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## Fracture dislocation proximal humerus fixed by PHILOS plate: A case series

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### Abstract

Fracture dislocation of proximal humerus are a rare pathological entity in the field of orthopedic surgery. One of the most feared complications associated with proximal humerus is avascular necrosis (AVN). The literature does not contain clear, evidence-based guidelines for the surgical management. Patients were treated with open reduction and internal fixation (ORIF). The patients did not show any signs of AVN of the humeral head. Anatomical neck fractures of the humerus are uncommon injuries in the literature. Due to the poor vascularization and the absence of attachment to soft tissue, there is a significantly high risk of AVN associated with fracture dislocation of proximal humerus. The patients presented in our report was treated with ORIF since it allows preservation of the humeral head.

**Keywords:** Fracture dislocation, proximal humerus, orthopedic surgery

### Introduction

Anterior shoulder dislocations secondary to trauma are common injuries, with an incidence of around 40 per 100,000 persons in the USA [2]. Among the young active population, the recurrence risk approaches 90% [3]. Henceforth, early operative management of the dislocation is oriented towards the restoration of glenohumeral stability and decreasing the risk of future recurrence of dislocations to 6-23% [3, 4]. Therefore, anterior shoulder dislocation associated with fracture of proximal humerus secondary to trauma is not only a rare, but also a complicated injury. The literature describes various surgical methods for the management of such injuries; however, the nonsurgical management of such injuries is not recommended [5-7]. Open reduction and internal fixation (ORIF) as well as shoulder arthroplasty are the surgical treatment options for the management of dislocation of the shoulder with anatomical neck fracture [8, 9]. One of the most feared complications (regardless of the fixation technique) is avascular necrosis (AVN) of the humeral head since it is a poorly vascularized area [10, 11]. Schnetzke *et al.* [12] reported that late surgery (defined as surgery time >48 h after sustained trauma) along with substandard/suboptimal reduction of the fracture are associated with a significant risk of AVN of the humeral head. Subsequently, there is an increased chance for revision surgeries. Although ORIF is associated with a greater risk of AVN, it allows preservation of the humeral head. The rationale behind choosing ORIF as a surgical option for the management of shoulder dislocation with concomitant anatomical neck fracture is that the symptoms of AVN of the humeral head will present late since the glenohumeral joint is a non-weight-bearing joint. Moreover, even if AVN of the humeral head develops, the overall function of the shoulder will not be compromised [6, 13, 14]. On the other hand, certain orthopedic surgeons do not prefer ORIF for the management of such injuries. They debate that the fixation of the humeral head in the context of anatomical neck fracture is difficult to attain and secure since it is a cartilage shell associated with a thin layer of bone. Furthermore, they claim that the prolonged immobilization for adequate union is associated with increased risk of the development of a stiff shoulder. They assert that hemiarthroplasty provide a more successful rehabilitation and that range of motion can be initiated earlier than usual [1, 5, 15]. Consequently, the literature remains controversial regarding the optimal surgical management. Moreover, it is advised that the location, size, and site of fracture fragments be taken into consideration during decision-making for surgical management [5].

Preoperative computed tomography (CT) with 3D reconstruction provides a better visualization of the fracture pattern which reflects positively in the decision-making process and in preoperative planning [5]. Herein, we present the case of a 72-year-old male patient presenting with anterior fracture dislocation of the shoulder with anatomical neck fracture.

### Case Series

#### Case 1

A 72-year-old male, right-hand-dominant, presented to the emergency department in 2023 after sustaining a traumatic event to his right shoulder following alleged history of self-fall. Upon presentation, the patient was conscious and denied any sustained trauma to the head. He was supporting his right elbow with his left hand and any attempted movement of his right shoulder elicited severe pain. Physical examination revealed small, superficial abrasions on his right hemithorax and right shoulder areas. However, there were no open wounds. Moreover, swelling and ecchymoses were noted over the lateral aspect of his right shoulder. The neurovascular examination of the patient revealed non compromised vasculature as well as preserved motor strength and sensation in all four extremities. Radiographs of the right shoulder

showed an empty glenoid and anterior dislocation of the humerus with a fracture of its anatomical neck showing marked overriding of the fragments as well as lateral displacement.



**Fig 1:** Anteroposterior plain radiograph of the right shoulder showing an anteriorly dislocated shoulder associated with fracture of the anatomical neck of the humerus.



