Is nonoperative treatment a valid and successful option for the management of three-part and four-part proximal humerus fractures?

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Background
Proximal humerus fractures are relatively common, accounting for about 5–9% of all fractures. There is no agreement regarding the optimal interventions for these fractures. This controversy makes a dilemma for decision-makers in the clinic. This study aimed to assess the functional outcome of nonoperative management in Neer's three, four parts proximal humerus fracture and the incidence of complications.

Patients and methods
This prospective case series study recruited 52 patients with three-part or four-part fractures of the proximal humerus in the Orthopedic Department. Patients were observed and followed up after conservative treatment. Patients of both sexes above 20 years, with closed Neer's three-part and four-part fractures of proximal humerus, were included. Old (>4 weeks) and open fractures, associated neurovascular injuries, presence of infection, and mentally ill patients were excluded from the study. Ethical approval was obtained from the Institutional Review Board at Cairo University. Written informed consent was obtained from all included patients. American shoulder and elbow surgeon's score, Constant score, and visual analog scale were assessed at 12 months.
Postinjury radiographs, including true anteroposterior and lateral views, were obtained at 1, 2, 4, and 8 weeks postimmobilization, then at 3, 6, and 12 months following injury.

Results
This study recruited 52 patients with three-part and four-part fractures of the proximal humerus. These patients were managed conservatively, followed up, and observed for 1 year. The mean age of included patients was 64.23 years old (28–87). The majority of included patients were females, 41 (78.8%). Forty-three (82.7%) patients of included patients had three-part fractures and nine (17%) patients had four-part fractures. The age of patients with four-part fractures (75.4 ± 7.8) was higher than the age of patients with three-part fractures (61.6 ± 13.2), and this was statistically significant (P<0.05). The mean Constant score after 12 months was 79.38 ± 8.26 and the American shoulder and elbow surgeon's was 78.9 ± 11.2. The visual analog score was 3.7 ± 1.7 after 1 year.

Conclusions
Nonoperative treatment of three-part and four-part proximal humeral fractures yield acceptable and satisfactory functional results. Four-part fracture has better clinical results than three-part ones.

Keywords:
avascular necrosis, conservative treatment, Constant score, nonunions, outcomes, proximal humeral fracture, visual analog score

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Introduction

Proximal humerus fractures are relatively common fractures, accounting for about 5–9% of all fractures [1]. These fractures are increasingly common in societies with aging populations and are challenging to treat. This is partly due to the great deforming forces acting on the fracture fragments and partly due to the osteoporotic nature of bones in the elderly [2]. Three-part and four-part patterns are increasingly seen above the age of 50 [3]. Different treatment options exist, and both operative and nonoperative treatments may yield good outcomes with proper patient selection. However, in many cases, it may be less than satisfactory

to the patient [4]. Several studies and trials reported no significant difference between surgical treatment and nonoperative treatment in patient-reported clinical outcomes over 2 years following displaced surgical neck fractures. These results do not support the trend of increased surgery for patients with displaced fractures of the proximal humerus [2,5,6].

Patients and methods

Between 2021 and 2023, a prospective case series study recruited 52 patients with three-part or four-part fractures of the proximal humerus in our department. Patients were observed and followed up after conservative treatment. Both males and females, above the age of 20 years, with recent (<4 weeks) closed three-part or four-part fractures of proximal humerus (according to Neer's classification) were included [7]. Neglected fractures (≥4 weeks), open fractures, associated neurovascular injuries, presence of infection, and mentally ill patients were excluded from the study. In this study, only 14 patients were below the age of 40, and it is difficult to isolate them from the study and report their results separately.

Ethical approval was obtained from the Institutional Review Board (IRB) at Cairo University. Written informed consents were obtained from all included patients enrolled in the study.

In the emergency department, patients were assessed and evaluated clinically (history, general examination, and local examination) and radiologically using radiograph and computed tomography. Patients were then counseled for nonoperative treatment. Those who agreed were enrolled in the study and signed a written consent.

