



Original Article

Association Between Predictor Variables and Outcome Among Patients with 3-Part and 4-Part Proximal Humerus Fractures

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ABSTRACT

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Nonoperative treatment is an option for the vast majority of proximal humerus fractures (around 65 to 85 percent). Stable, minimally displaced fractures or those not considered surgical candidates are typically best treated nonoperatively. After receiving appropriate approval and clearance, the patients who met the inclusion criteria were enrolled in the study after obtaining informed consent.

Upon admission, demographic data, historical information, clinical examination findings, and investigation details were documented in the research proforma.

All patients who visited the orthopaedic department throughout the study period and were scheduled for conservative treatment were included in the study. The patients were presented with shoulder exercises, physiotherapy, and treated with analgesics.

Significant associations were found for age group, gender, and hypertension status. Participants aged 61-70 years showed a significant improvement (100% satisfactory) compared to older age groups ($p < 0.001$). Females demonstrated a higher proportion of excellent and good outcomes compared to males ($p < 0.001$). Participants without hypertension had better outcomes compared to those with hypertension ($p = 0.031$).

Keywords: Predictor Variables, Outcome, 3-Part And 4-Part Proximal Humerus Fractures.

INTRODUCTION

Humerus forms the human arm and it is biggest bone in upper limb. Humerus is the longest, and stoutest bone in upper limb. When compared to the elbow joint, which connects the ulna and radius at the distal end of the humerus, the glenohumeral joint is the one that connects the proximal end of the humerus to the glenoid as opposed to the elbow joint.¹ The head is located on the inner surface of the humerus bone, which is another name for the bone. A socket-and-ball joint is created when the glenoid cavity of the scapula bone is joined to the surface of the joint.²² The humerus's anatomical neck is situated considerably behind its head. It divides the bigger and smaller tubercles from the humeral head. The portion of the humerus that still has the epiphyseal plate attached to it is called the anatomical neck. The two tubercles are divided vertically by the intertubercular grooves, which are found nearer the top. Adjacent to the tubercles lies the surgical neck of the humerus, which is prone to fractures.²

Nonoperative treatment is an option for the vast majority of proximal humerus fractures (around 65 to 85 percent). Stable, minimally displaced fractures or those not considered surgical candidates are typically best treated nonoperatively.^{3,4}

If the following five conditions are satisfied, nonsurgical treatment is advised:

- The head and the shaft are in touch with one other, called impaction
- There is no dislocation of the humeral head.
- With a head shaft angle of 100 to 160 degrees, the humeral head shows minimal varus or valgus angulation.
- Almost no tuberosity fracture has been displaced.
- The amount of involvement of the articular surface is limited.

METHODOLOGY:

STUDY DESIGN:

An observational analytical study

STUDY AREA:

The research study included individuals who were diagnosed with a proximal humerus fracture and were taken to the orthopaedics department.

STUDY PERIOD AND DURATION:

The research was conducted over a period of one year and four months

STUDY POPULATION:

Male and female patients with 3-part and 4-part proximal humerus fractures who meet the specified criteria and are admitted to the Department of Orthopaedics

SAMPLE SIZE CALCULATION

In 2016, Corley et al conducted a study which revealed that the occurrence rate of proximal humerus fracture was five percent. [23]

Formula:

$$N = 4 * p * q / d^2$$

Where,

P = prevalence

Q = compliment of p

D = absolute error (which is 5 percent) N = 75

Therefore, a minimum sample size of 75 was necessary to achieve a 95 percent confidence interval. The sample size was determined using nMaster software Version 2.0 by inputting the specified parameters into the formula mentioned above.

INCLUSION CRITERIA:

- All patients with 3-part and 4-part proximal humerus fracture
- Both gender of age more than 60 years
- Patients within minimum of one year duration from the period of study.

EXCLUSION CRITERIA:

- Patients with pathological fracture
- Patients underwent surgical treatment
- Patients with open fracture
- Patients with cognitive dysfunction
- Patients had a history of stroke and hemiplegia.

