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ORIGINAL ARTICLE

Functional Outcome of Surgical Management of Comminuted Proximal Fractures of Humerus Treated with Proximal Humerus Internal Locking System (Philos) Plate

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ABSTRACT

Objectives: To assess the functional outcome of surgical management of comminuted proximal fractures of humerus treated with proximal humerus internal locking system (PHILOS) plate.

Study Design: Descriptive study.

Place and Duration: Orthopaedic Complex Bahawal Victoria Hospital Bahawalpur from 07th May 2021 to 06th November 2021.

Materials & Methods: A total of 149 patients presenting with displaced proximal humerus fractures according to NEER two, three- and four-part fracture of either gender of age 18 to 60 year were included. Open fracture & Poly trauma, pathological fractures were excluded. Proximal humerus Locking plate (PHILOS) was used in each patient. Plate of appropriate size was placed over the lateral surface of humerus about 1 cm distal to upper end of greater tuberosity by an orthopedic surgeon having more than 5 years post fellowship experience. Wound close in all layers after inserting the suction drain and dressing was be applied. All postoperative rehabilitation was done under the guidance of an experienced physiotherapist. Patients encouraged to do exercises at home and called for follow-up at six weeks, three months & four months.

Results: Age range in this study was from 18 to 60 years with mean age of 37.15 ± 7.41 years. Majority of the patients 79 (59.73%) were between 18 to 40 years of age. Out of 149 patients, 99 (66.44%) were males and 50 (33.56%) were females with male to female ratio of 2:1. In this study, the excellent functional outcome was seen in 71 (47.65%) patients, very good in 14 (9.40%), good in 40 (26.85%) patients, fair in 15 (10.07%) and poor outcome in 09 (6.04%) patients.

Conclusion: This study concluded that excellent functional outcome of surgical management of comminuted proximal fractures of humerus treated with proximal humerus interlocking system (PHILOS) plate is very high.

Keywords: proximal fractures of humerus, proximal humerus interlocking system, outcome.

INTRODUCTION

Proximal humeral fractures are the second most common fractures of the upper extremity accounting for 4% to 5% [1] of all fractures and 45% of all humeral fracture[2]. Nearly 85% of these fractures occur in people over the age of 50 years with the peak incidence in 60 to 90 years of age[3]. In young individuals high velocity trauma is the cause of these fractures whereas simple fall can be the cause in older individuals because of osteoporosis[4]. Usually humeral fractures are stable non-displaced or minimally displaced which can be treated by immobilization, casts and splints[5]. Patients are most frequently treated non-operatively but some complex fractures require surgery. There are different techniques available for fixation of these fracture including bone sutures, cerclage wires, K-wires, tension band wires, T-plates, intramedullary devices, double tubular plates, the Polaris nail and prosthetic replacements. Surgical treatment is necessary especially in young patients and active elderly people in order to prevent minimal dislocations of tuberosity or articular surface from compromising the long-term articular function. A recently developed operative system is PHILOS (proximal humerus internal locking system) for open reduction and internal fixation of these fractures.

The influencing factors to functional outcome are fracture reduction, implant choice, quality of fracture reduction and fixation and early post-op mobilization. However complication (such as infection, damage to nerves and blood vessels, malunion or nonunion) rates following open reduction and internal fixation of displaced proximal humeral fractures still account for up to 30% and numerous studies investigated factors associated with poor outcome[6]. Each technique is associated with varying incidence of post-operative stiffness and restriction of movements to implant failure, osteonecrosis, non-union, mal-union and rotator cuff weakness[7]. The proximal humeral internal locking system (PHILOS) plate which are contoured anatomically according to the shape of proximal humerus known as Proximal Humeral Internal Locking System PHILOS (Synthes, Solothurn, Switzerland) has been developed by AO/ASIF foundation[8] to improve screw fixation in osteoporotic bone and to minimize soft-tissue dissection. Approximately 85% of patients with a proximal humerus fractures are non-displace and treated conservatively resulting in satisfactory results[9]. This reproducible technique improves fixation with regard to primary stability, allowing for an early passive and active rehabilitation process[10]. As per grading of the constant score, the outcome previous studies showed, excellent (40%), very good (6.66%) good (30%) fair (20%) and poor (3.33%)[4].

As the above study has to determine varying results regarding "to assess the functional outcome of surgical management of comminuted proximal fractures of humerus treated with PHILLOS Locking Plate. Open reduction and internal fixation (ORIF) with locking plating is proving to be a promising option in the treatment of comminuted proximal humerus fractures. So, I have planned to conduct this study is to evaluate the results in terms of functional outcome of proximal humeral fractures treated by proximal humerus interlocking system (PHILOS) plate. My study will not only help to reassess the results but will also be a useful addition in the existing literature. With the use of correct surgical technique by a competent surgeon, the anatomic locking compression plate is a suitable option for surgical management of proximal humeral fractures providing a good functional outcome.