**Fig 2:** Postoperative radiograph of the right shoulder showing satisfactory reduction after open reduction and internal fixation.

#### Case 2

A 42-year-old male, right-hand-dominant, presented to the emergency department in 2023 after sustaining a traumatic event to his left shoulder following alleged history of RTA. Upon presentation, the patient was conscious and denied any sustained trauma to the head. He was supporting his right elbow with his left hand and any attempted movement of his right shoulder elicited severe pain. Physical examination revealed small, superficial abrasions on his left shoulder area

and ecchymosis over his deltoid area. However, there were no open wounds. Moreover, swelling was noted over the lateral aspect of his left shoulder. The neurovascular examination of the patient revealed non compromised vasculature as well as preserved motor strength and sensation in all four extremities. Radiographs of the left shoulder showed an empty glenoid and anterior dislocation of the humerus with a fracture of its anatomical neck showing marked overriding of the fragments as well as lateral displacement.



**Fig 3:** Anteroposterior plain radiograph of the left shoulder showing an anteriorly dislocated shoulder associated with fracture of proximal humerus.



**Fig 4:** Postoperative radiograph of the left shoulder showing satisfactory reduction after open reduction and internal fixation.

### Case 3

A 45-year-old female, right-hand-dominant, presented to the emergency department in 2023 after sustaining a traumatic event to her left shoulder following alleged history of self-fall. Upon presentation, the patient was conscious and denied any sustained trauma to the head. She was supporting his left elbow with his left hand and any attempted movement of his right shoulder elicited severe pain. Physical examination revealed no external injuries. There were no open wounds. No

swelling and ecchymoses were noted. The neurovascular examination of the patient revealed non compromised vasculature as well as preserved motor strength and sensation in all four extremities. Radiographs of the left shoulder showed an empty glenoid and anterior dislocation of the humerus with a fracture of its anatomical neck showing marked overriding of the fragments as well as lateral displacement.



**Fig 5:** Anteroposterior plain radiograph of the left shoulder showing an anteriorly dislocated shoulder associated with fracture of the anatomical neck of the humerus.



**Fig 6:** Postoperative radiograph of the left shoulder showing satisfactory reduction after open reduction and internal fixation.

#### Case 4

A 53-year-old male, right-hand-dominant, presented to the emergency department in 2023 after sustaining a traumatic event to his right shoulder following alleged history of self fall. Upon presentation, the patient was conscious and denied any sustained trauma to the head. He was supporting his right elbow with his left hand and any attempted movement of his right shoulder elicited severe pain. There was no external injuries or open wounds. Swelling and gross deformity was

noted over the lateral aspect of his right shoulder. The neurovascular examination of the patient revealed non compromised vasculature as well as preserved motor strength and sensation in all four extremities. Radiographs of the right shoulder showed an empty glenoid and anterior dislocation of the humerus with a fracture of its anatomical neck showing marked overriding of the fragments as well as lateral displacement.



**Fig 7:** Anteroposterior plain radiograph of the right shoulder showing an anteriorly dislocated shoulder associated with fracture of the anatomical neck of the humerus.



**Fig 8:** Postoperative radiograph of the right shoulder showing satisfactory reduction after open reduction and internal fixation.

### Case 5

A 55-year-old female, right-hand-dominant, presented to the emergency department in 2023 after sustaining a traumatic event to his right shoulder following alleged history of self fall. Upon presentation, the patient was conscious and denied any sustained trauma to the head. He was supporting his right elbow with his left hand and any attempted movement of his right shoulder elicited severe pain. There was no external injuries or open wounds. Swelling and gross deformity was

noted over the lateral aspect of his right shoulder. The neurovascular examination of the patient revealed non compromised vasculature as well as preserved motor strength and sensation in all four extremities. Radiographs of the right shoulder showed an empty glenoid and anterior dislocation of the humerus with a fracture of its anatomical neck showing marked overriding of the fragments as well as lateral displacement.



**Fig 9:** Anteroposterior plain radiograph of the right shoulder showing an anteriorly dislocated shoulder associated with fracture of the anatomical neck of the humerus.



**Fig 10:** Postoperative radiograph of the right shoulder showing satisfactory reduction after open reduction and internal fixation.

