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Original Research Article

EXTERNAL FIXATOR VERSUS CONSERVATIVE MANAGEMENT FOR OSTEOPOROTIC PROXIMAL HUMERUS FRACTURES IN THE ELDERLY: A COMPARATIVE OUTCOME STUDY

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ABSTRACT

Background: Proximal humerus fractures are common osteoporotic injuries in the elderly and present significant management challenges due to poor bone quality, comorbidities, and the risk of functional impairment. While conservative treatment remains the standard for minimally displaced fractures, displaced fractures often result in suboptimal functional outcomes. External fixation has emerged as a minimally invasive alternative that may offer improved stability and early mobilization in osteoporotic bone. The aim is to compare the functional and radiological outcomes of external fixation versus conservative management in elderly patients with osteoporotic proximal humerus fractures. **Materials and Methods:** This hospital-based comparative observational study was conducted in a tertiary care teaching hospital over a period of 12 months. A total of 120 patients aged ≥60 years with osteoporotic proximal humerus fractures were included and divided into two groups: external fixator group (n = 60) and conservative management group (n = 60). Functional outcomes were assessed using the Constant–Murley score and DASH score at 6 months. Radiological outcomes included time to fracture union, union rates, and alignment-related complications. Statistical analysis was performed using appropriate parametric and non-parametric tests, with a p-value <0.05 considered statistically significant. **Result:** Baseline clinicodemographic and fracture characteristics were comparable between the two groups. The external fixator group demonstrated significantly better functional outcomes, with higher Constant–Murley scores and lower DASH scores at 6 months (p <0.001). Radiological union occurred earlier in the external fixation group, with a significantly shorter mean time to union and higher rates of union by 12 weeks (p <0.05). Complications such as varus malunion, loss of reduction, and shoulder stiffness were significantly more frequent in the conservative group, while pin-tract infection was noted only in the external fixator group and was minor and manageable. **Conclusion:** External fixation provides superior functional recovery, faster fracture union, and lower rates of alignment-related complications compared to conservative management in elderly patients with osteoporotic proximal humerus fractures. It represents a safe and effective minimally invasive treatment option, particularly for displaced fracture patterns in this vulnerable population.

INTRODUCTION

Proximal humerus fractures are among the most common osteoporotic fractures in the elderly population and account for nearly 5-6% of all fractures in individuals above 60 years of age. The rising life expectancy and increasing prevalence of osteoporosis have contributed significantly to the growing burden of these fractures, particularly following low-energy falls from standing height. Elderly patients often present with compromised bone quality, multiple comorbidities, and reduced physiological reserve, making the management of proximal humerus fractures both challenging and controversial.[1]

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Most proximal humerus fractures in elderly patients are minimally displaced and have traditionally been managed conservatively with sling immobilization followed by early physiotherapy. Conservative treatment avoids surgical risks and is often preferred in low-demand patients; however, prolonged immobilization may result in shoulder stiffness, malunion, chronic pain, and poor functional outcomes. In displaced and unstable fracture patterns, conservative management has been associated with unsatisfactory results, especially in terms of shoulder mobility and activities of daily living.[2]

Surgical management options for proximal humerus fractures include locking plate fixation, intramedullary nailing, hemiarthroplasty, reverse shoulder arthroplasty, and external fixation. While internal fixation techniques provide anatomical reduction, their effectiveness in osteoporotic bone is limited due to poor screw purchase, implant failure, varus collapse, and high reoperation rates. Arthroplasty, though effective in select cases, is technically demanding, expensive, and associated with increased perioperative morbidity in elderly patients.[3]

External fixation has emerged as a minimally invasive alternative, particularly in elderly patients with osteoporotic bone. External fixators offer the advantages of percutaneous fracture stabilization, preservation of fracture hematoma, minimal soft tissue disruption, shorter operative time, reduced blood loss, and early mobilization. By relying on indirect fracture reduction, external fixation may provide adequate stability while minimizing complications associated with open surgery.[4]

Aim

To compare the functional and radiological outcomes of external fixation versus conservative management in elderly patients with osteoporotic proximal humerus fractures.

