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Influence of Patient-Related Factors and Surgeon Experience on Functional Outcomes in Conservatively Treated Proximal Humerus Fractures: A Retrospective Cohort Study

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Abstract

Purpose

Proximal humerus fractures (PHFs) are common in the elderly population, but the optimal treatment strategy remains controversial. This study evaluated long-term functional outcomes of conservatively treated PHFs and assessed whether shoulder surgeon experience influences treatment indication and prognosis.

Material and Methods

A retrospective cohort study included 150 PHFs in 149 patients treated nonoperatively between 2020 and 2021. Two-, three-, and four-part fractures with a minimum 12-month follow-up were analyzed. Outcomes included QuickDASH, Oxford Shoulder Score (OSS), Subjective Shoulder Value (SSV), and SF-12. Radiographic features and demographic variables were analyzed. In a second phase, five shoulder surgeons independently reviewed anonymized cases and retrospectively indicated surgical or conservative treatment, blinded to outcomes.

Results:

At a mean follow-up of 32.1 months, younger age, absence of comorbidities, better pre-injury physical status, and dominant limb involvement were significantly associated with superior outcomes, whereas fracture fragment number had no significant impact. Displaced fractures showed worse outcomes than non-displaced fractures. However, among displaced fractures, no significant differences in SSV, OSS, QuickDASH, or SF-12 scores were found between fractures retrospectively considered surgical candidates and those considered suitable for conservative treatment.

Conclusions:

Functional recovery after conservatively treated PHFs appears to depend more on patient-related factors than fracture morphology or surgeon experience. Even displaced fractures can achieve satisfactory long-term outcomes with nonoperative treatment.

Introduction

Proximal humeral fractures (PHFs) are among the most common fractures in the elderly population. They account for approximately 5% of all fractures and represent the third most common osteoporotic fracture after hip and distal radius fractures. Their incidence is steadily increasing due to the progressive aging of the population [1–3].

Most proximal humeral fractures are treated no surgically, as reported in large epidemiological and clinical studies, with conservative management being the preferred option in up to 80% of cases. Despite their high prevalence and the extensive literature addressing their management, there is still considerable uncertainty regarding the optimal treatment strategy [4].

This ongoing controversy is the result of several factors. First, no currently available classification system for proximal humerus fractures has demonstrated consistently high prognostic or therapeutic value together with satisfactory inter-observer reproducibility across studies [5, 6]. This limitation has been documented in the literature, as both the Neer and AO/OTA classification systems show variable and often only moderate reproducibility, which hinders their reliability in clinical decision-making and comparative research [7–9].

Secondly, surgical treatment options are numerous and highly heterogeneous, ranging from minimally invasive fixation techniques to shoulder arthroplasty. Even within the same surgical category, technical variations can potentially influence outcomes, such as whether or not to repair the tuberosities in reverse shoulder arthroplasty [10].

Third, the publication of the ProFHER study has further contributed to uncertainty; despite its known methodological limitations (patient selection and heterogeneity of surgical techniques), it has encouraged a more conservative approach, particularly among orthopedic surgeons not specializing in shoulder surgery, leading to broader indications for nonsurgical treatment [11].

In this context, the role of surgeon experience and clinical judgment in determining the most appropriate treatment remains unclear. The purpose of this study was to evaluate the influence of shoulder orthopedic surgeon experience on clinical and functional outcomes in patients with proximal humeral fractures treated conservatively and to evaluate long-term functional outcomes of conservatively treated PHFs.

Materials and Methods

Study Design

An observational retrospective cohort study was conducted on patients affected by proximal humerus fractures who underwent non-operative treatment. Cases were identified among patients presenting to the Emergency Departments at AOU San Luigi Gonzaga Hospital, Orbassano (Italy).

The authors considered eligible all proximal humerus fracture diagnosed and classified between January 1st, 2020, and December 31st, 2021, that received a non-surgical indication in the emergency setting by on-call general orthopaedists without specific sub-specialization in shoulder surgery.

The database included patient demographic data, trauma-related information (side and date), patient comorbidities, fracture characteristics, type of imaging obtained, and the radiographic images were

classified based on the number of fragments, the presence or absence of fracture displacement, and the presence or absence of humeral head splitting.

All these patients were treated conservatively with one-month period of immobilization in a brace (day and night), according to local protocols, and subsequently referred for functional rehabilitation.