Treatment protocol

Treatment consists of sling immobilization for 6 weeks, allowing only elbow range of motion (ROM), hand, and wrist. Pendular exercises were started from 3 weeks onwards. Passive in sling forward elevation and abduction were started at 4 weeks. The sling was discontinued after 6 weeks, at which time active-assisted followed by active ROM was allowed.

Postinjury radiographs were obtained weekly for the first 2 weeks, then at 4 and 6 weeks, 3, 6, and 12 months. Functional assessment relied on the American shoulder and elbow surgeon's score, Constant score, and visual analog score, which were assessed at 12 months.

Result

Fifty-two patients with acute three-part or four-part fractures of proximal humerus were managed conservatively and followed up for 1 year. The mean age of included patients was 64.23 years old (range, 28–87). Forty-one (78.8%) were females, while 11 (21.2%) were males. Regarding comorbidities, 11.5% (six) of included patients were diabetic, 13.5% (seven) had hypertension, and 13.5% (seven) had cardiac diseases. Three (5.8%) of the included patients were smokers (Table 1).

Thirty-two (61.5%) patients sustained fractures of their right side, while 20 (38.5%) patients had injured their left side. Forty-three (82.7%) had three-part fractures, while nine (17%) patients had four parts fractures. The mechanism of injury was low-energy trauma (fall to the ground) in 34 (65.4%) patients and high-energy trauma (road traffic accident, fall from height) in eight (34.6%) patients of the patients (Table 2).

The mean age of patients with four-part fractures (75.4 ± 7.8) was higher than that of patients with three-part fractures (61.6 ± 13.2), and this was found to be statistically significant (P<0.05).

The mean Constant score after 12 months was 79.38 ± 8.26 ranging from while the mean American shoulder and elbow surgeon's at the final follow-up was 78.9 ± 11.2.

The mean VAS score was 3.7+/-1.7 ranging from 2 to 5. Comparing three-part and four-part fractures, four-part fractures showed significantly better flexion and abduction ROM on the Constant score and better American shoulder and elbow surgeon's score with a P value of 0.05 (Table 3).

Regarding complications, four (7.7%) patients showed nonunion, 11 (21.2%) patients reported avascular necrosis (AVN), and five (9.6%) patients developed osteoarthritis after 1 year follow-up. Out of 20 patients with complications, three nonunions patients required

Table 1 Patient demographics and comorbidities

	Conservative treatment		Surgical treatment		*P* value
	Mean	SD	Mean	SD	
Age	64.0	14.0	64.5	13.2	
	n (%)		*n* (%)		
Sex					
Female	21 (80.8)		20 (76.9)		
Male	5 (19.2)		6 (23.1)		
Comorbidities					
Diabetes mellitus	3 (11.5)		3 (11.5)		0.9
Hypertension	4 (15.4)		3 (11.5)		0.68
Cardiac disease	4 (15.4)		3 (11.5)		0.68
Smoking	2 (7.7)		1 (3.8)		0.52

Table 2 Fracture properties

	Total	Conservative treatment	Surgical treatment	*P* value
Side of fractures [*n* (%)]				
Right	32 (61.5)	17 (65.4)	15 (57.7)	0.38
Left	20 (38.5)	9 (34.6%)	11 (42.3%)	
Parts of fractures [*n* (%)]				
3 parts	43 (82.7)	22 (84.6)	21 (80.8)	0.5
4 parts	9 (17.3)	4 (15.4)	5 (19.2)	
Mechanism of fractures [*n* (%)]				
Low-energy trauma (fall to ground)	34 (65.4)	16 (61.6)	17 (65.4)	0.79
High-energy trauma (road traffic accident, fall from height)	18 (34.6)	10 (38.5)	9 (34.6)	

Table 3 Correlation between fracture parts and Constant score, American shoulder and elbow surgeon's score, flexion and abduction range of motion

	Overall		Conservative		Surgical	
	r	*P* value	*r*	*P* value	*r*	*P* value
Flexion	–0.536**	0.000	–0.450*	0.021	–0.619**	0.001
Abduction	_0.471**	0.000	–0.498**	0.01	–0.445*	0.023
Constant score	_0.492**	0.000	–0.379**	0.04	–0.646**	0.00
ASES	–0.480**	0.000	–0.509**	0.008	–0.463*	0.017

ASES, American shoulder and elbow surgeon's.

open reduction and internal fixation (ORIF), four of the AVN patients, and two of those who developed osteoarthritis required reversed shoulder replacement.

