CASE SERIES

Clinical and functional outcomes of displaced proximal humerus fractures treated with PHILOS plate system and autologous bone graft

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Abstract

This retrospective case series analyses the clinical and radiological outcomes of displaced proximal humerus fractures treated with PHILOS plate system and iliac crest bone autograft. Twenty-six patients with displaced fractures of proximal humerus, who were treated with PHILOS plate and autologous iliac crest bone grafts from January 2015 to September 2020, were included in this study. The inclusion criteria were proximal humerus fractures with displacement of more than 1cm and angulation of more than 45 degrees. The functional outcomes were evaluated using DASH and constant score. Radiological outcomes were measured by calculating the fracture union. The average age of the cohort was 47.28±13.69 years. Over all, the mean DASH score was 10.25 and constant score was 77.65 at three-year follow-up. The PHILOS plate with iliac crest bone autologous graft provides good radiological and functional outcomes, especially for the cases with bone defects and poor-bone stock.

Keywords: Proximal humerus, fracture, locking plate, bone graft, iliac crest bone, orthopaedics.

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Introduction

Literature suggests unfavourable and unpredictable results for fixing displaced fractures, especially in osteoporotic and comminuted fractures.[1] Various implants, including proximal humerus interlocking screw (PHILOS) plate, intramedullary (IM) nailing, minimally invasive screw or pins fixations, and arthroplasty, have been described previously. IM nail is best applicable for meta and diaphysis fractures where tuberosities are intact. In complex fractures, it may negatively affect the rotator cuff.[2] The primary arthroplasty is the most preferable option for fractures that devascularised the humeral head and reduction is not further possible.[3] The PHILOS plate has proven better than other non-locking implants in fractures where the joint can be saved. It was designed to provide angular stability with multiple locking screws and small holes to fix the rotator cuff with cerclage wire, especially in osteoporotic complex proximal humerus fractures.[4] However, there are some complications associated with PHILOS such as infections, subacromial impingement, screw cut out, avascular necrosis (AVN), and varus malunion.[5] Many additional techniques have also been introduced to decrease the rate of complication in fixing PHILOS plate for proximal humerus. One of them is the augmentation of iliac crest bone autologous graft with PHILOS plate. This can be an effective technique in terms of providing medial support and to deal with bone defects in complex fractures. Besides, it can also be used in osteoporotic humerus fractures where bone stock is limited.[6]

The purpose of this study was to present a retrospective analysis of radiological and clinical outcomes of displaced humerus fractures treated with PHILOS plate and iliac crest bone autograft.

Case Series

This retrospective case series was conducted at the Department of Trauma and Orthopaedics, AO Hospital, Karachi. The records of 26 patients with displaced fractures of proximal humerus who had been treated with PHILOS plate and iliac crest bone graft from January 15, 2015 to September 20, 2020 were extracted from the hospital's electronic data base. Fractures were classified according to Neer classification as displaced 2, 3, and 4 part fractures based on radiographs.[7] The inclusion criteria for the study were isolated displaced proximal humerus fractures with displacement more than 1 cm and angulation of more than 45 degrees; only skeletally mature patients were included. Autologous iliac crest bone graft was augmented to fill up the bone defects due to fracture. Exclusion criteria were pathological fracture of the proximal humerus, fracture with joint dislocation, full-thickness rotator cuff tear, and neurological disorders. All patients provided informed and publication consent before participation and permission letter was obtained from the hospital.

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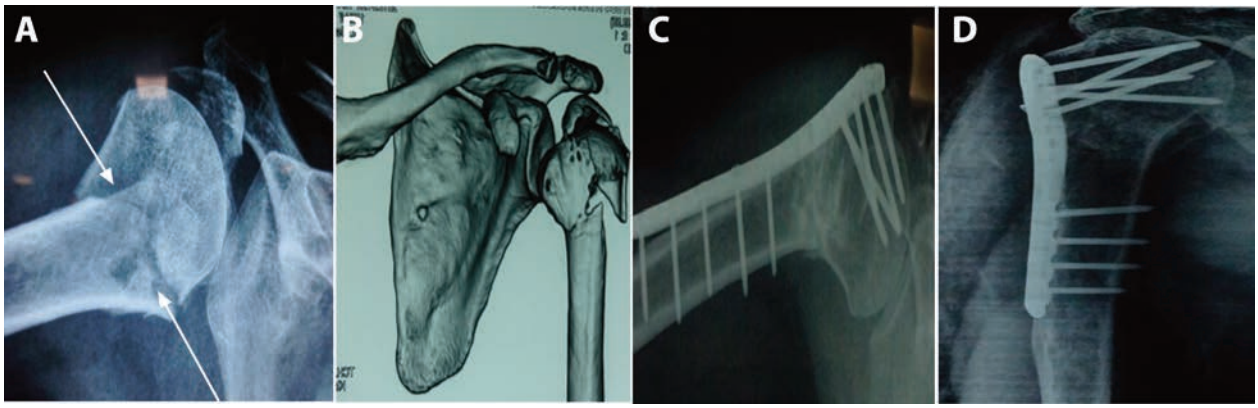

Figure-1: (A) Preoperative X-ray and CT scan of 35-year-old man who sustained displaced proximal humerus fracture after fall; (B) Post-operative radiographs; (C) after three months of surgery; and (D) at last follow-up after 5 years of PHILOS fixation.

