Section: Orthopaedics

Original Research Article

FAILED OSTEOSYNTHESIS OF HUMERAL SHAFT FRACTURE – OUR EXPERIENCE OF 12 CASES WITH REFIXATION & BONE GRAFT

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ABSTRACT

Background: Humeral shaft fractures, constituting 1-3% of all fractures, often pose significant challenges in management due to anatomical and functional considerations. Failed osteosynthesis remains a critical issue, demanding effective revision strategies for achieving union and restoring function.

Material and Methods: A retrospective review was conducted on 12 patients with failed osteosynthesis of humeral shaft fractures treated at a tertiary care center over two years. Causes of failure were categorized into re-trauma and mechanical failure. Revision surgery involved plating with iliac crest bone grafting in 11 cases, and an additional fibular strut graft in one complex case. Surgical approaches included posterior and anterolateral methods, with radial nerve exploration performed as necessary. Outcomes were assessed based on union time, complications, and follow-up results.

Results: Bone union was achieved in all cases within an average of 6.5 months. One patient experienced postoperative radial nerve palsy, which fully resolved within three months. No infections were reported. Revision surgery proved effective in addressing mechanical failures and enhancing structural stability.

Conclusion: Revision osteosynthesis, utilizing meticulous surgical techniques and bone grafting, demonstrates favorable outcomes in managing failed humeral shaft fractures. The study highlights the importance of approach selection, radial nerve preservation, and patient-specific planning in achieving optimal results. Further research with larger sample sizes is needed to refine revision protocols.

Key Words: Humeral shaft fracture, Osteosynthesis, Bone grafting, Revision surgery, radial nerve.

INTRODUCTION

Humeral shaft fractures account for approximately 1-3% of all fractures and present challenges in management due to their anatomical and functional significance. Most humerus shaft fractures can be managed conservatively. Operative fixation is often preferred for cases where conservative treatment is not viable or for unstable fractures. Two primary methods for fixation are intramedullary nailing and locking compression plating (LCP), each with distinct advantages.

Intramedullary nailing offers reduced soft tissue disruption and allows for a smaller scar, whereas LCP provides more accurate anatomical alignment, especially beneficial in complex fracture patterns but this comes at the cost of a longer scar and longer rehabilitation period. Despite these advantages, both

techniques can encounter failures, with risks of nonunion, malunion, infection, or implant failure, and radial nerve injury due to its proximity.[1,2]

This retrospective study reviews 12 cases of failed osteosynthesis of humeral shaft fractures treated at Pt. B.D. Sharma Institute of Medical Sciences PGIMS Rohtak, examining causes of failure and revision strategies.

Review of Literature

The treatment of humeral shaft fractures has evolved significantly with a growing preference for surgical management in cases where functional bracing or conservative methods are inadequate. Literature indicates that both intramedullary nailing and plate osteosynthesis have high success rates but come with specific risks. Intramedullary nailing is advantageous for its minimal invasive approach and preservation of periosteal blood supply, leading to faster recovery and lower infection risks.[3] However, complications such as shoulder impingement and rotational alignment issues are reported.

Compression plating provides precise anatomical fixation and is preferred for fractures with extensive comminution. Literature supports its effectiveness in achieving union, though it is more invasive and associated with increased soft tissue dissection and risk to the radial nerve, especially in the posterior approach.[4] Several studies report radial nerve palsy rates ranging from 8-12% in operative humeral fractures, necessitating careful surgical techniques to mitigate injury.[5] However mostly this injury is neuropraxia due to traction on the nerve and recovery occurs in 4-6 weeks.

Failure of plate osteosynthesis of humeral shaft fractures could be due to several factors. Lack of adequate mechanical stability is one of them as the humeral shaft is an anatomical area subjected to great displacing forces, particularly torsion, which must be effectively counteracted by a stable fixation until fracture union occurs.[6]

Various risk factors that may predispose patients to nonunion include obesity, osteoporosis, alcoholism, smoking, poor bone quality, and scar tissue. Many methods of treatment have been described with various degrees of success. The rates of healing of humeral nonunions by traditional means of internal fixation with bone graft range from 70% to 92%, although in cases of infection, poorly vascularized beds, and open, segmental, or severely comminuted fractures, secondary bony healing may still be compromised.[7]

MATERIALS AND METHODS

This study was conducted over two years at PGIMS Rohtak and included 12 patients with failed osteosynthesis of humeral shaft fractures. The initial treatment consisted of plate fixation in 11 cases and intramedullary nailing in 1 case. Radial nerve injury was observed postoperatively in two patients after primary surgery which recovered completely. All the patients presented within 1 year of primary Surgery. Causes of failure were

- Re-trauma: Five cases experienced failure due to additional trauma post-osteosynthesis.
- Mechanical Failure: Seven cases demonstrated implant failure due to mechanical issues without secondary trauma.

Infection was ruled out in all cases.

All cases underwent revision surgery. In 11 cases, revision involved open reduction and re-plating with iliac crest bone grafting, while in 1 case additionally - a fibular strut graft with iliac crest bone grafting was done. Radial nerve exploration was performed in 9 cases during revision surgery utilising the posterior approach to humerus, with 1 postoperative radial nerve palsy noted. The post operative Palsy recovered completely in 6 weeks.

