SHORT COMMUNICATION

Functional outcomes in proximal humerus fractures: A prospective registry-based analysis

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Abstract

The present study evaluated and compared functional outcomes of proximal humerus fractures of different categories and their management with different procedures. Data of this prospective cohort was obtained from the orthopaedic trauma registry at a tertiary care hospital for the period from June 2015 to October 2019. Sixty-eight adult patients with proximal humerus fracture were identified out of which 57 (84%) had been operated. Functional outcomes were assessed up to 12-month follow-ups and were compared with different treatment groups, fracture category, and between isolated versus proximal humerus with additional upper limb fractures. At 3-month follow-up, there was significantly better outcomes in Proximal Humeral Internal Locking System (PHILOS) treatment group as compared to PHILOS with bone graft/BMP (p=0.041). PHILOS combined with bone graft/BMP was associated with delayed recovery compared to other management methods. There was non-significant difference in functional outcomes between isolated versus proximal humerus fractures associated with other upper limb fractures, among different fracture categories and between genders.

Keywords: Proximal humerus fracture, Trauma, Treatment approaches, Outcomes, Quick DASH.

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Introduction

Proximal humerus fractures account for 5.7% of all fractures.[1] According to the literature, proximal humerus fractures are common in the elderly aged 80 years and above and are three times more common in women than in men.[2,3] Majority of these fractures are closed.[4] Falls in the elderly and high energy trauma in young adults are the most common causes of injury.[5]

According to Neer's classification, proximal humerus fractures are divided into one- to six-part fractures.[6] It is reported that 21% to 23% proximal humerus fractures are three- and four-part fractures.[3,7] Depending on the patient, factors and fracture category, there are several treatment options available to treat proximal humerus fractures such as conservative treatment, Open Reduction Internal Fixation (ORIF), PHILOS, arthroplasty, intramedullary nailing, etc. Appropriate procedure selection and implant fixation requires orthopaedic surgeon's expertise.

According to literature, patients who encountered two-part fractures and were treated with intramedullary nailing showed satisfactory results while patients who sustained three- and four-part proximal humerus fractures and were treated with ORIF, intramedullary nailing or conservatively showed non-satisfactory functional outcomes.[8-11] Patients managed with PHILOS achieved better functional outcomes and fracture stability in two- to four-part fractures.[12,13]

Furthermore, several research studies conducted on proximal humerus fractures, managed with different treatment approaches to evaluate their functional and clinical outcomes. It was observed that functional recovery was satisfactory for up to 14 months on average following proximal fracture treatment.[14] Patients who underwent ORIF, although achieved bone union within three months after surgery, immobilisation for four weeks post-surgery resulted in stiffness or developed number of complications including malunion, screw protrusion, osteonecrosis, etc. Some patients required revision surgery or implant removal after ORIF procedure.[15-17] PHILOS has become one of the most commonly used implant for fixation of proximal humerus fractures as several studies have suggested PHILOS to be the best treatment option for proximal humerus fractures. PHILOS had significantly better clinical and functional outcomes in majority of the patients, specifically in younger patients associated with satisfactory bone union. However, some patients did encounter surgery-related complications such as impingement, avascular necrosis, implant failure, stiffness, superficial surgical site wound infection and glenohumeral screw penetration.[12,18-22]

According to the null hypothesis of our study, there is no difference in functional outcomes among all proximal

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humerus fracture treatment groups and fracture categories. Based on available evidence, the current study aims to evaluate and compare functional outcomes of different categories of proximal humerus fractures managed with different treatment approaches as a routine care up to one-year post-management at a tertiary care hospital. This might assist orthopaedic surgeons in better decision-making for procedure selection. In addition, the study also aims to compare functional outcomes in proximal humerus fracture patients who have either isolated proximal humerus fracture or associated with other upper limb fractures and among different categories of proximal humerus fractures.

Patients/Methods and Results

The current study data was extracted from a single-centre, prospective ongoing Orthopaedic Trauma Registry initiated after all institutional and ethical approvals in June 2015 at the Aga Khan University Hospital.[23,24] Eligible patients older than 18 years of age, irrespective of gender, with trauma associated proximal humerus fractures were included. Patients with pathological fractures, and patients who underwent amputations were excluded. Written informed consent was taken from the patients or the guardian, if the patient was unable to give the consent by himself/herself. Trauma related data was obtained from patients' medical records and their outcomes were assessed by a senior researcher at 6 (±2) weeks, 3 months (±2 weeks), 6 (±1) months and 12 (±2) months after treatment.

