Proximal humeral internal locking system Plate in Proximal Humeral Fractures with and without Bone Graft

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Abstract

Objectives: This work was to compare functional shoulder recovery in proximal humeral fractures (PHFs) after fixation by PHILOS plate with versus without bone graft.

Background: PHFs are the 3rd highly occurred in elderly cases, and their management remains a challenge. The benefit of locking compression plate (LCP) offers positive outcomes for misplaced PHF. **Patients and Methods:** This every other case prospective research involved 34 patients with proximal humeral fractures. They were equally allocated into two groups. Group I: seventeen patients are only treated with a PHILOS plate, and Group II: seventeen patients are treated with a PHILOS plate and bone graft. Adult patients with comminuted, closed, 3 or 4 parts fractures were included, while patients with open, pathological, associated other upper limb fractures and rheumatoid patients were excluded. **Results:** Neck-shaft angle (NSA) was substantially greater in group II than in group I, although healing time was much shorter in group II than in group I. Group II had considerably greater active flexion, extension, internal rotation, external rotation, and abduction range of motion (ROM) following surgery than Group I. The function score was much higher in group II than in group I. In group, I, complications following surgery were substantially higher than in group II.

Conclusions: PHFs can be treated effectively with locking plate fixation in combination with bone graft. This surgical technique can result in satisfactory radiological and functional outcomes with an acceptable complication rate.

Keywords: Fracture, Graft, Humerus, Locked plate, Outcome.

Introduction:

Proximal humeral fractures (PHF) are the 3rd highly occurred in elderly cases (1), accounting for 5% to 6% of all elderly fractures (2). Low-energy injuries cause them, are closely linked to osteoporosis, and affect females two to three times more frequently than males (3), PHF includes all isolated or combined fractures of the surgical or anatomical neck, or greater (GT) or lesser tuberosity (4).

There are two classifications for PHF: the Neer and AO classifications, and the GT fracture classification (5). The diagnosis and treatment of PHF in elderly patients remain difficult and differs regarding clinical manifestations (6).

PHF treatment forms a major part of recent orthopedic trauma management (7). Although many may be treated with no surgical intervention, up to 20 % need surgical fixation to regain alignment and allow for early mobility (8, 9).

Locking-compression plate (LCP) benefit indicates favorable outcomes for osteoporotic PHF dislocation (10) and its mechanical benefit clearly appears in fracture stability enhancement because of the fixed angle design, i.e., the bone plate interface generates a "single-beam" construct, with no motion between separate portions, lead to enhanced resistance to withdrawal (11). Several approaches are recommended for combating varus collapse: bone grafting (either auto-or allow) (12, 13). Intramedullary nailing, especially inserting locking screws into the humeral head fragment inferior medial aspect, and calcium phosphate cement augmentation (14, 15). This study hypothesized that cases treated by open reduction and internal fixation (ORIF) with a PHILOS plate and bone grafting would have better results than patients treated with the same technique but without bone grafting.This research objected to comparing functional shoulder recovery in PHF after fixation by PHILOS plate with versus without bone graft.

Patients and Methods

This every other case prospective research involved 34 adult cases with 3 or 4 proximal humeral comminuted fracture attending to the orthopedic surgery department at Menoufia university hospital and Manshyt Elbakry general hospital from 2021 to 2023.

In all cases, informed permission was acquired, and the procedure is approved by the ethical committee.

Exclusion criteria include associated injuries especially scapula and clavicle, rheumatoid patients, open fracture, pathological fractures, associated neurovascular injury and extra fractures including wrist, elbow, hand.

Cases were allocated equally into two groups regarding method of orthopedic fixation they received. Group I was treated by ORIF using PHILOS plate and Group II was treated by the same method with bone grafting.

Medical history was taken from all patients and they underwent routine preoperative laboratory studies for proximal humerus fractures.

Operative technique was done following the basic AO principles of PHF fixation with PHILOS plate with bone graft and without.

The treatment was performed using a typical deltopectoral incision while the patient was in the beach-chair position. During surgery, this posture enhances shoulder mobilisation. Make a 12 to 14-centimeter-long skin incision between the proximal humeral shaft and the coracoid process, then expose the deltopectoral groove with the cephalic vein, retract the cephalic vein medially or laterally, and open along the groove (Figure.1)

Confirm the anatomical landmarks and expose the proximal humerus (lesser tuberosity, subscapularis tendon, greater tuberosity and bicipital groove with the biceps tendon). Expose the intraarticular side of the glenohumeral joint by incising the rotator interval at the subscapularis tendon upper border in the direction of the coracoid process. The biceps tendon was located and retracted, exposing the fracture between the tuberosities and behind the bicipital groove.

The reduction was checked by C-arm that was placed on the contralateral side by obtaining anteroposterior and lateral views to show Head shaft angle and PHILOS plate location, which should ideally be 5 to 8 mm below the larger tuberosity tip, then PHILOS plate was applied using a minimum of four proximal locking screws. (figure.2). In relation to Group II First, each patient was placed supine. The entire upper arm and the iliac donor site were disinfected. The iliac crest bone was first harvested from contralateral side. The iliac crest periosteum was incised, and the periosteal layer containing the iliac muscle was dissected medially bluntly. The skin over the iliac crest was stretched, and a 5cm incision was made parallel to the iliac crest, 2 cm beyond the anterior iliac spine. A 4-5 cm incision was made parallel to the iliac crest, and following subperiosteal stripping of the iliacus muscle, the muscle was withdrawn to reveal the ilium. Using an osteotome, a graft was produced; the wound was then closed in layers, and a pressure bandage was given to the region of the iliac crest, then the patient was turned to beach chair position for using deltopectoral approach.