#### Case 6

A 84-year-old male, right-hand-dominant, presented to the emergency department in 2023 after sustaining a traumatic event to his both shoulders following alleged history of RTA. Upon presentation, the patient was conscious and denied any sustained trauma to the head. His both hands were supported by arm sling and any attempted movement of his both shoulders elicited severe pain. Physical examination revealed no external injuries over shoulder area but minor abrasions

were present over both palms. However, there were no open wounds. Moreover, swelling was noted over the lateral aspect of his both shoulders. The neurovascular examination of the patient revealed non compromised vasculature as well as preserved motor strength and sensation in all four extremities. Radiographs of the bilateral shoulder showed an empty glenoid and anterior dislocation of the humerus with a fracture of its anatomical neck showing marked overriding of the fragments as well as lateral displacement.



**Fig 11:** Anteroposterior plain radiograph of the both shoulders showing an anteriorly dislocated shoulder associated with fracture of the anatomical neck of the humerus.



**Fig 12:** Postoperative radiograph of the both shoulders showing satisfactory reduction after open reduction and internal fixation.

### Case 7

A 80-year-old female, right-hand-dominant, presented to the emergency department in 2023 after sustaining a traumatic event to her left shoulder following alleged history of self fall. Upon presentation, the patient was conscious and denied any sustained trauma to the head. He was supporting his left elbow with his left hand and any attempted movement of his right shoulder elicited severe pain. There was no external injuries or open wounds. Swelling and gross deformity was

noted over the lateral aspect of his right shoulder. The neurovascular examination of the patient revealed non compromised vasculature as well as preserved motor strength and sensation in all four extremities. Radiographs of the left shoulder showed an empty glenoid and anterior dislocation of the humerus with a fracture of its anatomical neck showing marked overriding of the fragments as well as lateral displacement.



**Fig 13:** Anteroposterior plain radiograph of the left shoulder showing an anteriorly dislocated shoulder associated with fracture of the anatomical neck of the humerus.



**Fig 14:** Postoperative radiograph of the left shoulder showing satisfactory reduction after open reduction and internal fixation.

### Surgical Technique

Under brachial plexus block, the patient was put in the beach chair position, strapped, and draped. The strategy was to relocate the humeral head with minimal dissection and in one piece if possible, with perfect anatomical reduction and stable fixation. Using the deltopectoral approach, the biceps was located and then a proximal tenotomy, closure to the labrum, from the glenoid was done. We identified the rotator interval and completely opened it without any damage to the subscapularis. Digital pressure over the anterior aspect of the humeral head was attempted to allow relocation, but without success. It was opted to avoid prolonged manipulation of the humeral due to the tenuous blood supply, so using the rotator cuff tear that was identified, a periosteal elevator (Cobb) was introduced into the glenohumeral joint. With gentle traction over the humerus distally and proximally with the periosteal elevator, reduction was achieved with the help of a bone holding forceps which was then temporarily fixed with two K-wires. Adequate reduction and alignment was seen on

axillary and lateral views. The plate was placed slightly lateral and posterior to the bicipital groove, and one screw was placed in the elongated hole to fix it such as to allow fine-tuning of the final position, 6 mm distal to the greater tuberosity tip, aligned properly over the shaft using two fingers. Through appropriate drill sleeve, 3.5-mm screws were inserted carefully to reach the subchondral bone without damaging the cartilage and after measuring appropriate length. The K-wires were removed. The screws were inserted in multiple directions and tenodesis of the biceps was done while as rotator cuff tear was identified and repaired using two anchors with restoration of anatomical coverage of the humeral head (Fig. 5). The operation time was approximately 1 h and 20 min with an estimated blood loss of <250mL. The postoperative hospital course was uneventful and the drain was removed on postoperative day 2. The patient was discharged on day 3 to be followed up by his orthopedic surgeon as an outpatient.



## Discussion

Fracture dislocation of proximal humerus are infrequently reported injuries in the literature [17]. Henceforth, the literature does not contain clear, evidence-based guidelines for the surgical approach and operative management of such injuries. Since they are rare injuries, the diagnosis may be delayed or even missed. Moreover, dislocation of the glenohumeral joint with anatomical neck fracture is associated with a significantly high risk of AVN due to its poor vascularity. Hence, it is crucial for surgical intervention to be performed as early as possible.

These fractures are difficult to manage conservatively owing to their anatomical location which renders bracing, ineffective. Surgical options like percutaneous K wires are associated with less soft tissue damage, less blood loss and neurovascular injury. But these techniques do not ensure stable anatomical reduction and hinders early mobilization and fracture healing. Moreover, complications like pin tract infection and delayed mobilization, further curtails the indications for this procedure.