From June 2015 to October 2019, a total of 69 adult proximal humerus fracture patients were identified from trauma registry. Out of 69 one patient, who was treated with circlage wire, was excluded from the analysis, while 68 patients remained in the study. Prospective cohort data obtained from trauma registry demonstrated 56 (82%) cases with isolated proximal humerus fractures, and 12 (18%) had associated other upper limb fractures as well. Functional outcomes were assessed on follow-up using Quick Disabilities of the Arm, Shoulder and Hand questionnaire (Quick DASH), categorised on the basis of scores as 'good (0-24)' to 'fair (25-49)' and 'poor (50-74)' to 'severe disability (75-100)'.[25] Neer's classification was used for proximal humerus fracture categories.[6] Data was analysed on SPSS version 19.0. Descriptive analysis was performed for age, gender, mechanism of injury and type of management. Continuous variables were expressed as mean (± standard deviation) and categorical variables as percentages (%). The p-value of less than 0.05 was considered as statistically significant with a confidence interval of 95%.

Of the 68 eligible patients 38 (56%) were males and 30 (44%) were females. Median age for proximal humerus fractures was 53 years (IQR 27, range 18-84 years) while 46% of the cohort were of age >55 years (Table-1). Common mechanism of injury was fall (N=36, 53%) followed by road traffic accidents (N=29, 43%). Sixty (88%)

Table-1: Patient's demographics and fracture characteristics.

	No. of Patients (%)
Age Groups (Years)	
18-35	14 (21%)
36-55	23 (34%)
56-75	28 (41%)
76 and above	3 (4%)
Mechanism of Injury	
Fall	36 (53%)
Ground level	29 (19 patients ≥60 years' age)
From height	7 (2 patients ≥60 years' age)
RTA	29 (43%)
Firearm injury	2 (3%)
Blast injury	1 (1%)
Isolated Proximal Humerus Fractures	56 (82%)
Proximal Humerus Fractures associated with other upper limb fractures	12 (18%) (Proximal humerus fracture associated with: Other humerus fractures = 4 Radius/ulna fractures = 3 Scapula fracture = 2 Elbow fracture = 1 Multiple upper limb fractures = 2)

Table-2: Patient's visit status.

Follow-up visit	Patients arrived (Outcomes measured)	Patient admit	Lost to follow-up	Visit Due	Visit complete
2 weeks*	63 (3)	1	4	-	-
6 weeks	61 (47)	-	4	3	-
3 months	42 (33)	-	18	8	-
6 months	25 (17)	-	27	15	1
12 months	10 (7)	-	34	24	-

*At 2 weeks only radius/ulna shaft fracture outcomes are assessed.

Note: None of the patient refused to participate in the study or dropped out.

