

Result of proximal humerus fracture fixation in adults - A prospective study of 31 cases.

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Citation this Article: Dr. Krishnakumar Ashwin, Dr. Parag M Tank, Dr. Harsh N Patel, Dr. Kushal Upadhyay, Dr. Dhaval V Patel, “Result of proximal humerus fracture fixation in adults - A prospective study of 31 cases”, IJMSIR- May - 2022, Vol – 7, Issue - 3, P. No. 318 – 324.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

Most proximal humerus fractures are low-grade osteoporotic injuries with higher incidence in elderly population. Open reduction internal fixation in the appropriate patient utilizing proper surgical techniques gives excellent results. Complete surgical indications are rare and include compound, pathological, multi-fragmentary head-splitting fractures and fracture dislocations, as well as those associated with neurovascular injury. A growing range of reconstruction and flexibility options has been expanding the indications for surgical management of proximal humerus fractures. As a result, management decisions become even more difficult, in an effort to provide the best possible treatment for each patient, which will effectively address the configuration of a specific fracture, comorbidities and functional expectations.

Method: 31 patients (mean age 47.87 years) with proximal humeral fracture were treated with open reduction and internal fixation with a locking proximal humeral plate or cannulated cancellous screws. Follow

up examination of the patients were done at the end of third month, sixth month, and one-year. Patients were assessed with regard to pain, shoulder mobility, and rate of union. The Constant score was determined at each follow up.

Result: Mean range of motion and Mean Constant score increased gradually from third month follow up to one year follow up. Mean constant score was 81 in 2-part type Neer classification whereas it was 72 and 58.6 in 3 part and 4-part fracture pattern respectively. Four patients (12.90%) encountered complications post-surgery.

Conclusion: Open reduction internal fixation with the use of locking proximal humeral plate and cannulated cancellous screws in the displaced proximal humeral fractures can lead to a good functional outcome provided that the correct surgical technique is used.

Keywords: Proximal humerus fracture, Neer classification, Open reduction internal fixation, Locking plates, Cannulated cancellous screws, Constant score

Introduction

Proximal humeral fractures are the second most common fractures of the upper extremity accounting for 4% to 5% of all fractures.¹ More than 70% of patients with these fractures are older than sixty years of age and it is the third most common fracture in this age group², and 75% are women³. In the elderly population, most of these fractures are related to osteoporosis and are usually associated with the trivial trauma. Simple fractures with minimal displacement and adequate stability can be treated nonoperatively. In contrast, the treatment of displaced and unstable fractures remains controversial. Internal fixation has led to unpredictable results, especially in patients with osteoporotic bone and those with comminuted fractures. A variety of treatment techniques has been proposed, including open reduction and internal fixation with proximal humeral plates, hemiarthroplasty, and percutaneous or minimally invasive techniques such as pinning, screw osteosynthesis, and the use of intramedullary nails. However, several complications have been described in association with these techniques, including implant failure, loss of reduction, non-union or malunion of the fracture, impingement syndrome, and osteonecrosis of the humeral head. Conservative treatment with short immobilization and early physiotherapy is a non-invasive, simple, and safe option, and acceptable results after nonoperative treatment have been reported. Nonsurgical options focus on early functional exercises with the goal of achieving a functionally acceptable range of motion. Various methods of internal fixation using k wires⁴ and screws, blade plates, external fixators, T-plates, intramedullary devices, locking compression plates and shoulder arthroplasty have been reported but none of these methods has been consistently successful.

For full functional recovery anatomical reduction, stable fixation and early mobilization are required. Extensive exposure and the insertion of implants increase the risk of the development of AVN⁵ and limited exposure and dissection of the soft tissues at the fracture site with minimal internal fixation have been recommended.