Table: Patient Demographics (n=26).

Demographics	n (%)
Male	16(61.5)
Female	10(38.5)
Mean Age (years)	47.28±13.69
Fracture type	
Two-part	11(42.31)
Three-part	10(38.46)
Four-part	5(19.23)
Fracture union (weeks)	13.62±4.5
Follow up time (months)	36±5
Mean time from injury to surgery (weeks)	12.5±2.5
Acute (surgery within three weeks of injury)	15(57.60)
Delayed (surgery after three weeks of injury)	11(42.30)
Complications	
Varus malunion	2(7.69)
Delayed union	1(3.84)
Subacromial impingement	2(7.69)
Irritability at the donor site of autologous bone graft	2(7.69)

According to operative notes, preoperative workup and necessary haematological and radiological examination (Figure-1) were done in all patients. All surgeries were performed under general anaesthesia with endotracheal intubation. Broad-spectrum antibiotics were given to all patients postoperatively. The shoulder was immobilised in a sling for two weeks after surgery and after two weeks gentle shoulder exercises were commenced.

Functional assessment was done by Constant Murley[8] shoulder score and Quick Disability of the arm, shoulder, and hand (Quick DASH) score.[9] Follow-up was done at 3, 6 and 12 months, and 3 and 5 years postoperatively. Radiographs were taken at each follow-up to evaluate bone union and the time frame from injury to surgery was also noted. Pain intensity was measured by visual analogue scoring system and complications were also reported at each follow-up.

Results

Of the 26 patients, 16(61%) were males and 10 (39%) were females. The ratio of male to female acquiring humerus fractures was 2:1 in this study. The average ages for both males and females and other demographic information have been mentioned in Table.

At six-month follow-up, there was a significant improvement in Quick DASH score when compared with three-month score (p=0.03). Over all, the mean DASH score was 10.25 three years after surgery. The mean time from injury to surgery was 12.5 weeks. However, 15 patients had their fractures fixed in the acute phase (within three weeks) and 11 patients had fixation after three weeks of fracture. However, time frame from injury to surgery was not significantly associated with fracture union (p=1). Two-part fractures were most common and comprised 42.31% of total fractures as mentioned in table. The mean time for two-part fractures' union was 10.2 weeks, for three-part fractures 14.5 weeks, and 18.2 weeks for four-part fracture. Overall, all patients showed improvement at three months to a three-year interval when compared (p=0.01). The mean constant score at three-year follow-up was 77.65 as shown in Figure-2. The mean constant score is 60.3 for four-part fracture, 67.2 and 78.6 for three and two-part fractures, respectively. However, there is no significant association between fracture type and functional outcomes (p=0.38). The mean VAS score at six weeks postoperatively was 10.2 which decreased to 4.2 at five-year follow-up. All complications are listed in Table.

Discussion

Our findings suggested that PHILOS fixation with autologous bone graft gives satisfactory functional outcomes following displaced proximal humerus fractures. Many biomechanical studies have compared a locking plate with a non-locking plate and their efficacy in treating

Figure-2: Three-month follow-up after PHILOS plate fixation and showing satisfactory range of motion for shoulder flexion, abduction, internal rotation and an external rotation.

proximal humerus fractures.[4,5] It has been reported that the locking plate has significantly greater torsional and bending stability.[6] In the current analysis, only patients who had PHILOS fixation with autologous iliac crest bone graft were included. Only two varus malunions and one delayed union were observed. The case series of 82 patients presented by Erasmo R et al reported excellent functional outcomes for 8 patients, good for 52, moderate for 17 and poor for 5 patients.[10] In our series, the constant score improved with every follow-up. The average constant score was 77.65 at three-year follow-up and consistent afterward.

According to literature, the PHILOS plate cannot be considered a "gold standard" for proximal humerus fracture, but this is a reliable device to fix displaced humerus fractures. Despite the good functional outcomes, there was a high complication rate particularly AVN and varus positioning of the humeral head.[5,6] Furthermore, Plath et al compared PHILOS plate with locking nail in their randomised control trial (RCT) and reported that locking nail yielded similar functional outcomes as the PHILOS plate. However, there was a significantly lower rate of secondary complications like the loss of reduction and screw cut-out in the locking nail group.[11] In contrast, our analysis did not have any comparative group but also none of the patients reported a loss of reduction and screw cut-out. The results may be contradictory because of the use of autologous bone graft in our analysis that reduced implant-related complications reported in the RCT discussed above. In the present study, only the patients who had PHILOS fixation with iliac crest autologous bone graft were included. Earlier studies had reported the effectiveness of crest bone autologous graft in non-united, complex proximal humerus fractures.[6,12]

There are certain limitations to the present study. It involved only one type of implant. Therefore, our findings may not be applicable to other types of implants being used in clinical setting for proximal humerus fractures. In this study, all surgeries were performed by a single surgeon; therefore, it is hard to comment about the involvement of surgeon and surgical technique. Multicentre studies should be carried out to focus on long-term follow-ups, surgical techniques and different implants for fixation of proximal humerus displaced fracture.

Conclusion

PHILOS plate fixation with iliac crest bone autologous graft for displaced proximal humerus fracture is associated with acceptable functional outcomes and early fracture union. This can be considered a reliable procedure to reduce the risk of complications like varus malunion, non-union and AVN.

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Conflict of interest: None.

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