SAMPLING METHOD:

All consecutive patients diagnosed with 3-part and 4-part proximal humerus fracture between August 2022 and January 2024 who were hospitalized to the Orthopaedics department at the Tertiary Care Hospital in Bangalore, and had identical symptoms.

DATA COLLECTION PROCEDURE

After receiving appropriate approval and clearance, the patients who met the inclusion criteria were enrolled in the study after obtaining informed consent.

Upon admission, demographic data, historical information, clinical examination findings, and investigation details were documented in the research proforma.

All patients who visited the orthopaedic department throughout the study period and were scheduled for conservative treatment were included in the study. The patients were presented with shoulder exercises, physiotherapy, and treated with analgesics.

All routine investigations were sent and collected. Radiological investigations like chest x-ray, shoulder xray etc were carried out. Then all the patients were followed up after 6 months.

Assessed for functional and radiological outcome

Assessment of pain relief was done using VAS scoring

RESULTS

Table 1: Association between predictor variables and pain reduction due to conservative management among the study participants (n = 75)

Variables			Pain reduction		Total	Chi- square test	P- Value
			No	Yes			
Age group	61 to 70 years	Count	0	26	26	2.885*	0.344
		%	0.0%	100.0%	100.0%		
	71 to 80 years	Count	1	39	40		
		%	2.5%	97.5%	100.0%		
	More than 80 years	Count	1	8	9		
		%	11.1%	88.9%	100.0%		
Gender	Female	Count	0	36	36		
		%	0.0%	100.0%	100.0%		
	Male	Count	2	37	39		
		%	5.1%	94.9%	100.0%		
Hypertension	No	Count	2	58	60	0.514	1.000
		%	3.3%	96.7%	100.0%		
	Yes	Count	0	15	15		
		%	0.0%	100.0%	100.0%		
Diabetes	No	Count	2	65	67	0.245	1.000
		%	3.0%	97.0%	100.0%		
	Yes	Count	0	8	8		
		%	0.0%	100.0%	100.0%		
Coronary vascular disease	No	Count	2	69	71	0.116	1.000
		%	2.8%	97.2%	100.0%		
	Yes	Count	0	4	4		
		%	0.0%	100.0%	100.0%		
Alcohol moking	No	Count	1	64	65	2.391	0.250
		%	1.5%	98.5%	100.0%		
	Yes	Count	1	9	10		
		%	10.0%	90.0%	100.0%		
	No	Count	2	65	67	0.245*	1.000
		%	3.0%	97.0%	100.0%		
	Yes	Count	0	8	8		
		%	0.0%	100.0%	100.0%		
Spouse alive	No	Count	0	9	9	0.280*	1.000
		%	0.0%	100.0%	100.0%		
	Yes	Count	2	64	66		
		%	3.0%	97.0%	100.0%		

*Fischer exact value

The table presents the association between various predictor variables and pain reduction due to conservative management among 75 study participants. Age groups 61-70 and 71-80 show high rates of pain reduction, with 100% and 97.5% respectively, while the >80 group shows 88.9% reduction. Females exhibit a 100% pain reduction, whereas males show 94.9%. Participants without hypertension, diabetes, or coronary vascular disease have high pain reduction rates (96.7%, 97.0%, and 97.2%, respectively), similar to those with these conditions, though the differences are not

significant. Non-smokers and non- alcohol users show slightly higher pain reduction (97.0% and 98.5%) compared to smokers and alcohol users (100% and 90.0%). Lastly, participants with a living spouse have a 97.0% reduction compared to 100% in those without. None of the chi-square tests indicate significant associations, with p-values all above 0.05.