Discussion

The most important findings of this study are that nonoperative treatment of three-part and four-part proximal humeral fractures is successful and yields good functional outcomes. It has low complication rates and good overall patient satisfaction. Four-part fractures have shown better scores than three-part fractures. The critique of this study is the lack of comparison with different treatment options, surgical fixation, and replacement.

Proximal humeral fractures are very common and may cause serious disability, with elderly patients being more prone. Proximal humeral fractures come in third place after wrist and hip fractures. Osteoporosis and repeated falls are the two most important predisposing factors for fractures of the proximal humerus. Displaced three-part and four-part fractures are challenging fracture patterns. They may pose long-term disabilities and affect the quality of life of patients [8,9].

Nonoperative treatment is successful in the majority of proximal humerus fractures (Figs 1 and 2), with surgical management being performed in unstable and displaced fractures [10]. This is consistent with the findings of different studies across the literature. Furthermore, the rate of complications like AVN, osteoarthritis, and nonunions are high with ORIF for those fracture patterns [11]; they reported 10% AVN, 16% varus mal-union, and 14% reoperation rate. They also reported 4% infection. Although operative treatment was undertaken, there were high complication rates. Furthermore complications like infection and screw penetration into the head only occur with ORIF.

Another study in 2023 by Fazzari *et al.* [12], reported an 11% AVN rate with ORIF and found a significant association with four-part fractures.

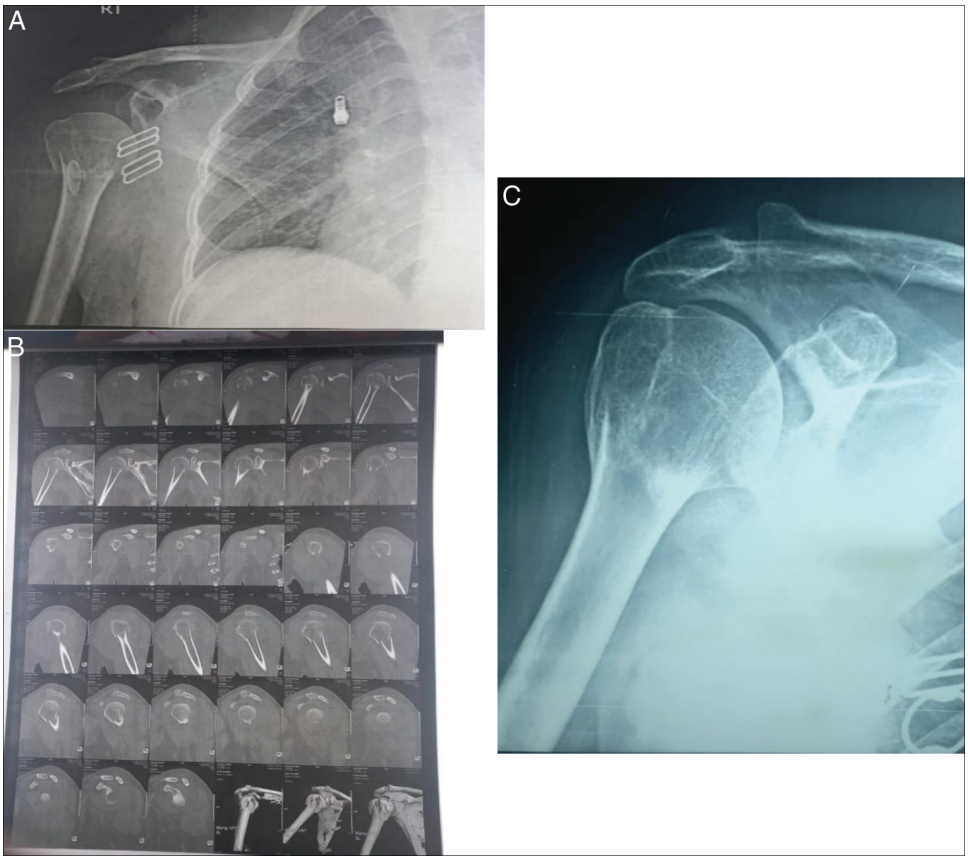
Treatment of proximal humerus fractures is challenging. ORIF aims to restore the anatomy and biomechanics of the shoulder joint and is the treatment of choice for complex fracture patterns [13]. There is no consensus in the literature on the best treatment option for these fractures [14,15].