MATERIALS AND METHODS

This descriptive study was conducted at Orthopaedic Complex Bahawal Victoria Hospital Bahawalpur from 07th May 2021 to 06th November 2021.

Sample Size: Sample size was calculated using WHO sample size calculator. By keeping frequency of very good functional outcome in comminuted fracture proximal humerus treated with PHILOS plating is 6.6%4, margin of error 4% and confidence interval 95%. The require sample size for this study 149.

Sample selection:

Inclusion Criteria:

- Patients of 18-60 years of age.

- Patients presenting with displaced proximal humerus fractures according to NEER two, three- and four-part fracture
- Patients with fracture dislocation of the shoulder.
- The ASA (American Society of Anesthesiology) class I &II.

Exclusion Criteria:

- Pathologic fractures in proximal humerus.
- Open fracture & Poly trauma.
- Revision of surgery or failure of conservative treatment.
- Four part fracture proximal humerus with neurovascular deficits
- Patients treated non-operatively for fracture proximal humerus that was not willing for surgery.

After permission from the ethical review committee and CPSP, total number of 149 patients who were presented to the emergency Department of Orthopedics, Bahawal Victoria Hospital, Bahawalpur, fulfilling the Inclusion criteria were selected. Informed written consent was taken from every patient. The demographic information (Name, Age, Sex and Address) was obtained and entered in the proforma.

Examinations of both the shoulders were done. Any Swelling, skin changes, tenderness, associated injury or fractures was noted. Radiographs antero-posterior (AP) and lateral view were taken of the affected shoulder. Blood routine investigations were done if required. Pre anesthetic checkup was done. The patients counseled and consent was taken for participation. In the operating room to start procedure under G/A on a fracture table, traction was applied under image intensifier to reduce the fracture. Proximal humerus Locking plate (PHILOS) was used in each patient. Plate of appropriate size was placed over the lateral surface of humerus about 1 cm distal to upper end of greater tuberosity by an orthopedic surgeon having more than 5 years post fellowship experience. Wound close in all layers after inserting the suction drain and dressing will be applied. Check x-ray (antero-posterior and axillary view) taken on 1st post-operative day and assessed the reduction of fracture fragments and position of implants. Stitches were removed on the 9th day. Active and passive exercises of the shoulder was done during the first three weeks, after which active range of motion of shoulder was started along with muscle strengthening exercises. All postoperative rehabilitation was done under the guidance of an experienced physiotherapist. Patients encouraged to do exercises at home and called for follow-up at six weeks, three months & four months. Phone numbers and addresses of all patients was taken for proper follow up. All the information such as age, sex, occupation, duration of injury, ASA class, side of fracture, duration of procedure, type of fracture and fracture outcome was recorded in a pre-designed Performa.(Annexure-I).

Data analysis was performed by using software SPSS v25.0. Such as Mean + standard deviation or median (I/Q) were reported for confirm variable such as age and duration of procedure and duration of injury. Normality of data was assessed by using shabirowilk test. Qualitative variables such as gender, place of resident, occupation, type of fracture, side of fracture, ASA class and functional outcome were reported as frequency and percentage.

Effect modifier such as age, gender, duration of injury, occupation, ASA class, site of fracture, type of fracture were controlled through stratification. Post stratification Chi square test or Fisher exact test was used. Taking P - Value less than 0.05 was considered to be statistically significant.

RESULTS

Out of 149 patients, 99 (66.44%) were males and 50 (33.56%) were females with male to female ratio of 2:1 as shown in figure I.

Age range in this study was from 18 to 60 years with mean age of 37.15 ± 7.41 years. Majority of the patients 79 (59.73%) were between 18 to 40 years of age. Mean duration of fracture was 5.77 ± 2.67 days. According to the ASA status, 92 (61.74%) patients had ASA class I and 57 (38.26%) patients had ASA class II. According to side affected, 91 (61.07%) patients had right side and 58 (38.93%) had left side. According to type of fractures, 70 (46.98%) patients had 2 parts, 57 (38.26%) and 22 (14.77%) had 3 and 4 parts respectively. (Table 1)

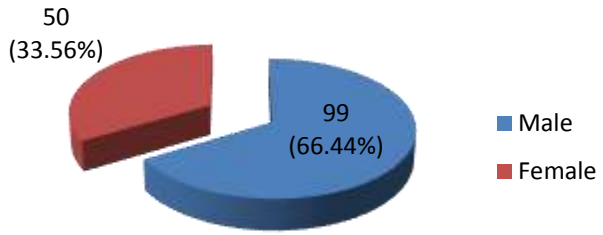

Figure 1: Distribution of patients according to gender (n=149).