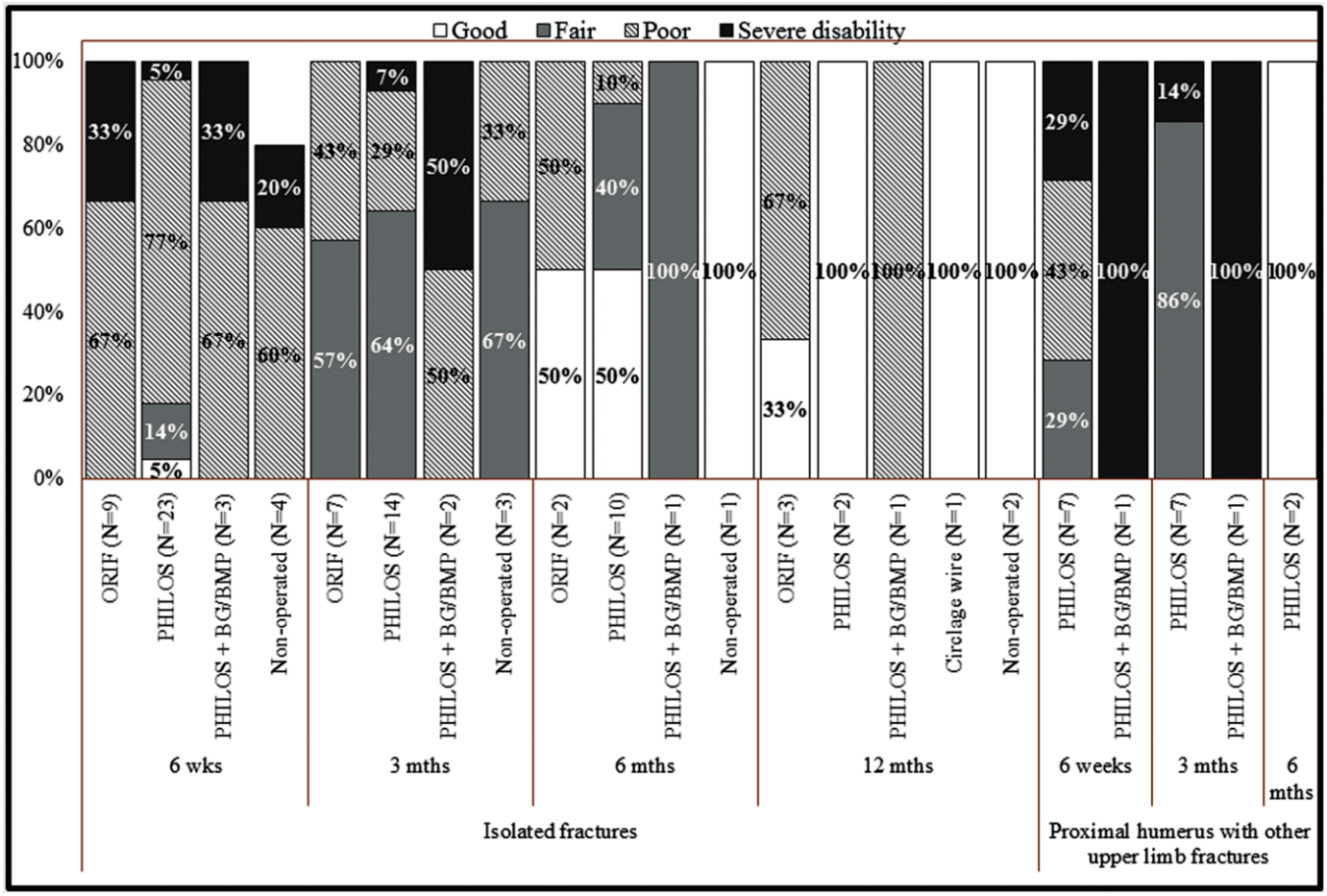

Figure: Percentage of functional outcomes according to treatment procedures.

patients encountered closed fractures and the rest (N=8, 12%) were open fractures.

All the patients were managed with standard care by their treating orthopaedic surgeon and the cost was covered by the patient. Based on treatment procedures, the patients were divided into four groups ORIF, PHILOS, PHILOS with bone grafting/bone morphogenetic protein (BMP) and non-operated. As a routine practice, orthopaedic surgeons selected bone grafting or BMP with PHILOS, depending on 3-part to 6-part fracture category. Majority of the patients (N=42, 62%) underwent PHILOS procedure, followed by ORIF (N=9, 13%). PHILOS combined with bone grafting or BMP was performed in 6 (9%) patients and 11 (16%) patients were managed conservatively. The difference in outcome ('good' to 'fair' and 'poor' to 'severe disability') between surgical procedures was analysed using Fisher Exact test.

According to Neer classification, out of all 68 patients, 30 (44%) patients sustained 3-part fracture, 20 (29%) had 4-part fracture, 7 (10%) 6-part fracture, 6 (9%) patients had 2-part fracture, 3 (4%) had 1-part fracture and 2 (3%) had 5-part fracture. Functional outcome of different fracture categories was analysed by Fisher Exact test.

Further to this, all eligible subjects were divided into two groups on the basis of proximal humerus fracture with or without associated other upper limb fractures that might impact functional outcomes. Group A comprised isolated proximal humerus fracture and Group B had proximal humerus associated with other upper limb fractures. Similar to procedure groups, the outcomes difference in Group A versus Group B was analysed by Fisher Exact test.