Surgical Technique

Careful surgical planning and approach selection were essential for revision osteosynthesis. Two approaches were used based on the fracture pattern and based on the approach used during primary surgery:

1. Posterior Approach to humerus shaft: Chosen for 9 cases in which the fracture involved either the distal third of humerus or if the primary surgeon used posterior approach. A midline Triceps Splitting Posterior approach was used. The posterior approach allowed direct access to the humeral shaft and radial nerve exploration. The radial nerve was carefully dissected and protected using a feeding tube. In our case dissection of the nerve started proximally between the long head and the lateral head of triceps. The dissection was then done distally in the spiral groove till the lateral intermuscular septum.[6] The nerve was gently retracted using Feeding tube and plating was done . The screw number over which the nerve was placed after completion of fixation was noted for future reference in case another revision surgery was required.

2. Anterolateral Approach: Utilized in 3 cases because the primary surgery was done using this approach, providing anterior access to the humeral shaft. The previous incision was reused and plane was made between Biceps and Brachialis. Then brachialis was split to reach the implant. Distally the tissue was dissected carefully to prevent iatrogenic radial nerve injury,[7] as the nerve crosses the intermuscular septum to come anteriorly into the cubital fossa .

Following exposure, revision plating was performed with iliac crest bone grafting in 11 cases. For one complex case, a fibular strut graft was used in addition to iliac crest bone grafting to reinforce structural support and promote healing.

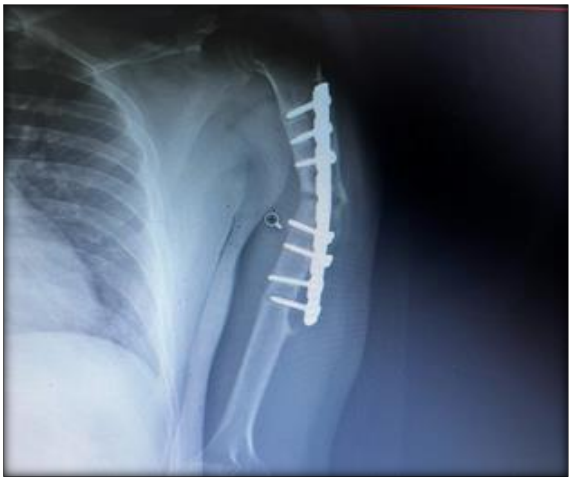

Figure 1: 32 Male, Pre-op X- Ray Showing implant failure with fibular Strut for structural support

Figure 2: Immediate post- op X- Ray Showing replating with fibular strut for support.

Figure 3: Post Op X- Ray at 5 months showing Complete union

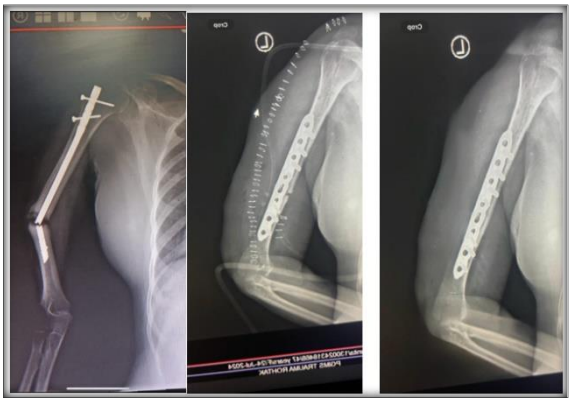

Figure 4: 45 F, Replating with Bone grafting done & union achieved in 7 months

RESULTS

All patients were followed up for a mean duration of 18 months following revision surgery. Bone union was successfully achieved in all cases, with an average union time of approximately 6.5 months. One patient developed postoperative radial nerve palsy, which improved over follow-up. No cases of postoperative infection were reported.

Table 1: Patient Details

Total number of patients	**12**
Mean Age	45.6 y (26-62)
Male: Female	3:1 (9 Male & 3 Females)
Side	Right – 8 Left - 4
Time to achieve union	6.5 months
Bone graft	Illiac Crest -11 Fibula -1
Complications- Post Op Radial Nerve Injury	1 (Recovered in 3 months)
Infection	Nil

DISCUSSION

Osteosynthesis failure in humeral shaft fractures may arise from multiple factors, including re-trauma and mechanical issues with implant selection or application. In this series, implant failure was primarily attributed to mechanical stress and re-trauma. Revision surgery involved the use of iliac crest bone grafting to enhance biological healing and provide structural support.[7]

Posterior and anterolateral approaches were selected based on fracture configuration and need for radial nerve visualization. While radial nerve exploration is vital, one case of postoperative nerve palsy highlights the associated risks even with careful

handling. Literature indicates that plating with bone grafting yields favorable outcomes in complex revision scenarios, supporting the approach adopted in this study.[8]

Bernard et al in 2010 surgically treated 21 patients for nonunion of the humeral diaphysis with a mean follow up of 50 months. Open reduction and internal fixation in compression using plates and screws with autologous bone graft enhancement was used. Eight cases were revisions of nonunions following a closed orthopaedic treatment and 13 cases were revisions following a failed surgical treatment. All the patients obtained union within a mean 4.5 months. The functional scores for the shoulder (Constant) and the elbow (Mayo) were 77 and 97 points (mean), respectively. 2 patients developed transient paresis related to radial nerve and musculocutaneous nerve injuries and one had a recurring fracture while one patient required a second surgery for delayed union.

CONCLUSION

Failed osteosynthesis of humeral shaft fractures presents a challenging issue. In this study, revision surgery involving plating with iliac crest bone grafting or fibular strut grafting achieved bone union within an average of 6.5 months. Surgical technique, patient management, and careful approach selection are critical in preventing complications and ensuring successful outcomes. Further studies with larger cohorts are necessary to optimize treatment protocols for revision surgery.

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