Inclusion criteria were proximal humerus fractures (two-, three-, or four-part fractures); initial non-operative indication in the emergency department; conservative treatment followed by rehabilitation and minimum follow-up of 12 months.

Exclusion criteria were isolated greater tuberosity fractures; diaphyseal fractures; fracture sequelae; subsequent surgical treatment; severe psychiatric or cognitive disorders preventing adequate follow-up and lack of radiographic documentation.

This first phase of the study was dedicated to evaluating the clinical and functional outcomes of the conservative approach.

In the second phase of the study, five orthopedic surgeons specialized in upper limb surgery (MA, DB, RG, AM, PP) independently reviewed the anonymized radiological images and clinical data of all 150 fractures. Blinded to patient outcomes, the reviewers were first asked to categorize each fracture as displaced or non-displaced based on their clinical judgment. Subsequently, for those cases classified as displaced, they were required to determine the most appropriate treatment indication (surgical or conservative).

Follow-Up and Statistical Analysis

Functional and quality-of-life outcomes were assessed using validated Italian versions of the following instruments: Quick Disabilities of the Arm, Shoulder and Hand (QuickDASH) [12]; Oxford Shoulder Score (OSS) [13]; Subjective Shoulder Value (SSV) [14]; Short Form-12 Health Survey (SF-12), including Physical (PCS) and Mental (MCS) components [15].

The data collected were analyzed using Jamovi software (The jamovi project (2025). jamovi (Version 2.6) [Computer Software]). The distribution of the variables was assessed using the Shapiro–Wilk test, which indicated that the data were not normally distributed. Therefore, non-parametric statistical methods were applied throughout the analyses.

Differences in SF-12 scores before and after trauma, for both the Physical Component Score (PCS) and Mental Component Score (MCS), were evaluated using the Wilcoxon signed-rank test for paired samples. Univariate analyses stratified by a binary dependent variable were performed using the Mann–Whitney U test. The Kruskal–Wallis test, was used for univariate analyses with non-binary dependent variables. Correlations between continuous variables were assessed using Spearman’s rank correlation coefficient (rho). A p-value of less than 0.05 was considered statistically significant.

Results

Study Population

We initially identified a total of 374 fractures in 373 patients. The final study cohort included 149 patients with 150 proximal humerus fractures, as shown in Fig. 1.

Females represented most of the study population, accounting for 119 fractures (79.3%).

Nearly half of the 150 fractures included involved the dominant limb (73 fractures, 48.7%).

The mean age at the time of injury was 72.2 ± 11.5 years, ranging from 25 to 90 years, while the mean age at follow-up was 74.9 ± 11.5 years, with a range of 27 to 93 years.

The average follow-up period was 32.1 ± 6.7 months, with a minimum of 22 months and a maximum of 49 months.

Out of the 149 patients, 44 (29.5%) occurred in patients without any known comorbidities, whereas 105 fractures (70.5%) involved patients with one or more comorbid conditions.

The most frequently observed comorbidities were arterial hypertension, cardiovascular disease, cancer, and diabetes, with hypertension being the most prevalent overall (33.3% of fractures), followed by cardiovascular disease (14%), cancer (12.7%), and diabetes (11.3%).

Functional Outcomes

The outcome scores used to evaluate the clinical outcomes in the population are summarized in the Table 1.

Table 1
Functional outcomes' general sample studied.

SSV	**Overall n = 150**
Mean (SD)	**78.8 (21)**
Range	**10–100**
OSS	38.3 (10.5)
Mean (SD)	3–48
Range	
Quick Dash	19.2 (20.5)
Mean (SD)	0-77.5
Range	
PCS post-trauma	44.3 (12.4)
Mean (SD)	19-63.8
Range	
MCS post trauma	53.8 (9.9)
Mean (SD)	20.3–66.5
Range	

Patient outcomes were afterwards analyzed in relation to demographic, clinical, and radiographic factors, as well as pre- and post-injury physical and mental health.

Female patients (119/150, 79.3%) generally exhibited lower functional scores compared to males, with statistically significant differences observed for OSS (37.3 ± 11.1 vs 42.3 ± 6.8) and QuickDASH (20.8 ± 21.3 vs 13.3 ± 15.6) while the SF-12 components and SSV showed no significant difference (Table 2).

Table 2
Results of follow-up measurements stratified by Gender. Mann-Whitney U Test.