The mode of intervention of proximal humerus fractures is predicated on the ability of the operating surgeon to identify nature of the injury in a timely and accurate fashion and have a complete and thorough understanding of the fracture pattern. Apart from mode of injury and physical examination, radiograph imaging remains the mainstay of diagnosis which gives assessment of alignment, comminution, and bone quality and a basic understanding of the fracture planes involved within the articular segment. A plain radiograph trauma series of the shoulder, including an AP, scapular Y, and axillary lateral, is an appropriate first and, possibly, definitive imaging of these images⁶. For more detailed understanding of the fracture pattern, CT scans of the patients were taken. The objective of the study was to evaluate the functional outcome after internal fixation of proximal humeral fractures with the Locking proximal humeral plate or cancellous cannulated screw.

Material and Method

This study was conducted at Smt. Shardaben General Hospital, Ahmedabad, after gaining approval from the institutional review board. Before the inclusion in the study, the patients were informed and consents were obtained in the local languages. Thirty-one patients had been selected for this study, who had been admitted and treated in the orthopaedic ward of the hospital. Skeletally matured patients with the fractures having tuberosity displacement of greater than 5 mm, articular fracture with displacement more than 2 mm, displaced surgical neck

and fractures with large varus or valgus deformity were included for open reduction internal fixation after achieving proper consent. Patients with significant head split and major articular fractures were excluded from the study. The exclusion criteria included open fracture, pathological fracture or refracture, pseudarthrosis, previous operative treatment of the proximal part of the humerus and concomitant ipsilateral fracture of the distal part of the humerus or the elbow joint. The fracture pattern was classified based on the Neer classification of proximal humerus fractures⁷

Operative Technique: Surgery was commenced by keeping the patient in the beach-chair position or supine position on a radiolucent operating table and using a deltopectoral or deltoid-splitting surgical approach according to the preference of the surgeon. The fracture was then reduced and stabilized temporarily with Kirschner wires. This adequate reduction was then confirmed with the use of image intensifier C- arm. The Locking Proximal Humerus Plate (Fig 1 & 2) was positioned at least 5 to 7 mm distal to the proximal end of the greater tuberosity of humerus and just 2 mm posterior to the bicipital groove, while making sure that an adequate gap is present between the plate and the tendon of the long head of the biceps muscle. When fracture reduction and screw positioning were found to be adequate, definitive fixation was done with the insertion of angular screws into the humeral head. The decision regarding the use of angular stable locking or standard cortical screws for the humeral shaft holes were left to the discretion of the treating surgeon. A final image intensifier image was taken to verify correct screw placement and to make sure there was no joint penetration by the screws.

In case two part isolated tuberosity fractures, using the same approaches as mentioned above, cannulated cancellous screws with or without washer were used to bring about the anatomical reduction (Fig 3 & 4).

Postoperatively, the arm was immobilized in a sling and passive range-of-motion exercises were started within 36 – 48 hours after surgery. Firstly, patient was started on pendulum exercises followed by Controlled active mobilization with abduction and flexion beyond 90° was started one to three weeks post-operatively, depending on the stability of the osteosynthesis and the bone quality. All the patients were evaluated clinically and radiologically at three, six and one year follow up. All the patients were evaluated with the Constant score⁸.

Results & Discussion

The incidence of proximal humerus fractures is observed to be higher in the elderly population, in a study by Court Brown et al⁹, it is shown that only one-fifth of the patients treated for proximal humerus fractures occurred in the age group of above 50 years age. In the study, there were 15 patients in the above 50 age group. This is also due to the fact, that many elderly patients were not treated operatively.

31 patients with an acute unstable proximal humeral fracture were included in the study and were managed with open reduction and internal fixation in which 27 patients (87%) were treated with a Locking Proximal Humerus Plate and remaining 4 patients (13%) were treated with cannulated cancellous screws. The mean age of all patients was 47.87 years. The patients included 10 women (32.3%) and 21 men (67.7%). The proximal humeral fracture was caused by a low-energy injury in fourteen patients (45.1%) and by a high-energy injury in seventeen patients (54.8%). The distribution of fracture types according to the Neer classification system is

shown in table 1. The average time from the injury to surgery was 5 days. The deltopectoral approach was used in twenty-three patients (74.2%), whereas the deltoid-splitting approach was used in eight patients (25.8%). There was no significant difference between the two approaches with respect to functional outcome or complication rates. There were two patient (6.4%) with early post operative infection which was resolved with debridement and intravenous antibiotics. Rate of radiological union is shown in table 2.