A recent meta-analysis published in the *Journal of Shoulder and Elbow Surgery* 2023, concluded that there are no statistically significant differences for either clinical outcomes or ROM between surgically managed and conservatively treated displaced proximal humerus fractures. The weak point of this meta-analysis is most of the included studies did not state the fracture pattern, patient age, and the follow-up duration, which is the main issue in this fracture [16].

A meta-analysis by Hohmann and colleagues concluded similar results to Beks *et al.*[17], who included 23 studies and could not demonstrate any significant differences between surgical and conservative treatment and recommended conservative treatment for elderly patients over 65 years.

The PROFHER trial, a multicentric trial conducted in the UK, published their 5-year results, reporting no significant differences between operative and

Figure 1



Case number 1. (a) Radiographs right shoulder showing three-part proximal humeral fracture. (b) Computed tomography right proximal humerus showing three-part proximal humeral fracture. (c) Final radiographs at 12 months follow-up, showing complete healing in satisfactory position.

nonoperative treatment of proximal humeral fractures regarding functional outcomes, pain, and ROM [5]. The trial is, however, criticized for including a very wide age range, from skeletal maturity to 65 years. Patients in different age groups have different demands and activity levels. Furthermore, in their operative group, the means of fixation was not consistent across the trial. However, in argument, proximal humeral fractures are uncommon injuries in the younger age groups, and it is difficult to isolate them and report them separately.

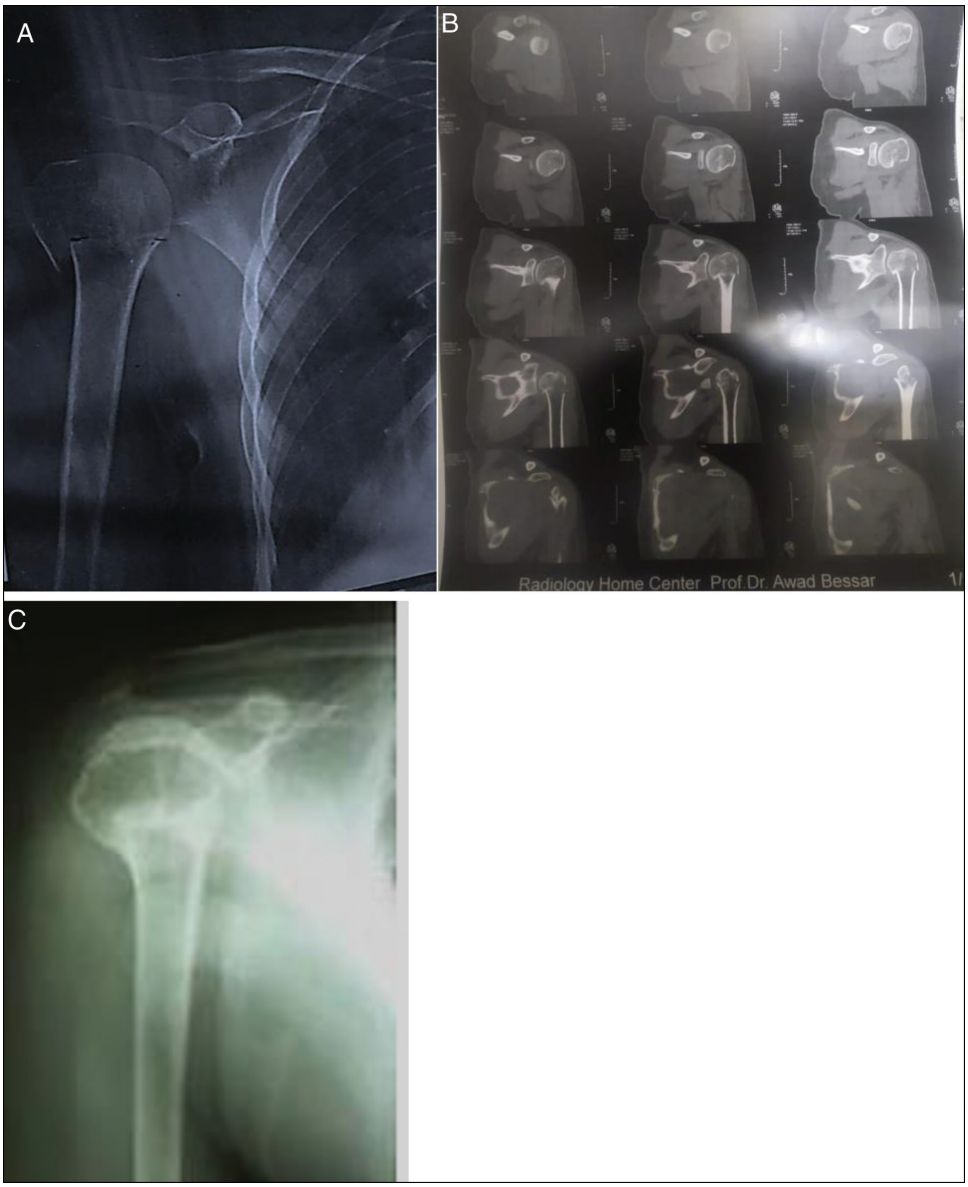
The PROFHER two trial is an ongoing study in the UK that has not yet published the results. They are studying the outcomes of nonoperative treatment versus hemiarthroplasty versus reverse shoulder replacement. The results are not yet published.