In order to determine relationship of different proximal humerus fracture categories and their functional outcomes, 47 patients were assessed at six weeks in which 'good' to 'fair' outcome was achieved in 4 (57%) patients with 3-part fracture, 2 (29%) with 2-part fracture and 1 (14%) with 1-part fracture. At 3-month follow-up, 34 patients were assessed for functional outcomes in which 'good' to 'fair' outcome was achieved in 11 (52%) patients with 3-part fracture, 3 (14%) each with 2-part, 4-part, 6-

part fractures and 1 (5%) with 1-part fracture. At 6-month follow-up, 16 patients were assessed for functional outcomes in which 'good' to 'fair' outcome was achieved in 6 (43%) patients with 3-part fracture, 3 (21%) with 6-part fracture, in 2 (14%) each with 2-part and 4-part fractures, and 1 (7%) with 5-part fracture. At 12-month follow-up, 8 patients were assessed for functional outcomes in which 'good' to 'fair' outcome was achieved in 3 (60%) with 3-part fracture and 2 (40%) with 4-part fracture. Although, better functional outcomes were achieved in 3-part fracture category, there was no significant difference in outcomes among all fracture categories.

On the basis of different treatment approaches, relationship between treatment procedures to functional outcomes was assessed. At 6-week follow-up, except for PHILOS treatment group, in which 30 patients were assessed for outcomes, 7 (23%) achieved 'good' to 'fair' outcome. The rest of the patients in all treatment groups had 'poor' to 'severe disability' by this time.

At 3-month follow-up, 21 patients treated with PHILOS were assessed for outcomes in which 15 (71%) achieved 'good' to 'fair' outcome. Four (57%) out of 7 assessed patients who were treated with ORIF achieved 'good' to 'fair' outcome. Two (67%) out of 3 assessed patients, treated conservatively, achieved 'good' to 'fair' outcome. None of the patients treated with PHILOS combined with bone graft/BMP achieved 'good' to 'fair' outcome. There was significantly better outcome in PHILOS procedure versus PHILOS with bone graft/BMP with significance of p=0.041. There was no significant difference between other treatment groups.

At 6-month follow-up, 11 (92%) out of 12 patients in PHILOS treated group and 1 patient each in conservative and PHILOS with bone graft/BMP treated group was assessed and achieved 'good' to 'fair' outcome. Two patients in ORIF treated group were assessed for outcomes in which 1 (50%) achieved 'good' to 'fair' outcome.

At 12-month follow-up, all 4 patients, who were assessed for outcomes in PHILOS and non-operative group were able to perform routine daily activities without limitation. ORIF (N=2 of 3, 67%) and PHILOS combined with bone graft/BMP (N=1, 100%) treated groups still had difficulty in shoulder range of movement and impaired grip.

In connection to this, relationship of functional outcomes between isolated proximal humerus fracture and proximal humerus fracture combined with other upper limb fracture was determined. In Group A patients (N=56), who encountered isolated proximal humerus fracture only, outcomes at 3-month follow-up were available in 26 patients. 'Fair' outcome was seen in 15 (58%) patients while 'poor' to 'severe disability' was seen in 11 (42%) patients. At 6-month follow-up, outcomes were available for 14 patients in which 'good' to 'fair' outcomes were present in 12 (86%) patients, while 2 (14%) had 'poor' outcomes. At 12-month follow-up, out of 9 assessed patients, 6 (67%) patients had 'good' outcomes and 3 (33%) patients had 'poor' outcomes.

In Group B patients (N=12), who sustained proximal humerus fracture in addition to other upper limb fracture, 3-month follow-up outcomes were available for 8 patients, out of which 6 (75%) had 'fair' outcomes and 2 (25%) had 'severe disability'. At 6-month follow-up, outcomes of 2 patients were available and both (100%) had 'good' outcomes (Figure). Fisher Exact test showed non-significant difference in functional outcomes at follow-ups 6 weeks onwards between groups A and B.

There was non-significant difference in functional outcomes between males and females. Patients' visit status was also recorded for each follow-up visit (Table-2).

Conclusion

Current research evidence showed better functional recovery in PHILOS treated group as compared to PHILOS with bone graft/BMP treated patients. Recovery was delayed for six months in patients who underwent PHILOS combined with bone graft/BMP insertion. No significant difference in functional outcomes was observed between proximal humerus fractures whether isolated or associated with additional upper limb fractures, among different fracture categories, and between genders.

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Conflict of Interest: None

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