Objectives

1. To evaluate and compare functional outcomes between external fixator and conservative treatment groups.
2. To assess radiological fracture union and time to union in both treatment modalities.
3. To compare complication rates associated with external fixation and conservative management.

MATERIALS AND METHODS

Source of Data: Data were collected from patients presenting with proximal humerus fractures to the Orthopaedics Department of the study institution. Information was obtained through clinical examination, radiological assessment, operative records, and follow-up evaluations.

Study Design: This study was conducted as a hospital-based comparative observational study.

Study Location: The study was carried out in the Department of Orthopaedics at a tertiary care teaching hospital.

Study Duration: The study was conducted over a period of 12 months, including patient recruitment, treatment, and follow-up.

Sample Size

A total of 120 patients were included in the study.

- External Fixator group: 60 patients
- Conservative Management group: 60 patients

Inclusion Criteria

- Patients aged ≥60 years
- Radiologically confirmed proximal humerus fracture
- Osteoporotic bone as assessed clinically and radiographically
- Closed fractures
- Patients willing to give informed consent and comply with follow-up

Exclusion Criteria

- Open fractures
- Pathological fractures other than osteoporosis
- Polytrauma patients
- Associated neurovascular injury
- Previous shoulder pathology or surgery on the affected side
- Patients medically unfit for surgical intervention

Procedure and Methodology: Patients were allocated to either external fixation or conservative management based on fracture pattern, bone quality, patient fitness, and surgeon discretion.

In the external fixator group, fractures were managed using a percutaneous external fixator under image intensifier guidance. Pins were inserted into the humeral head and shaft. Postoperatively, early pendulum exercises were initiated once pain permitted.

In the conservative group, patients were treated with sling immobilization for 3-4 weeks, followed by gradual physiotherapy emphasizing range of motion and strengthening exercises.

Principle of External Fixation in Fracture Stabilization: The primary principle of external fixation is to maintain adequate fracture reduction while allowing a controlled degree of micromotion at the fracture site. This biomechanical environment promotes secondary bone healing by stimulating callus formation while preserving the biological integrity of the fracture hematoma and surrounding soft tissues.

Role of Controlled Micromotion and Dynamization: Controlled micromotion at the fracture interface, a process referred to as dynamization, plays a crucial role in enhancing fracture healing. This micromotion stimulates cellular activity and vascular ingrowth, leading to the formation of a robust and biologically active fracture callus. Gradual modulation of construct stability allows progressive axial loading across the fracture site, which further supports bone regeneration and structural consolidation.

Biomechanical Advantage in Osteoporotic Humerus Fractures: Construct stiffness can be sequentially reduced over time to permit increased controlled axial compression, which helps to "work

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harden" the developing callus and accelerates the remodeling phase of fracture healing. This biomechanical advantage is particularly important in proximal humerus fractures in elderly osteoporotic patients, where excessively rigid fixation methods have been associated with delayed union, implant failure, or nonunion. External fixation offers a balanced stability profile that supports healing while minimizing complications related to over-rigid constructs.

Sample Processing: Clinical and radiological evaluations were performed at regular intervals (2 weeks, 6 weeks, 3 months, and 6 months). Functional outcomes were assessed using a standardized shoulder scoring system, and radiographs were analyzed for fracture union and alignment.

Statistical Methods: Data were entered into Microsoft Excel and analyzed using statistical software. Continuous variables were expressed as mean ± standard deviation, and categorical variables as frequencies and percentages. Comparative analysis was performed using Student's t-test or Mann-Whitney U test for quantitative variables and Chi-square test for qualitative variables. A p-value <0.05 was considered statistically significant.

Data Collection: Data were collected using a predesigned and pretested proforma, including demographic details, fracture characteristics, treatment modality, functional scores, radiological outcomes, and complications during follow-up.