SSV	Group	N	Mean	SD	p
	Female	**119**	**77.1**	**22.2**	**0.101**
	Male	**31**	**85.4**	**13.8**	
OSS	Female	119	37.3	11.1	0.010
	Male	31	42.3	6.8	
Quick Dash	Female	119	20.8	21.3	0.044
	Male	31	13.3	15.6	
PCS post-trauma	Female	119	43.8	12.4	0.218
	Male	31	46	12.4	
MCS post-trauma	Female	119	53.9	10.2	0.978
	Male	31	53.7	8.8	

Fractures involving the dominant limb (73/150, 48.7%) were associated with better outcomes, with significant differences noted for SSV ($p = 0.028$), OSS ($p = 0.012$), QuickDASH ($p = 0.031$), and SF-12 PCS ($p = 0.015$) (Table 3). Comorbidity status also influenced recovery: patients without comorbidities (44/149, 29.5%) achieved higher scores on OSS ($p = 0.015$), QuickDASH ($p = 0.009$), and SF-12 PCS ($p = 0.025$), whereas among individual comorbidities, only cardiovascular disease (14% of fractures) was associated with significantly lower SF-12 PCS scores, while hypertension (33.3%), diabetes (11.3%), and cancer (12.7%) did not significantly affect shoulder-specific outcomes (Table 4).

Table 3
Results of follow-up measurements stratified by dominant limb. Mann-Whitney U Test.

SSV	Group	N	Mean	SD	p
	Not Dominant limb	**77**	**74.2**	**24.4**	**0.028**
	Dominant limb	**73**	**83.7**	**15.4**	
OSS	Not Dominant limb	77	36.2	11.7	0.012
	Dominant limb	73	40.6	8.7	
Quick Dash	Not Dominant limb	77	22.5	21.6	0.031
	Dominant limb	73	15.8	18.8	
PCS post-trauma	Not Dominant limb	77	41.7	12.7	0.015
	Dominant limb	73	47	11.4	
MCS post-trauma	Not Dominant limb	77	52.9	10.9	0.485
	Dominant limb	73	54.9	8.7	

Table 4
Results of follow-up measurements stratified by comorbidities. Mann–Whitney U test.

SSV	Group	N	Mean	SD	p
	With comorbidities	**105**	**77.3**	**20.8**	**0.063**
	Without comorbidities	**44**	**82.3**	**21.4**	
OSS	With comorbidities	105	37.2	10.6	0.015
	Without comorbidities	44	41	10.1	
Quick Dash	With comorbidities	105	21.6	20.7	0.009
	Without comorbidities	44	13.5	18.9	
PCS post-trauma	With comorbidities	105	42.8	12.6	0.025
	Without comorbidities	44	47.9	11	
MCS post-trauma	With comorbidities	105	53.5	9.9	0.530
	Without comorbidities	44	54.6	9.8	

Increasing patient age was correlated with worse outcomes both at the time of injury (Table 5) and at follow-up (Table 6, Fig. 2), with the strongest associations observed for OSS ($r = -0.407$ at injury, $r = -0.406$ at follow-up; $p < 0.001$), QuickDASH ($r = 0.399$ at injury, $r = 0.399$ at follow-up; $p < 0.001$), and SF-12 PCS ($r = -0.504$ at injury, $r = -0.460$ at follow-up; $p < 0.001$). Follow-up duration (mean 32.1 ± 6.7 months) did not show a significant correlation with functional outcomes

Table 5
Age-related outcomes at the time of trauma. Spearman's rank correlation coefficient (rho).

SSV		**Age at trauma**
	Spearman's rho	**-0.304**
	p-value	**< 0.001**
OSS	Spearman's rho	-0.407
	p-value	< 0.001
Quick Dash	Spearman's rho	0.399
	p-value	< 0.001
PCS pre-trauma	Spearman's rho	-0.504
	p-value	< 0.001
MCS pre-trauma	Spearman's rho	-0.197
	p-value	0.016

Table 6
Age-related outcomes at the time of follow-up. Spearman's rank correlation coefficient (rho).

SSV		**Age at follow-up**
	Spearman's rho	**-0.299**
	p-value	**< 0.001**
OSS	Spearman's rho	-0.406
	p-value	< 0.001
Quick Dash	Spearman's rho	0.399
	p-value	< 0.001
PCS post-trauma	Spearman's rho	-0.460
	p-value	< 0.001
MCS post-trauma	Spearman's rho	-0.228
	p-value	0.005

Pre-injury physical and mental health, assessed using the SF-12 PCS and MCS components, was significantly associated with post-trauma outcomes across all evaluated scores (Table 7).