Early and correct diagnosis is important to prevent any delay in management. Neer [18] suggested that direct open reduction be favored over closed reduction to prevent further damage to the already compromised vascularity of the humeral head. The case presented in this study involved a 72-year-old male patient with an anteriorly dislocated glenohumeral joint associated with a laterally displaced fracture of the anatomical neck of the humerus. Time to surgery is of critical importance and early operative management of anatomical neck fracture of the humerus is associated with a significantly lower risk of AVN [12]. Delayed surgery leads to difficulty in the reduction of the fracture, increases the risk of AVN, and increases the risk of instability for secondary surgery [19]. Moreover, delay in diagnosis or misdiagnosis of

anatomical neck fracture of the humerus can also be due to inadequate imaging [1]. In our case, X-rays of the right shoulder were obtained in the anteroposterior, lateral. Preoperative CT is advised since it allows for better visualization of the fracture pattern, thus leading to a more accurate diagnosis. Moreover, CT helps in the decision-making process of choosing the adequate surgical approach. In the case of our patient, CT confirmed the X-ray result, showing a comminuted displaced fracture of the anatomical neck of the right humerus associated with an anteriorly dislocated shoulder. As for the surgical management, the patient underwent ORIF. ORIF is associated with an increased risk of AVN; however, this surgical approach allows preservation of the humeral head.

There are few complications like plate breakage, screw cut out, avascular necrosis, varusmal reduction and revision surgery associated with the use of locking plates [20, 21]. Owseley KC and Gorczyca JT in their series of 53 patients had a screw cut out rate of 23% [22]. They also stated that screw cut out is one of the most common reasons for revision surgery. The rate of screw cut out in the present study was 0%. This failure can be attributed to majority of the patients in elderly age group with osteoporotic bones.

Fracture geometry also plays an important role in the final outcome. Hertel R *et al.*, in their series of 100 patients with intracapsular humerus fracture assessed the perfusion with the help of Doppler study [23]. They developed a binary description system and concluded that anatomical neck fracture, shorter calcar and disruption of the posteromedial hinge when present together has a positive predictive value for ischaemia of 97%. Avascular necrosis is another but

delayed complication which occurs in three and four part fractures with severe comminution. It usually occurs years after the fixation and can cause poor functional outcomes [24, 25]. Still, there are few series which shows favourable outcomes inspite of avascular necrosis [26]. There was no case of avascular necrosis encountered in the present study. Short term follow up can be one of the reasons that this complication was not seen.

Reduction of the fracture is of paramount importance in any surgery which holds true even for proximal humerus fractures. Varusreduction is one of the serious intraoperative complications which are unacceptable as it leads to early failure in most of the cases. In the present study, difficulty in reduction was encountered in 3.77% cases which lead to varus collapse. These cases were revised with hemiarthroplasty due to severe osteoporosis. In our experience, patients with two part fractures did well as compared to three and four part fracture cases. Although, many people state that the results of hemiarthroplasty in three and four part fractures are superior to plating, recent meta-analysis deny the same [26].

Proper placement of the plate is equally important for a superior outcome in these fractures. These plates, unlike non-locking plates, are anatomically pre-countoured and thus even a slight displacement can result in shoulder impingement. The ideal position of the upper most extent of the plate is 5 mm-8 mm distal to the greater tuberosity as per the AO-OTA principles. There have been cases with shoulder impingement varying from 1.8%-8% in the literature [27-31]. In contrast to the aforementioned studies, there were no cases of impingement found in the present study, which was highly statistically significant.

The average time for radiological union was 12±4.5 weeks which is comparable to the previous studies [21]. Final results were compared with the study by Neer [32], using the Neer's scoring system which was statistically significant ( $p < 0.05$ ).

## Conclusion

Fracture dislocation of the proximal humerus is a rare entity that is very challenging technically in old patients. It is vital to do the surgery as soon as possible after initial trauma for the best results. Intraoperatively careful manipulation of the humeral head is key for proper alignment and reduction with minimal disruption of vascularity while achieving rigid fixation. We present this case series to show our management of such a difficult fracture and the ensuing excellent results on follow-up.

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## Author's Contribution

Not available.

## Conflict of Interest

Not available.

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