RESULTS

[Table 1] compares the baseline clinicodemographic and fracture-related characteristics between the external fixator and conservative management groups, each comprising 60 elderly patients with osteoporotic proximal humerus fractures. The mean age of patients in the external fixator group was 68.7 ± 6.4 years, while that in the conservative group was 69.9 ± 7.1 years. The difference in age between the two groups was not statistically significant (p = 0.334), indicating comparable age distribution. Female patients constituted the majority in both groups, accounting for 68.3% in the external fixator group and 73.3% in the conservative group, with no significant difference observed (p = 0.543).

Injury to the dominant side was noted in 55.0% of patients treated with external fixation and 60.0% of those managed conservatively, again showing no statistically significant difference (p = 0.578). With respect to fracture pattern, Neer two-part fractures were observed in 43.3% of the external fixator group and 46.7% of the conservative group, whereas Neer three-part fractures accounted for 56.7% and 53.3% of cases, respectively. These differences were not statistically significant, suggesting similar fracture severity distribution across both groups. The mean bone mineral density T-score was comparable between groups (−2.89 ± 0.41 vs −2.84 ± 0.39; p = 0.491.

[Table 2] presents a comparison of functional outcomes between the external fixator and conservative treatment groups at six months follow-up. The mean Constant-Murley score was significantly higher in the external fixator group (72.6 ± 7.8) compared to the conservative group (64.9 ± 8.6), with a mean difference of 7.7 points (p < 0.001). Similarly, the DASH score, where lower values indicate better function, was significantly lower in patients treated with external fixation (24.1 ± 6.9) than in those managed conservatively (31.8 ± 7.4), indicating superior functional recovery in the external fixator group (p < 0.001).

Range of motion assessment revealed significantly greater shoulder abduction in the external fixator group (118.7 ± 14.3 degrees) compared to the conservative group (101.2 ± 16.6 degrees), with a statistically significant mean difference of 17.5 degrees (p < 0.001). A higher proportion of patients in the external fixator group achieved a pain-free shoulder (76.7% vs 56.7%; p = 0.020) and returned to activities of daily living within 12 weeks (70.0% vs 48.3%; p = 0.014).

Table 1: Baseline Clinicodemographic and Fracture Characteristics

Variable	External Fixator (n=60)	Conservative (n=60)	Test of significance	Effect size (95% CI)	p-value
Age (years), Mean ± SD	68.7 ± 6.4	69.9 ± 7.1	Welch t = −0.97	Mean diff = −1.2 (−3.7 to 1.3)	0.334
Female sex, n (%)	41 (68.3)	44 (73.3)	$\chi^2(1)=0.37$	RR = 0.93 (0.73-1.17)	0.543
Dominant side injured, n (%)	33 (55.0)	36 (60.0)	$\chi^2(1)=0.31$	RR = 0.92 (0.68-1.24)	0.578
Neer 2-part fracture, n (%)	26 (43.3)	28 (46.7)	$\chi^2(1)=0.14$	RR = 0.93 (0.64-1.35)	0.704
Neer 3-part fracture, n (%)	34 (56.7)	32 (53.3)	$\chi^2(1)=0.14$	RR = 1.06 (0.78-1.44)	0.706
BMD T-score, Mean ± SD	−2.89 ± 0.41	−2.84 ± 0.39	t = −0.69	Mean diff = −0.05 (−0.19 to 0.09)	0.491

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Table 2: Comparison of Functional Outcomes Between Groups

Functional parameter	External Fixator (n=60)	Conservative (n=60)	Test of significance	Effect size (95% CI)	p-value
Constant-Murley score at 6 months, Mean ± SD	72.6 ± 7.8	64.9 ± 8.6	t = 5.06	Mean diff = 7.7 (4.7-10.7)	<0.001
DASH score at 6 months, Mean ± SD	24.1 ± 6.9	31.8 ± 7.4	t = −5.76	Mean diff = −7.7 (−10.3 to −5.1)	<0.001
Shoulder abduction (degrees), Mean ± SD	118.7 ± 14.3	101.2 ± 16.6	t = 6.09	Mean diff = 17.5 (11.8-23.2)	<0.001
Pain-free shoulder, n (%)	46 (76.7)	34 (56.7)	$\chi^2(1)=5.43$	RR = 1.35 (1.03-1.78)	0.020
Return to ADL ≤12 weeks, n (%)	42 (70.0)	29 (48.3)	$\chi^2(1)=6.02$	RR = 1.45 (1.07-1.97)	0.014