Table 7
Related results for pre-trauma PCS and MCS scores. N = 150. Spearman's rank correlation coefficient (rho).

SSV		**PCS-12 pre-trauma**	**MCS-12 pre-trauma**
	Spearman's rho	**0.473**	**0.367**
	p-value	**< 0.001**	**< 0.001**
OSS	Spearman's rho	0.647	0.412
	p-value	< 0.001	< 0.001
Quick Dash	Spearman's rho	-0.594	-0.354
	p-value	< 0.001	< 0.001
PCS post-trauma	Spearman's rho	0.798	0.383
	p-value	< 0.001	< 0.001
MCS post-trauma	Spearman's rho	0.282	0.822
	p-value	< 0.001	< 0.001

Radiographic characteristics were also associated with functional recovery. Patients with non-displaced (simple) fractures (64 fractures) had significantly higher shoulder-specific scores (all, $p < 0.001$) and SF-12 PCS ($p < 0.001$) compared to those with displaced fractures (86 fractures), while SF-12 MCS did not differ significantly ($p = 0.111$) (Table 8). The number of fracture fragments (2, 3, or 4) did not significantly affect outcomes, independent of fracture displacement.

Table 8
Outcome results stratified by fracture composition. Mann–Whitney U test.

SSV	Group	N	Mean	SD	p
	Displaced	**86**	**73.4**	**22.3**	**< 0.001**
	Non-displaced	**64**	**86**	**16.7**	
OSS	Displaced	86	35.6	11.3	< 0.001
	Non-displaced	64	42	8.2	
Quick Dash	Displaced	86	24.5	22.1	< 0.001
	Non-displaced	64	12.2	15.7	
PCS post-trauma	Displaced	86	41.5	12.5	< 0.001
	Non-displaced	64	48	11.3	
MCS post-trauma	Displaced	86	52.7	10.3	0.111
	Non-displaced	64	55.3	9.2	

Within the subgroup of displaced fractures, correlation analyses confirmed the trends observed in the overall cohort.

Higher pre-injury SF-12 scores, particularly the PCS component, were significantly associated with better post-trauma shoulder function (Table 9), with the strongest correlations observed for OSS ($r = 0.655$; $p < 0.001$) and post-trauma SF-12 PCS ($r = 0.737$; $p < 0.001$).

Stratification by dominant limb (Table 10) showed that displaced fractures of the dominant arm consistently yielded higher functional scores across all outcome measures. In contrast, displaced fractures of the non-dominant arm demonstrated a marked decline in functional outcomes compared to the complete dataset. Patients with displaced fractures were older, with a mean age at the time of injury of 76.2 ± 7.9 years and a narrower age range (54–90 years) compared to the entire study population.

Table 9
Score-related outcomes in displaced fractures, according to pre-trauma PCS and MCS. N = 86. Spearman's rank correlation coefficient (rho).

SSV		PCS-12 pre-trauma	MCS-12 pre-trauma
	Spearman's rho	**0.487**	**0.346**
	p-value	***< 0.001***	***< 0.001***
OSS	Spearman's rho	0.655	0.466
	p-value	< 0.001	< 0.001
Quick Dash	Spearman's rho	-0.578	-0.379
	p-value	< 0.001	< 0.001
PCS post-trauma	Spearman's rho	0.737	0.391
	p-value	< 0.001	< 0.001
MCS post-trauma	Spearman's rho	0.292	0.812
	p-value	0.006	< 0.001

Table 10
Follow-up measurement outcomes in displaced fractures, stratified by dominant side. Mann–Whitney U test.

SSV	Group	N	Mean	SD	p
	Dominant limb	**35**	**81**	**16**	**0.024**
	Not Dominant limb	**51**	**68.2**	**24.6**	
OSS	Dominant limb	35	39.1	9.6	0.012
	Not Dominant limb	51	33.2	11.8	
Quick Dash	Dominant limb	35	17.5	19.5	0.006
	Not Dominant limb	51	29.2	22.6	
PCS post-trauma	Dominant limb	35	46.9	10.8	0.002
	Not Dominant limb	51	37.8	12.3	
MCS post-trauma	Dominant limb	35	54.6	8	0.312
	Not Dominant limb	51	51.5	11.4	

Surgeon Indication

In this second phase, the surgeons identified 62 fractures classified as non-displaced (instead of 64 classified by general surgeons) with a mean concordance rate of 93% (SD 11.48). Among the 88

fractures classified as displaced, the overall level of agreement was similarly high (mean 93%, SD 11.48).