Table 2: Association between predictor variables and Functional outcome by Constant Shoulder Scoring due to conservative management among the study participants (n = 75)

			Functional outcome by Constant Shoulder Scoring				Chi- square value	P- value
			Absent	Excellent	Good	Satisfactory		
Age group	61 to 70 years	Count	0	0	26	0	25.376*	<0.001
		%	0.0%	0.0%	100.0%	0.0%		
	71 to 80 years	Count	2	13	19	6		
		%	5.0%	32.5%	47.5%	15.0%		
	More than 80 years	Count	1	0	6	2		
		%	11.1%	0.0%	66.7%	22.2%		
Gender	Female	Count	0	13	23	0	26.544*	<0.001
		%	0.0%	36.1%	63.9%	0.0%		
	Male	Count	3	0	28	8		
		%	7.7%	0.0%	71.8%	20.5%		

Hypertension	No	Count	3	13	36	8	7.771*	0.031
		%	5.0%	21.7%	60.0%	13.3%		
	Yes	Count	0	0	15	0		
		%	0.0%	0.0%	100.0%	0.0%		
Diabetes	No	Count	3	13	43	8	2.735*	0.399
		%	4.5%	19.4%	64.2%	11.9%		
	Yes	Count	0	0	8	0		
		%	0.0%	0.0%	100.0%	0.0%		
Coronary vascular disease	No	Count	3	13	47	8	1.251*	0.777
		%	4.2%	18.3%	66.2%	11.3%		
	Yes	Count	0	0	4	0		
		%	0.0%	0.0%	100.0%	0.0%		
Alcohol	No	Count	2	13	43	7	3.590	0.237
		%	3.1%	20.0%	66.2%	10.8%		
	Yes	Count	1	0	8	1		
		%	1.3%	0.0%	10.7%	1.3%		

Smoking	No	%	10.0%	0.0%	80.0%	10.0%	5.890	0.070
		Count	3	13	46	5		
	Yes	%	4.5%	19.4%	68.7%	7.5%		
		Count	0	0	5	3		
	No	%	0.0%	0.0%	62.5%	37.5%		
		Count	0	4	5	0		

Spouse alive	No	%		%			4.502	0.143
		Count	3	9	46	8		
		%	4.5%	13.6	69.7%	12.1		
	Yes	%		%				

*Fischer exact value

The table presents the association between predictor variables and functional status due to conservative management among 75 study participants, assessed using the Constant Shoulder Scoring. Significant associations were found for age group, gender, and hypertension status. Participants aged 61-70 years showed a significant improvement (100% satisfactory) compared to older age groups ($p < 0.001$). Females demonstrated a higher proportion of excellent and good outcomes compared to males ($p < 0.001$). Participants without hypertension had better outcomes compared to those with hypertension ($p = 0.031$). No significant associations were observed for diabetes, coronary vascular disease, alcohol consumption, smoking, or whether the spouse was alive. The p-values indicate the strength of these associations, with lower values denoting stronger evidence against the null hypothesis.

Table 3: Association between predictor variables and Radiological outcome by X-ray due to conservative management among the study participants (n = 75)

Variables			Radiological outcome by X- ray		Total	Chi-square value	P-value
			Good	Poor			
Age group	61 to 70 years	Count	24	2	26	7.102	0.029
		%	92.3%	7.7%	100.0%		
	71 to 80 years	Count	27	13	40		
		%	67.5%	32.5%	100.0%		
	More than 80 years	Count	5	4	9		
		%	55.6%	44.4%	100.0%		
Gender	Female	Count	20	16	36	13.368	<0.0001
		%	55.6%	44.4%	100.0%		
	Male	Count	36	3	39		
		%	92.3%	7.7%	100.0%		
Hypertension	No	Count	45	15	60	0.018*	1.000
		%	75.0%	25.0%	100.0%		
	Yes	Count	11	4	15		
		%	73.3%	26.7%	100.0%		
Diabetes	No	Count	51	16	67	0.701	0.410
		%	76.1%	23.9%	100.0%		
	Yes	Count	5	3	8		
		%	62.5%	37.5%	100.0%		
Coronary vascular disease	No	Count	53	18	71	0.001*	1.000
		%	74.6%	25.4%	100.0%		
	Yes	Count	3	1	4		
		%	75.0%	25.0%	100.0%		
Alcohol	No	Count	46	19	65	3.915*	0.057
		%	70.8%	29.2%	100.0%		
	Yes	Count	10	0	10		
		%	100.0%	0.0%	100.0%		
Smoking	No	Count	48	19	67	3.038*	0.106
		%	71.6%	28.4%	100.0%		
	Yes	Count	8	0	8		
		%	100.0%	0.0%	100.0%		
Spouse alive	No	Count	4	5	9	4.938*	0.041
		%	44.4%	55.6%	100.0%		
	Yes	Count	52	14	66		
		%	78.8%	21.2%	100.0%		