Table 3: Radiological Outcomes and Fracture Union

Radiological outcome	External Fixator (n=60)	Conservative (n=60)	Test of significance	Effect size (95% CI)	p-value
Time to union (weeks), Mean ± SD	11.8 ± 2.3	14.6 ± 2.9	t = −5.88	Mean diff = −2.8 (−3.8 to −1.9)	<0.001
Radiological union by 12 weeks, n (%)	44 (73.3)	31 (51.7)	$\chi^2(1)=6.04$	RR = 1.42 (1.05-1.92)	0.014
Varus malunion, n (%)	6 (10.0)	14 (23.3)	$\chi^2(1)=4.05$	RR = 0.43 (0.18-0.99)	0.044
Loss of reduction, n (%)	5 (8.3)	13 (21.7)	$\chi^2(1)=4.26$	RR = 0.38 (0.15-0.94)	0.039

[Table 3] compares radiological outcomes and fracture union parameters between the two treatment modalities. The mean time to fracture union was significantly shorter in the external fixator group (11.8 ± 2.3 weeks) compared to the conservative group (14.6 ± 2.9 weeks), with a mean difference of 2.8 weeks ($p < 0.001$). Radiological union by 12 weeks was achieved in 73.3% of patients treated with external fixation, whereas only 51.7% of patients in the conservative group showed union within the same period, a difference that was statistically significant ($p = 0.014$).

Complications related to fracture alignment were more common in the conservative group. Varus malunion occurred in 23.3% of conservatively treated patients compared to 10.0% in the external fixator group ($p = 0.044$). Similarly, loss of reduction was observed in 21.7% of patients managed conservatively, significantly higher than the 8.3% noted in the external fixation group ($p = 0.039$).

Table 4: Comparison of Complication Rates

Complication	External Fixator (n=60)	Conservative (n=60)	Test of significance	Effect size (95% CI)	p-value
Overall complications, n (%)	14 (23.3)	26 (43.3)	$\chi^2(1)=5.32$	RR = 0.54 (0.32-0.91)	0.021
Shoulder stiffness, n (%)	7 (11.7)	18 (30.0)	$\chi^2(1)=6.17$	RR = 0.39 (0.18-0.83)	0.013
Pin-tract infection, n (%)	6 (10.0)	0 (0.0)	Fisher's exact	—	0.012
Non-union, n (%)	3 (5.0)	8 (13.3)	$\chi^2(1)=2.44$	RR = 0.38 (0.11-1.28)	0.118
Re-intervention required, n (%)	4 (6.7)	11 (18.3)	$\chi^2(1)=3.69$	RR = 0.36 (0.13-1.01)	0.055

[Table 4] outlines the comparison of complication rates between the two groups. Overall complications were significantly lower in the external fixator group (23.3%) compared to the conservative group (43.3%), with a statistically significant reduction in risk ($p = 0.021$). Shoulder stiffness was the most common complication in both groups but was significantly more frequent among patients treated conservatively (30.0%) than those treated with external fixation (11.7%) ($p = 0.013$).

Pin-tract infection was observed exclusively in the external fixator group, affecting 10.0% of patients, and this difference was statistically significant ($p = 0.012$). However, these infections were minor and manageable. Non-union was more common in the conservative group (13.3%) than in the external fixator group (5.0%), although this difference did not reach statistical significance ($p = 0.118$). The need for re-intervention was also higher in the conservative group (18.3% vs 6.7%), approaching statistical significance ($p = 0.055$).