Within this group (displaced fractures), 50 fractures received a predominant recommendation for conservative treatment, with a mean concordance of 81% (SD 16.2), whereas 38 fractures received a predominant recommendation for surgical treatment, with a mean concordance of 76% (SD 16.7).

No statistically significant differences were observed in SSV, OSS, QuickDASH, or SF-12 (PCS and MCS) scores between patients for whom the five experienced shoulder surgeons predominantly recommended surgical treatment and those for whom conservative management was recommended.

Table 11
Outcome results in displaced fractures, stratified by indication. Mann–Whitney U test.

SSV	Group	N	Mean	SD	p
	Surgery	**38**	**71.7**	**23.3**	**0.517**
	Conservative	**50**	**74.8**	**21.7**	
OSS	Surgery	38	36.3	10.1	0.965
	Conservative	50	35	12.3	
Quick Dash	Surgery	38	23.3	21.7	0.811
	Conservative	50	25.4	22.6	
PCS post-trauma	Surgery	38	39.8	11.9	0.225
	Conservative	50	42.8	12.8	
MCS post-trauma	Surgery	38	53.6	8.5	0.983
	Conservative	50	52	11.5	

Discussion

Proximal humerus fractures (PHFs) are among the most frequent injuries in the elderly population. [16, 17, 18]. However, despite their high incidence and the extensive literature available, the optimal management of these fractures remains a subject of ongoing debate. [17, 19].

The present study was structured in two phases: the first aimed to evaluate long-term outcomes, and the second investigated the influence of the experience of upper limb specialist orthopedic surgeons on therapeutic decision-making.

Our cohort consisted of 150 PHFs treated conservatively, all with a minimum follow-up of 12 months (range 22–49 months, mean 32.1 months). Demographic factors such as age and sex emerged as significant predictors of functional outcomes in the present cohort. Female patients showed significantly lower functional scores compared with male patients, with statistically significant differences in OSS

(37.3 ± 11.1 vs 42.3 ± 6.79; p = 0.010) and QuickDASH (20.8 ± 21.3 vs 13.3 ± 15.6; p = 0.044), and increasing age was consistently associated with poorer results across all outcome measures.

Advanced age was correlated with poorer outcomes across all measures, a finding consistent with evidence that age-related deterioration of bone quality, particularly in women, adversely affects both fracture incidence and recovery [16, 17, 20]. Although bone quality was not directly measured in this study, these results align with the established pattern of proximal humerus fractures occurring predominantly in older women due to skeletal fragility.

Systematic reviews by Handoll and colleagues have emphasized that patient-related factors, including age, frailty, and baseline health status, substantially influence recovery after proximal humerus fractures across treatment modalities. Prognostic studies such as those reported by Beks et al [20], further support the concept that baseline biological and clinical characteristics are major determinants of functional outcome. Therefore, the sex- and age-related differences observed in our data are plausibly consistent with previously described associations between aging, fragility, and recovery potential, rather than being attributable solely to fracture characteristics.

The presence of comorbidities also influenced functional recovery. Patients without comorbidities achieved significantly higher OSS, QuickDASH, and SF-12 PCS scores compared with those with comorbidities (OSS: 41 ± 10.1 vs 37.2 ± 10.6, p = 0.015; QuickDASH: 13.5 ± 18.9 vs 21.6 ± 20.7, p = 0.009; PCS: 47.9 ± 11 vs 42.8 ± 12.6, p = 0.025). These findings suggest that the impact of comorbidities on functional recovery may reflect reduced physical capacity and mobility rather than bone fragility. Although our study did not identify specific comorbidities significantly associated with worse shoulder-related functional outcomes, the overall presence of comorbidities was associated with poorer recovery. This observation is consistent with the findings of the EPIDOS prospective study [21], which emphasized the role of global health status and functional capacity rather than individual diseases in influencing fracture risk and clinical outcomes. Taken together, these results suggest that comorbidities may primarily act as markers of general frailty and reduced physiological reserve, rather than as isolated predictors of functional recovery after proximal humerus fractures. Consequently, the impact of comorbidities on outcome appears to be mediated by the patient's overall functional status and baseline quality of life, rather than by the effect of specific pathological conditions.