The average clinical result obtained in the study, with a mean Constant score of 76.77 points is satisfactory, shown in table 3. The score was better in younger patients with better bone quality and less severe fractures. These patients were seen to resume their daily routine activities with limited complaints. It was noted that with early mobilization and an early resumption of daily physical activities were factors leading to a better functional outcome. It was also noted in our study that anatomical reduction of all fracture fragments and tuberosities is very important for providing good results and for reduction of complications. It was noted that poor functional outcome is more in elderly patients as seen in table 3.

A 2006 prospective study reported an average Constant score of 72.4 points using cloverleaf plates, and 59% of the treated patients achieved good or very good results¹⁰. Paavolainen et al¹¹ reported satisfactory results in 74.2% of their 41 patients with severe proximal humerus fractures treated with plate and screw devices Kohler et al achieved good results using the Neer score in 95% of the cases with a clink plate¹². With the exclusive use of Kirschner wires, good results have likewise been reported.

Comparable studies of internal fixation of Proximal humerus fractures demonstrate similar short term results. Although the follow-up period of 31 patients was short, studies have shown that early function is comparable to the final long term outcome. The outcome seems to be correlating with fracture severity, anatomic reduction, aetiology, bone quality, length of time elapsed from injury to surgery, concomitant injuries and the exact positioning and fixation of the implant¹³. In the study, it was observed that the majority of the two and three-part fractures occurred in the elderly population and it was noted that age was a good indicator of the functional prognosis. There was a higher degree of complications seen in these patients especially related to pain and stiffness. This was due to the failure of following physiotherapy protocol and improper follow-up visits. We had compared our results with other published studies as well, and results were found to be comparable and consistent as seen in table 4. The studies compared were that of Kettler¹⁴ et al and Lill et al¹⁵ who studied the functional outcomes in patients treated with angle stable humerus plates and derived a mean constant score of 70 points 73 points respectively. In another study by Kollig et al¹⁶ in which the used implants were T- plate screws and k wires showed a mean constant score of 72.1.

Tables

Table 1: The distribution of fracture types according to the Neer classification system

Type of fracture according to NEER’s classification	Number of patients
Two part- surgical neck	16
Two part – greater tuberosity	3
Two part -lesser tuberosity	1
Three-part fracture	8
Four-part fracture	3

Table 2: Time taken for radiological union

Weeks	Radiological union	
	Number	Percentage
8	0	0 %
9	16	52%
10	6	19%
11	4	13%
12	3	10%
13	2	6%

Table 3: constant score vs age distribution

Age distribution	Mean Constant Score	N Number
21 – 40 years	84	13
41 – 60 years	75.5	12
>60 >60 years	65	6

Table 4: comparison of results with other studies.

Conclusion

The treatment of complex humeral 3- or 4-part fractures can be very challenging. The surgeon is required to achieve an exact anatomical reduction and a stable fixation, along with the reduction of the risk of avascular head necrosis by maximal conservation of the periarticular soft tissues. An in-depth knowledge of the soft tissue and bone is a very important pre-requisite for the operating surgeon. The poor results in these complex fractures are often observed as a result of inadequate fracture reduction especially of the tuberosities, unstable fixation or incorrect positioning of the fixation devices . Early functional rehabilitation of the shoulder also plays a very important role. In recent years, rigid internal fixation have been increasingly used in the operative care of proximal humeral fractures. It was hoped that these implants despite an early and secure functional postoperative therapy, would reduce the risk of

secondary reduction loss, in particular in elderly patients with osteoporotic bone.

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Legend Figures

Fig 1: Pre-operative X-ray of a 2-part proximal humerus fracture.



Fig 2: Post-operative X-ray treated with proximal humerus locking plate.



Fig 3: Pre-operative X-ray of isolated greater tuberosity fracture of proximal humerus.



Fig 4: Post operative X-ray treated with cannulated cancellous screws

