outcomes in femoral and tibial nonunion, its effectiveness in humeral shaft nonunion remains comparatively limited.

The Ilizarov ring fixator has emerged as an effective alternative, particularly in complex cases associated with infection, bone loss, or failed previous surgeries[18,19]. This technique has an advantage of stable fixation while preserving the fracture healing biology and reduces additional soft tissue damage[19]. In addition to this, careful insertion of pins and wires within safe anatomical zones aids in avoiding complications associated with neurovascular system. Moreover, it has the ability to correct deformities either during surgery or gradually in the post-operative period[20]. Notably, minor residual deformities in the humerus are typically well tolerated and rarely manifest in significant functional impairment. Our study treatment is based in the gradual compression after achieving adequate alignment of the fracture fragments. Initial compression was applied until pain at the docking site indicated adequate contact between bone ends, following which slower compression was continued to maintain stability and stimulate healing. The overall union rate observed in the present study was satisfactory and functional outcomes were favorable in most patients. Major complications such as persistent infection, refracture, vascular compromise, or implant failure were not observed.

CONCLUSION

The Ilizarov technique manages the major challenges associated with humeral nonunion effectively. This method provides stable fixation, promotes fracture healing and enables early mobilization of adjacent joints, thereby improving functional recovery. Based on the satisfactory clinical and radiological outcomes observed, Ilizarov ring fixation can be considered a reliable and effective treatment option for both septic and aseptic nonunion of diaphyseal fractures of the humerus.

Conflict of Interest

The authors declare no conflict of interest

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REFERENCES

1. Khmelnitskaya E, Lamont LE, Taylor SA, Lorich DG, Dines DM, Dines JS. Evaluation and management of proximal humerus fractures. Advances in orthopedics. 2012;2012(1):861598.
2. Carroll EA, Schweppe M, Langfitt M, Miller AN, Halvorson JJ. Management of humeral shaft fractures. JAAOS-Journal of the American Academy of Orthopaedic Surgeons. 2012 Jul 1;20(7):423-33.
3. Updegrove GF, Mourad W, Abboud JA. Humeral shaft fractures. Journal of shoulder and elbow surgery. 2018 Apr 1;27(4):e87-97.
4. Brinker MR, Loftis CM, Khoriaty JD, Dunn WR. The devastating effects of humeral nonunion on health-related quality of life. Journal of Shoulder and Elbow Surgery. 2022 Dec 1;31(12):2578-85.
5. Davis BP, Mauter LA, Sears BW, Hatzidakis AM. Intramedullary nailing technique for proximal humeral fractures using a straight antegrade nail with locking tuberosity fixation. JBJS Essential Surgical Techniques. 2024 Jul 1;14(3):e23.
6. Leiblein M, Verboket R, Marzi I, Wagner N, Nau C. Nonunions of the humerus–Treatment concepts and results of the last five years. Chinese journal of traumatology. 2019 Aug 1;22(4):187-95.
7. Meselhy MA, Sanad E, Elkaramany M. Role of Ilizarov external fixator in treatment of humeral non-union. Acta Orthopaedica Belgica. 2020 Jun 1;86(S 2):125-32.
8. Kiran M, Jee R. Ilizarov's method for treatment of nonunion of diaphyseal fractures of the humerus. Indian journal of orthopaedics. 2010 Oct;44(4):444.
9. El-Alfy BS, Maaty M, Niazy T. Reconstruction of infected nonunion of the distal humerus by Ilizarov external fixator. Injury. 2021 Jun 1;52(6):1418-22.
10. HEALY WL, WHITE GM, MICK CA, BROOKER JR AF, WEILAND AJ. Nonunion of the humeral shaft. Clinical Orthopaedics and Related Research (1976-2007). 1987 Jun 1;219:206-13.
11. Naclerio EH, McKee MD. Approach to humeral shaft nonunion: evaluation and surgical techniques. JAAOS-Journal of the American Academy of Orthopaedic Surgeons. 2022 Jan 15;30(2):50-9.
12. Billings A, Coleman SS. Long-term follow-up of persistent humeral shaft non-unions treated with tricortical bone grafting and compression plating. The Iowa Orthopaedic Journal. 1999;19:31.
13. Westrick E, Hamilton B, Toogood P, Henley B, Firoozabadi R. Humeral shaft fractures: results of operative and non-operative treatment. International orthopaedics. 2017 Feb;41(2):385-95
14. Olson JJ, Entezari V, Vallier HA. Risk factors for nonunion after traumatic humeral shaft fractures in adults. JSES international. 2020 Dec 1;4(4):734-8.
15. Mukhopadhaya J, Bhadani JS, Ranjan R, Kushwaha SR. Operative Management of Aseptic Humeral Shaft Nonunion: A Retrospective Study from Eastern India. Indian Journal of Orthopaedics. 2024 Dec;58(12):1793-805.
16. Rupp M, Biehl C, Budak M, Thormann U, Heiss C, Alt V. Diaphyseal long bone nonunions—types, aetiology, economics, and treatment recommendations. International orthopaedics. 2018 Feb;42(2):247-58.
17. Panagiotis M. Classification of non-union. Injury. 2005 Nov 1;36(4):S30-7.
18. Lammens J, Bauduin G, Driesen R, Moens P, Stuyck J, De Smet L, Fabry G. Treatment of nonunion of the humerus using the Ilizarov external fixator. Clinical Orthopaedics and Related Research (1976-2007). 1998 Aug 1;353:223-30.
19. Kiran M, Jee R. Ilizarov's method for treatment of nonunion of diaphyseal fractures of the humerus. Indian journal of orthopaedics. 2010 Oct;44(4):444.
20. McKee MD, Miranda MA, Riemer BL, Blasier RB, Redmond BJ, Sims SH, Waddell JP, Jupiter JB. Management of humeral nonunion after the failure of locking intramedullary nails. Journal of orthopaedic trauma. 1996 Oct 1;10(7):492-9.