Fracture characteristics were also relevant. Displaced fractures were associated with poorer outcomes compared with non-displaced fractures, whereas the number of fragments did not significantly influence recovery. These results align with the findings of Beraldo et al. [22], who reported that fracture characteristics are important predictors of functional outcome in elderly patients treated non-surgically for proximal humerus fractures. Displaced fractures were associated with a poorer prognosis, whereas the number of fragments did not significantly affect recovery, supporting the notion that fracture displacement rather than fragment count is a key determinant of functional outcomes in conservative management [22].

In the present study, fractures involving the dominant limb were associated with better functional outcomes, possibly due to higher compliance with rehabilitation protocols and better baseline functional capacity of the dominant upper extremity. This finding suggests that limb dominance may influence recovery after conservatively treated proximal humerus fractures, although its role remains controversial in the literature. Previous studies have reported that limb dominance does not necessarily affect functional outcomes or quality of life after proximal humerus fractures, even when conservatively managed, indicating that dominance alone may not be a strong independent predictor of prognosis [23]. However, other evidence has highlighted the relevance of functional factors and habitual use of the dominant limb in the recovery process, suggesting that patients may achieve better rehabilitation performance and functional adaptation when the dominant arm is involved [16, 24]. In this context, the present results may reflect the interaction between limb dominance and patient-related factors, such as baseline functional status, motivation, and adherence to rehabilitation, rather than a direct biomechanical effect of dominance itself. Taken together, these findings support the hypothesis that limb dominance may play a contributory, but not decisive, role in functional recovery after non-surgical treatment of proximal humerus fractures and should be interpreted in combination with other clinical and radiographic determinants of outcome.

Our analysis of functional outcomes in relation to radiographic morphology confirms that displaced fractures yield significantly poorer results compared to non-displaced patterns. However, interpreting this finding solely through a mechanical lens would overlook a fundamental selection bias: it is highly probable that more complex and displaced fracture patterns occur in patients who are inherently frailer. In such individuals, even low-energy trauma can result in severe displacement due to compromised bone quality and diminished physiological reserve.

While a methodologically ideal comparison would involve evaluating morphologically identical fractures across populations with differing baseline health statuses, the multifactorial nature of general well-being involves too many variables to be quantified objectively without significant confounding.

A particularly noteworthy finding emerges when isolating the pool of displaced fractures. In this subgroup, functional outcomes tend to converge; no statistically significant differences were observed between cases that shoulder specialists retrospectively identified as surgical candidates and those for whom they would have maintained a conservative approach (Table 11). This lack of significant divergence suggests that, once a certain threshold of morphological severity is reached, the primary driver of the final functional outcome may not be the theoretical treatment choice, but rather the patient's global biological potential and rehabilitative capacity.

These results align with and extend those of the ProFHER trial, which did not demonstrate any functional superiority of surgery over conservative treatment in adults with displaced PHFs and reported higher complication rates among surgically treated patients [18]. The Cochrane reviews by Handoll et al. [16, 17] similarly support conservative management, particularly in elderly patients, emphasizing patient-related factors rather than fracture morphology as primary determinants of outcomes.

Recent meta-analyses and systematic reviews further corroborate these observations. A 2023 meta-analysis of 13 studies found no significant functional advantage of surgery over conservative treatment, while reporting higher complication rates associated with surgical intervention [20]. Other systematic reviews [19, 25] have reiterated that non-surgical management can yield satisfactory outcomes even in displaced fractures, provided that appropriate rehabilitation is implemented. Moreover, studies comparing early versus delayed mobilization suggest that the timing of rehabilitation significantly influences functional recovery in conservatively treated patients [25].

In the present study, only shoulder specialists were involved in the decision-making process. This methodological choice is relevant because previous studies have shown that treatment recommendations for proximal humerus fractures may differ according to surgeons' training and sub-specialization. In particular, shoulder surgeons and trauma surgeons often diverge in their therapeutic approach, with trauma surgeons showing a greater tendency towards nonoperative management in elderly patients, whereas shoulder surgeons are more frequently inclined towards surgical solutions in selected fracture patterns and patient profiles [26]. Moreover, significant variability in treatment preferences between shoulder and trauma surgeons has been reported across common clinical scenarios, highlighting the impact of surgical background on therapeutic strategies [27].