Soler-Peiro and colleagues, concluded that conservative treatment for three-part fractures was successful in the majority of patients. On the contrary, four-part fractures showed inferior functional outcomes despite good healing and union rates. Therefore, they advocate nonoperative treatment only for patients with low-functional demands or those with severe comorbidities [18]. This agrees with a recent meta-analysis by Fu *et al.* [8], that investigated overlapping meta-analyses and concluded that surgical treatment appears to be beneficial. This is different from the findings of this study, where functional outcomes appeared to be better with four-part fractures despite the fact that their mean age was higher. This might be explained by the fact that the number of patients with four-part was significantly less than those with three-part fractures. The other reason might be that the four-part fractures were valgus impacted, a pattern which has better results.

Xie and colleagues, stated that the overall complication rate was higher in the operative group than the conservative one for the management of complex proximal humeral fracture, especially the need for additional surgery. However, there was no statistical difference in the incidence of AVN, osteoarthritis, nerve injury, nonunion, and impingement [6]. In this study, the complication rate was low. However, no correlation was made for the complication rate according to the fracture pattern and parts.

There are some weaknesses to this study. A wide age range is included in the study; this might pose an element of bias to the results, and it would be more

Figure 2



Case 2 shows the results of conservative management of three-part proximal humeral fracture. (a) Radiographs right shoulder showing three-part proximal humeral fracture. (b) Computed tomography right proximal humerus showing three-part proximal humeral fracture. (c) Final radiographs at 12 months follow-up, showing complete healing in satisfactory position.

sound to study narrower age ranges. A randomized controlled trial to compare operative and nonoperative management in terms of functional outcomes, radiological union, and complication rates is essential.

Conclusion

Nonoperative treatment of three-part and four-part proximal humeral fractures has acceptable functional results and overall patient satisfaction with low complication rates. Nonoperative versus operative treatment is a decision that must be considered carefully and individualized for every patient depending on their functional level, comorbidities, and expectations. Proximal humeral fractures are specialized injuries that must be managed by a specialized upper limb or shoulder surgeon.

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Conflicts of interest

There are no conflicts of interest.

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