*Fischer exact value

The table presents the association between predictor variables and radiological outcomes assessed by X-ray among 75 study participants undergoing conservative management. Significant associations were observed for age group, gender, and whether the participant's spouse was alive. Participants aged 61-70 years had the highest percentage of good radiological outcomes (92.3%) compared to older age groups ($p = 0.029$). Males had a significantly higher proportion of good outcomes (92.3%) compared to females (55.6%) ($p < 0.0001$). Participants whose spouse was alive had better outcomes (78.8%) compared to those whose spouse was not alive (44.4%) ($p = 0.041$). No significant associations were found for hypertension, diabetes, coronary vascular disease, alcohol consumption, or smoking. These findings indicate that younger age, male gender, and having a living spouse are associated with better radiological outcomes in this study population.

DISCUSSION

In 2011, Olerud et al. conducted a clinical research in Sweden to evaluate the effectiveness of surgical and non-surgical treatments for patients diagnosed with a 3-part proximal humerus fracture. The trial used randomization to assign patients to different treatment groups. The findings of this study indicate that the operational technique offers a clear benefit over non-operative treatment in terms of functional outcome and quality of life. However, it is important to note that the cost of the operative process is more than 30 percent higher than that of the non-operative technique.⁵

Olerud et al conducted a RCT in Sweden in 2011. The study included 55 elderly patients diagnosed with a 4-part fracture of the proximal humerus. The study's findings revealed a notable superiority in the quality of life for older patients with a displaced 4-part fracture of the proximal humerus who underwent surgical treatment, compared to those who received nonoperative treatment. The primary benefit of surgical intervention was a reduction in pain, with no observed disparities in range of motion (ROM).⁶

Soler-Peiro et al conducted a systematic review on the conservative treatment of 3-part and 4-part proximal humeral fractures, including a total of 6 papers. The researchers found that the majority of three-part PHFs that were treated conservatively resulted in the healing of the fracture, with a very low rate of malalignment. These patients also had satisfactory to good functional outcomes and experienced few complications. On the other hand, the treatment of four-part PHFs by orthopedic methods resulted in a higher rate of fracture healing compared to three-part PHFs, with a lower rate of malalignment. However, patients with four-part PHFs had poor functional outcomes and also experienced few complications.⁷

Rodriguez-Corlay et al. documented a case with a 71-year-old woman who had a fracture in both of her upper arm bones near the shoulder joint. The researchers determined that most senior patients with minimal functional needs who have 3- or 4-part displaced fractures can be effectively treated with conservative measures. This approach provides sufficient pain relief and results in a satisfactory functional outcome, although it may be somewhat limited.⁸

Rangan et colleagues conducted the PROFHER Randomized Clinical Trial on a cohort of 250 patients to assess the clinical efficacy of surgical versus nonsurgical interventions for people with displaced fractures of the proximal humerus that include the surgical neck.³ Patients with displaced PHFs affecting the surgical neck did not have any significant difference in patient-reported clinical outcomes during a 2-year period following the fracture, regardless of whether they had surgery or nonsurgical therapy. The results obtained do not provide evidence in favor of the growing tendency to perform surgery on patients with displaced fractures of the proximal humerus.

CONCLUSION

Significant associations were found for age group, gender, and hypertension status. Participants aged 61-70 years showed a significant improvement (100% satisfactory) compared to older age groups ($p < 0.001$). Females demonstrated a higher proportion of excellent and good outcomes compared to males ($p < 0.001$). Participants without hypertension had better outcomes compared to those with hypertension ($p = 0.031$).

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