Beyond surgeon-related factors, the literature consistently indicates that clinical decision-making in proximal humerus fractures is driven primarily by patient-related variables, including age, comorbidities, functional demand, and bone quality, rather than fracture morphology alone [28]. These findings suggest that therapeutic strategies are increasingly individualized and influenced by global patient characteristics, reinforcing the concept that fracture pattern, although relevant, is often secondary to biological and functional factors in guiding treatment decisions.

Limitations

This study presents several limitations. First, only conservatively treated proximal humerus fractures were included, unlike large comparative studies such as ProFHER, which analyzed both surgically and non-surgically treated fractures. This selection limits the external validity and generalizability of our findings, as the cohort represents a subgroup already managed nonoperatively.

Second, more than half of the initially eligible patients were lost to follow-up, which may have introduced selection bias in the final cohort.

Third, pre-injury quality of life was assessed retrospectively, requiring patients to recall their pre-injury health status at the time of follow-up, without objective baseline data, which may have introduced recall bias.

Taken together, these limitations underline the observational nature of our study and the challenges inherent in long-term follow-up data collection, but the findings remain relevant for understanding functional recovery and decision-making in conservatively treated proximal humerus fractures.

Conclusions

In proximal humerus fractures treated conservatively, patient-related factors such as age, baseline health status, and limb dominance appear to have a greater influence on functional outcome than fracture pattern or surgeon experience.

Even in displaced fractures, conservative treatment can provide satisfactory results in most cases. The experience of the orthopedic shoulder specialists, when retrospectively applied to treatment decision-making, appears to have limited prognostic value.

These findings support a patient-centered approach emphasizing functional demands, general health, and rehabilitation potential over fracture complexity alone.

Abbreviations

PHFs
Proximal humerus fractures
QuickDASH
Quick Disabilities of the Arm, Shoulder and Hand
OSS
Oxford Shoulder Score
SSV
Subjective Shoulder Value
SF-12
Short Form-12 Health Survey
PCS
Physical Component Score
MCS
Mental Component Score

Declarations

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related to the subject of this article.

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All Authors certify they not have signed any agreement with a commercial interest related to this study, which would in anyway limit publication of any data generated for the study or to delay publication for any reason.

This article does not contain any studies with animals performed by any of the authors.