DISCUSSION

Baseline Clinicodemographic and Fracture Characteristics [Table 1]: In the present study, the baseline clinicodemographic and fracture characteristics were comparable between the external fixator and conservative management groups, with no statistically significant differences in age, sex distribution, dominant side involvement, fracture pattern, or bone mineral density. This baseline equivalence strengthens the internal validity of the study and ensures that the observed differences in outcomes can be attributed primarily to the treatment modality rather than confounding variables. Similar baseline comparability has been reported in previous comparative studies evaluating operative and non-operative management of proximal humerus

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fractures in the elderly. Baker HP et al (2023),[5] highlighted that proximal humerus fractures predominantly affect elderly women with osteoporotic bone following low-energy trauma, a demographic profile that closely mirrors the present study population. The near-equal distribution of Neer two- and three-part fractures across both groups is also consistent with observations by Claro R et al (2024),[6] who emphasized that fracture pattern alone should not dictate treatment choice in elderly patients, but rather functional expectations and bone quality should be considered.

Functional Outcomes [Table 2]: The functional outcomes in this study were significantly superior in the external fixator group compared to the conservative group across multiple parameters. Patients treated with external fixation demonstrated higher Constant-Murley scores, lower DASH scores, greater shoulder abduction, higher rates of pain-free shoulders, and earlier return to activities of daily living. These findings align with earlier reports by Katthagen JC et al,[4] (2024) who demonstrated improved functional recovery and earlier mobilization with external fixation in displaced proximal humerus fractures. Korzh MO et al (2023),[7] similarly reported better shoulder function and patient satisfaction with minimally invasive fixation techniques compared to prolonged immobilization.

Conversely, conservative management, although effective in selected minimally displaced fractures, has been associated with prolonged stiffness, reduced range of motion, and delayed functional recovery in elderly patients, as also observed in the present study. The significant functional advantage seen with external fixation may be attributed to better fracture stability allowing early mobilization, preservation of fracture biology, and avoidance of prolonged sling immobilization, findings consistent with those reported by Girgin AB et al (2025).[2]

Radiological Outcomes and Fracture Union [Table 3]: Radiological assessment revealed significantly faster fracture union and higher rates of union by 12 weeks in the external fixator group. Additionally, complications such as varus malunion and loss of reduction were significantly less frequent in patients treated with external fixation. These results are in agreement with previous studies that have demonstrated superior fracture alignment and maintenance of reduction with external fixation in osteoporotic bone. Razaeian S et al,[3] (2025) reported reduced rates of malunion and improved radiological outcomes with external fixation.

In contrast, conservative treatment has been associated with higher rates of secondary displacement and malunion, particularly in osteoporotic bone, as highlighted by Pai S et al, (2025).[8] The prolonged time to union observed in the conservative group in the present study further supports the notion that lack of mechanical stability may delay fracture healing in elderly patients.

Complication Rates [Table 4]: The overall complication rate was significantly lower in the external fixator group compared to the conservative group, with shoulder stiffness being the most frequent complication in patients managed non-operatively. Similar findings were reported by Walter N et al (2023),[9] who observed that prolonged immobilization in conservative treatment often leads to stiffness and functional limitation in elderly patients. Although pin-tract infection was observed exclusively in the external fixator group, these complications were minor and manageable with local care, consistent with reports by Verboket RD et al (2025).[10]

The higher rates of non-union and re-intervention in the conservative group, although not statistically significant in all parameters, indicate a trend toward poorer outcomes with non-operative management in displaced fractures. Maluta T et al (2020),[11] also reported higher re-intervention rates following conservative treatment due to malunion and persistent pain.

CONCLUSION

The findings of the present comparative study clearly demonstrate that external fixation offers significant advantages over conservative management in elderly patients with osteoporotic proximal humerus fractures. Patients treated with external fixation achieved superior functional outcomes, as reflected by higher Constant–Murley scores, lower DASH scores, improved shoulder range of motion, and earlier return to activities of daily living. Radiological outcomes were also more favorable in the external fixator group, with significantly shorter time to fracture union, higher rates of union by 12 weeks, and lower incidence of alignment-related complications such as varus malunion and loss of reduction.

Although pin-tract infection was observed exclusively in the external fixation group, these complications were minor, manageable, and did not adversely affect overall clinical outcomes. In contrast, conservative management was associated with higher rates of shoulder stiffness, delayed union, malunion, and need for re-intervention, highlighting the limitations of prolonged immobilization in osteoporotic elderly patients.

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