There were visits at 2 and 6 weeks, and 3 months after surgery. Regular radiographs were done to monitor the location of the plate and the fracture healing. The shoulder range of motion (ROM) of the patient was recorded. The patients were assessed using the Constant shoulder score at 3 and 6 months postoperatively, when the fracture had purportedly healed and the rehabilitation regimen had been finished. ROM and Functional Results estimated through 100-point Penn shoulder score.

Statistical analysis was performed with SPSS v27 (IBM, Armonk, NY, USA). Using histograms and the Shapiro-Wilks test, the normality of data distribution was determined. The mean and standard deviation (SD) of parametric quantitative data were reported and compared using an unpaired student t-test. Using the Mann Whitney test to compare non-parametric quantitative data given as the median and interquartile range (IQR). Using the Chi-square test or Fisher's exact test to compare qualitative variables expressed as frequency and percentage (%). A two-tailed P value of 0.05 or below was considered significant.

Results

In terms of postoperative statistics, the neck-shaft angle (NSA) was substantially greater in group II than in group I ($p = 0.002$), and healing time was significantly shorter in group II than in group I ($p = 0.003$). There was no significant difference between the two groups in terms of kind of reduction and >5 mm reduction loss. (Table 1)

Regarding the Penn shoulder score, there was no significant difference between groups in terms of pain at rest, during usual activities, during intense activities, and overall pain. Also, there was no significant difference in the satisfaction scores of the two groups. In contrast, the function score in group II was considerably higher than in group I ($p = 0.003$). (Table.2)

Significantly more complications occurred in group I compared to group II ($p = 0.034$). (Table.3)

Discussion

In the present study, there was no significant variance regarding operative data (time from injury to surgery, operation time, and intraoperative bleeding) between the studied groups.

Xiaopeng et al demonstrated that there were no notable differences.in operative data among both groups (16).

Regarding postoperative data, NSA was much higher in group II than in group I. In group II, fracture healing was substantially faster than in group I.

Similarly, Xiaopeng et al observed that NSA was significantly increased in the bone graft group than group with no bone graft and time needed for fracture healing was significantly reduced in the bone graft group compared to group with no bone graft (16).

Lee et al. found that following surgery and at final follow-up, NSA improvements were much better in the FA group than in the LP group (17).

Our results are confirmed by Zhao et al as they revealed that the NSA was significantly reduced in PHILOS combined with fibular allograft group than PHILOS alone (18).

However, Kim et al observed that no variance among both groups as regard the NSA. The discrepancy may be due to the two different techniques used in their studies (19).

Regarding Penn shoulder score, there was no significant difference between the two groups in pain at rest, during routine activities, during vigorous activities, or in the total pain score. Also, there was no significant difference in the satisfaction scores of the two groups.

Kim et al demonstrated that there were no significant variance among both groups regarding VAS 1 year postoperatively (19).

Additionally, Zhao et al declared that the pain was not significantly different among both groups (18).

In contrast, Zhu et al, VAS was lower in the PHILOS with fibular allograft group than in the PHILOS group alone. (20).

Complications after operation were significantly enhanced in group II than group I.

Xiaopeng et al found that one case in the no bone graft group experienced humeral head aseptic necrosis and underwent second-stage shoulder replacement (16).

Zhao et al. observed that problems in the PHILOS with fibular allograft group were considerably lower than in the PHILOS alone group (18).

Limitations include that the last period of follow-up was quite brief to assess long-term problems. We excluded additional fractures involving elbow, wrist, hand and associated neurovascular injury, pathological fractures as well as open fractures. This research was limited by a small sample size that prevented the observation of the incidence of donor site morbidity secondary to iliac crest graft harvest.

Conclusions:

PHFs can be effectively treated with plate fixation and iliac crest bone graft.This surgical technique can result in satisfactory radiological and functional outcomes with an acceptable complication rate.

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Legends of figures
Figure.1 Surgical exposure of the proximal humeral shaft
Figure.2 PHILOS plate placement

Table 1: Postoperative data in the studied groups

		Group I (n =17)	Group II (n =17)	p value
Neck-shaft angle (degree)	Mean ± SD	115.29 ± 11.18	126.47 ± 7.87	0.002*
Fracture healing (week)	Mean ± SD	12.47 ± 2.18	9.94 ± 2.41	0.003*
Reduction	Anatomical reduction	12 (70.6%)	16 (94.1%)	0.185
	Acceptable reduction	4 (23.5%)	1 (5.9%)	
	Mal-reduction	1 (5.9%)	0 (0.0%)	
>5mm loss of reduction	Yes	5 (29.4%)	1 (5.9%)	0.175
	No	12 (70.6%)	16 (94.1%)	

Table 2: Penn shoulder score in the studied groups

		Group I (n =17)	Group II (n =17)	p value
Pain at rest	Median (IQR)	1 (1 - 2)	1 (0 - 2)	0.555
Pain with normal activities	Median (IQR)	2 (1 - 2)	2 (0 - 2)	0.348
Pain with strenuous activities	Median (IQR)	2 (2 - 3)	2 (2 - 3)	0.754
Total pain score	Median (IQR)	6 (5 - 7)	4 (4 - 6)	0.064
Satisfaction score	Median (IQR)	6 (5 - 7)	7 (6 - 8)	0.067
Function score	Median (IQR)	37 (36 - 38)	41.25 (40 - 44)	0.003*

Table 3: Complications in the studied groups

		Group I (n =17)	Group II (n =17)	p value
Complications	Avascular necrosis	7 (41.2%)	2 (11.8%)	0.034*
	Cut-out or back-out of the screws	1 (5.9%)	0 (0.0%)	
	Varus collapse	2 (11.8%)	0 (0.0%)	
	No complications	7 (41.2%)	15 (88.2%)	