Table 1: Baseline characteristics of all the patients

Variable	Category	Frequency (n)	Percentage (%)
Age Range	18 to 40 years	79	59.73
	41 to 60 years	53	40.27
Mean Age	-	37.15 ± 7.41	-
Duration of Fracture (days)	-	5.77 ± 2.67	-
ASA Class	Class I	92	61.74
	Class II	57	38.26
Side Affected	Right side	91	61.07
	Left side	58	38.93
Type of Fracture	2-part fracture	70	46.98
	3-part fracture	57	38.26
	4-part fracture	22	14.77

In this study, the excellent functional outcome was seen in 71 (47.65%) patients, very good in 14 (9.40%), good in 40 (26.85%) patients, fair in 15 (10.07%) and poor outcome in 09 (6.04%) patients (Table 2).

Table 2: Functional outcome of surgical management of comminuted proximal fractures of humerus treated with proximal humerus interlocking system (PHILOS) plate (n=149)

Functional Outcome	No. of patients	%age
Excellent	71	47.65
Very good	14	9.40
Good	40	26.85
Fair	15	10.07
Poor	09	6.04

n this study, the functional outcomes were categorized as excellent, very good, good, fair, and poor. The Chi-square test was conducted to analyze the relationship between these outcomes and several variables such as age, gender, ASA class, sides affected, and types of fractures.

Age: There was a significant difference in functional outcomes based on age groups. Younger patients (18–40 years) showed a better outcome (excellent and very good) compared to older age groups (41–60 years).

Gender: The results indicated no significant difference between male and female patients regarding their functional outcomes.

ASA Class: Patients with ASA class I had significantly better functional outcomes than those with ASA class II, suggesting that patients with fewer co-morbidities have better recovery after fractures.

Side Affected: The side of the body (right or left) had no significant impact on the functional outcomes, with similar distributions across both sides.
Type of Fracture: There was a statistically significant relationship between fracture type and functional outcomes. Patients with 2-part fractures had the best recovery, while those with 4-part fractures showed poorer outcomes.

Table 3: Stratification of functional outcomes with respect to age, gender, side, ASA class and types of fracture

Variable	Category	Functional Outcome	Chi-Square p-value
Age	18-40 years	Excellent: 50, Very Good: 10, Good: 10, Fair: 5, Poor: 4	0.03
	41-60 years	Excellent: 21, Very Good: 4, Good: 30, Fair: 10, Poor: 5	
Gender	Male	Excellent: 40, Very Good: 5, Good: 20, Fair: 10, Poor: 5	0.15
	Female	Excellent: 31, Very Good: 9, Good: 20, Fair: 5, Poor: 4	
ASA Class	Class I	Excellent: 60, Very Good: 12, Good: 15, Fair: 5, Poor: 0	0.01
	Class II	Excellent: 11, Very Good: 2, Good: 25, Fair: 10, Poor: 9	
Side Affected	Right Side	Excellent: 45, Very Good: 8, Good: 25, Fair: 8, Poor: 5	0.42
	Left Side	Excellent: 26, Very Good: 6, Good: 15, Fair: 7, Poor: 4	
Type of Fracture	2-part	Excellent: 40, Very Good: 10, Good: 15, Fair: 3, Poor: 2	0.02
	3-part	Excellent: 20, Very Good: 3, Good: 10, Fair: 5, Poor: 4	
	4-part	Excellent: 10, Very Good: 1, Good: 15, Fair: 7, Poor: 3	

Interpretation:
Age: The p-value of 0.03 suggests a statistically significant relationship between age and functional outcomes. Younger patients tend to have better functional outcomes.
Gender: The p-value of 0.15 indicates that there is no significant difference in functional outcomes between male and female patients.
ASA Class: A p-value of 0.01 indicates a significant relationship between ASA class and functional outcomes, with ASA class I patients performing better.
Side Affected: The p-value of 0.42 suggests that the side affected (right or left) does not significantly impact functional outcomes.
Type of Fracture: The p-value of 0.02 suggests a significant relationship between the type of fracture and functional outcomes, with 2-part fractures showing better recovery.