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Figures

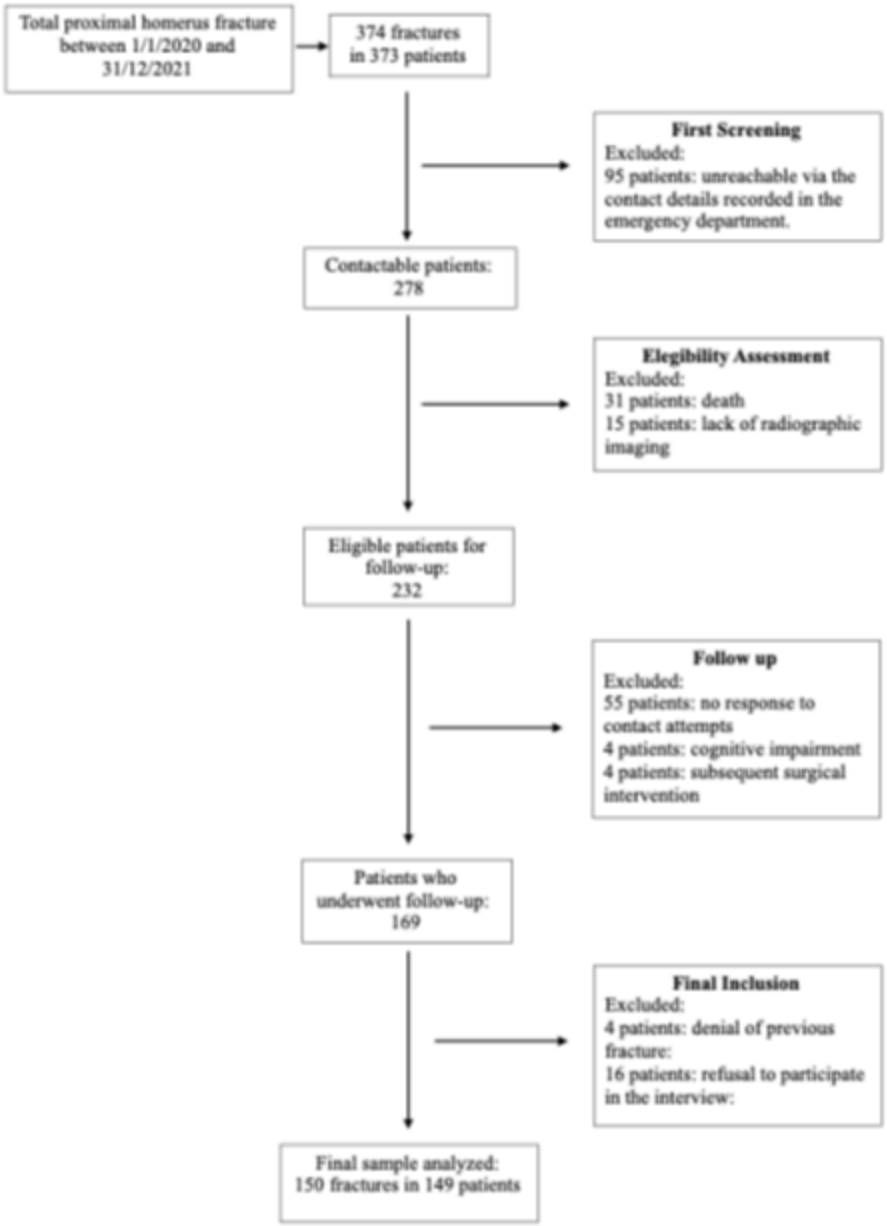
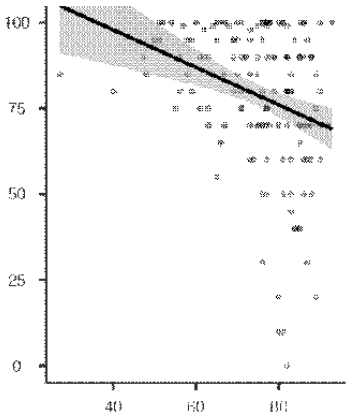
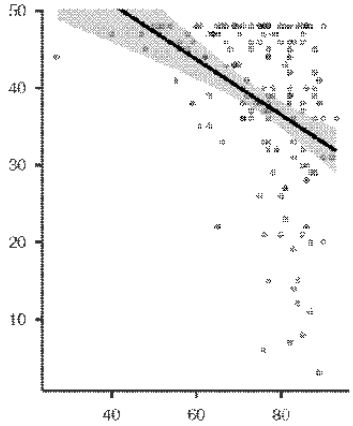


Figure 1

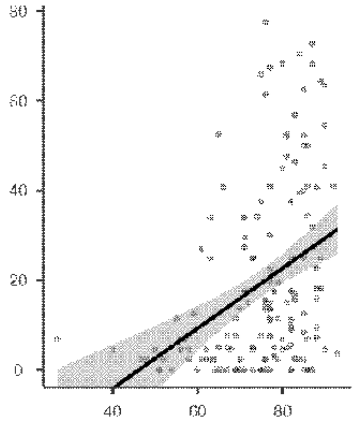
CONSORT flow-diagram for patients included in the study



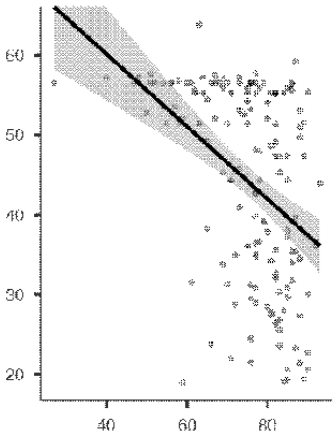
a) SSV (x-axis) in relation to age (y-axis).



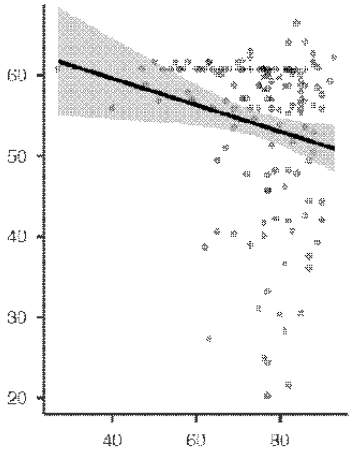
d) OSS (x-axis) in relation to age (y-axis).



b) Quick-DASH (x-axis) in relation to age (y-axis).



e) PCS (x-axis) in relation to age (y-axis).



c) MCS (x-axis) in relation to age (y-axis).

Figure 2

Outcome plots in relation to age.