DISCUSSION

Many techniques have evolved over time to treat displaced or comminuted proximal humerus fractures. Percutaneous pinning and intramedullary nailing have been employed with generally satisfactory results and carry a low risk for infection, soft tissue disruption, and blood loss. However, many of these constructs are less stable than open reduction and internal fixation (ORIF) with locking plates.[11,12] Open reduction and internal fixation (ORIF) with locking plating is proving to be a promising option in the treatment of displaced, comminuted proximal humerus fractures. This approach offers several potential advantages compared with more traditional open techniques.[13,14] These benefits include improved fracture stability because of the fixed-angle construct, particularly in more comminuted fracture patterns and in osteoporotic bone; a short period of immobilization with the opportunity for earlier rehabilitation.[15]

We have conducted this study to assess the functional outcome of surgical management of comminuted proximal fractures of humerus treated with proximal humerus interlocking system (PHILOS) plate. In this study, the excellent functional outcome was seen in 71 (47.65%) patients, very good in 14 (9.40%), good in 40 (26.85%) patients, fair in 15 (10.07%) and poor outcome in 09 (6.04%) patients. As per grading of the constant score, the outcome previous studies showed, excellent (40%), very good (6.66%) good (30%) fair (20%) and poor (3.33%)[4].

Thyagarajan et al in their study on 30 patients reported an average Constant score of 57.5, with mean age of 58 years (range 19-92 years) and fractures were Neer's 2- part, 3-part, and 4-part fractures.[16] Aggarwal et al found moderate to excellent outcome in 90% of patients in their study. Constant score for younger patients was also significantly higher (p=0.12). The mean age of the patients was reported as 58.51 years (range 23-81 years) and fracture types were Neer 2-part, 3-part, and 4-part fractures and fracture dislocations.[17]

Rizwan Shahid et al[18] in their study reported that the results of PHILOS plating were equally good in all patients but functional outcome was better in younger age group. They reported that with associated dislocation the results were deteriorated. In one prospective study, mean constant score was 68.31 in 19 patients.[19] Kettler et al reported a Constant-Murley score between 52 to 72 points after ORIF with the PHILOS plate.[20] Hente et al reached a mean Constant-Murley score of 55 points in these specific fracture types, which was lower than for fractures without dislocation.[21]

Kulkarni S et al[22] in a prospective study found that out of 56 patients that were available for follow-up: 24 patients, according to the Constant Murley Score, have Excellent results in which 4 patients are Two part, 20 patients are Three-part fractures. 32 patients having Good results in which 22 are three part, 10 are Four-part fractures. None of the patients had fair or poor results.[22] However, the systematic review by Thanasis et al reported an overall Constant score of 74.3.[23] and most of other studies have reported good functional outcomes and recommended the use of locking plates for proximal humerus fractures especially in elderly patients with poor bone quality. This leads us to believe that application of locking plate technology for proximal humerus fractures has a steep learning curve and appropriate surgical technique is very important to achieve good functional outcome.

However, more recently Koukakis et al. published a series of 20 patients with two-, three-and four-part fractures treated with this plate and have shown no difference in functional outcome between younger (<65 years) and older (>65 years).[24] The recent evolution of locking plate technology for proximal humerus fractures seems to have revolutionized the management of these fractures. However there have been very limited prospective studies investigating the results of locking plates for open reduction and internal fixation of proximal humeral fractures.[25-27] Most of these studies have reported good functional outcomes and recommended the use of locking plates for proximal humerus fractures especially in elderly patients with poor bone quality.

Brunner et al. evaluated the incidence of complications and functional outcome after open reduction and internal fixation with PHILOS. Study was prospective, multicenter study between September 2002 to September 2005, with 158 fractures in 157 patients. They had primary screw perforation of 14% and secondary screw perforation of 8% and a vascular necrosis of humeral head 8%. They concluded that fixation with PHILOS plate preserves achieved reduction and a good functional outcome can be expected. More accurate screw length measurement and shorter screw selection should prevent primary screw perforation.[28]

Liu et al in 2010 concluded that treatment of proximal humeral fractures in elderly patients with application of PHILOS plate combined with injectable artificial bone as satisfactory, especially suitable for osteoporotic and comminuted proximal humeral fractures. They studied 17 patients from March 2007 to March 2009 with an average age 71 years (66 to 81). The clinical outcome was excellent in 9 patients, good in 6, moderate in 2 cases.[29] In a study carried out by Arumugam S et al satisfactory to excellent results were found in 76.7% of patients while poor results were found in 23.3% of the patients.[30]

The limitations of this study is that there is no control group in the present study; therefore, we cannot determine if another method of treatment would have led to different results. Longer follow up would help to determine the long-term outcome and complications using these locking plates for fixation of proximal humerus.

CONCLUSION

This study concluded that excellent functional outcome of surgical management of comminuted proximal fractures of humerus treated with proximal humerus interlocking system (PHILOS) plate is very high. So, we recommend that proximal humerus interlocking system (PHILOS) plate should be used as a first line treatment for treating these types of fractures in order to reduce the morbidity of these patients.

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