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Original Research Article

Functional Outcome with Different Modalities in Fixation of Proximal Humerus Shaft Fractures: A Comparative Study

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Abstract

Aim: The aim of the present study was to assess and compare the functional outcome with different modalities in fixation of proximal humerus shaft fractures.

Methods: The present prospective study was conducted in the Department of Orthopaedics, PMCH, Patna for a period of 3 years. In the present study conducted at a tertiary care hospital for two years a total of 50 cases who fulfilled the inclusion criteria were enrolled.

Results: 46% of the cases were between 41-60 years with 32% between <18-40 years and 22% of cases >60 years of age. The age range was from 19 to 68 years with a mean age of 48.2 years. 52% of cases were females and 48% were males. 64% of the cases sustained fracture on the left side and 36% on right side. 84% of fractures were of closed type and 16% were open. As per Neer's type of fracture classification, the most common type of fracture observed in our study cases was two-part fracture accounting to 40% of cases followed in order by three part (26%), four part observed in 24% of cases. 5 cases (10%) had fracture dislocation. Road traffic injury was the most common mechanism for injury in 60% of cases and next was a history of fall in 32% of cases and one case was electric shock and other was hit by an iron rod. 23 cases (46%) were managed by open reduction and internal fixation with locking compression plate using 4.5 mm cortical screw plates and 6.5 mm cancellous screws. Percutaneous pinning was done in 10 cases (20%). Open reduction with K-wire was done in 6 cases (12%) and open reduction with K-wire and cancellous screws in 3 cases (6%). Closed reduction with intramedullary nailing was done in 4 cases (8%). The mean scores observed on Neer's score were pain (34.6 units), function (23.5 units), range of motion (16.55 units) and anatomy (6.9 units).

Conclusion: The present study concluded that good surgical skills, surgeons experience in selection of the type of surgery depending upon the factors like type of fracture are necessary to achieve correct and best outcome. Clinical evaluation, obtaining proper radiological views, age of the patient and activity holds the key for realistic approach and surgical management of complex humerus fractures.

Keywords: Neer's Score, Humerus Fracture, Range Of Motion, Functional Outcome.

Introduction

Proximal humerus fractures are one of the commonest fractures encountered in an orthopaedic practice. They account for nearly 6-10% and may be on a rise. They are the third most common osteoporotic fracture after distal radius and vertebra. The distribution of humeral fracture according to age is typical with high velocity trauma being the common cause among young individuals and a simple fall in older individuals because of osteoporosis. [1]

Proximal humerus fractures comprise almost 5.7% of all fractures and represent the most common humerus fractures (80%). In addition, proximal humeral fractures (PHFs) are the third most common fracture in geriatric patients, typically associated with systemic osteoporosis. Their incidence is expected to triple over the coming three decades. [2,3] The non-surgical treatment is the most common; 20% of these fractures need Surgical treatment due to increasing complications with the patient's age. Open reduction and fixation with locking plates are the most common interventions for displaced proximal humerus fractures. However, other options exist, such as closed reduction and percutaneous pinning, proximal humeral interlocking nailing, and primary hemiarthroplasty of the shoulder. [4]

Majority of these fractures are stable, minimally displaced or nondisplaced and mostly managed by nonoperative techniques like immobilization, splints and casts etc. However, these techniques are associated with complications and disabilities like avascular necrosis, nonunion and malunion. [5] Treatment of proximal humerus fracture has been the subject of much controversy and confusion. This is because of the complexity of these injuries, fracture displacements without careful radiographic views and associated soft tissue injuries. [5] This is because of the complexity of these injuries, fracture displacements without careful radiographic views and associated soft tissue injuries. Further, there has always been diversity of opinion about the care of shoulder fractures, with frequent controversies and lively debate.

With increase in the incidence of upper humerus fractures and advances in the techniques of surgery most of the surgeons prefer an operative management than conservative management. The various surgical modalities used are transosseous suture fixation, closed reduction and percutaneous fixation, open reduction and internal fixation with conventional plates, locking plate fixation and hemiarthroplasty which have shown to have mixed results. There is a significant heterogeneity among the studies in describing the best surgical procedure in proximal humerus fracture. [6] The present aim of the study is to study the occurrence, mechanism of injury and displacement of various types of fracture according to Neer's score system.

The aim of the present study was to assess and compare the functional outcome with different modalities in fixation of proximal humerus shaft fractures.

Materials and Methods

The present prospective study was conducted in the Department of Orthopaedics, PMCH, Patna for a period of 3 years. In the present study conducted at a tertiary care hospital for two years a total of 50 cases who fulfilled the inclusion criteria were enrolled.The entire study was conducted as per the guidelines of the committee. The study participants were informed about the study details and informed written consent was obtained from them. The history of injury of the participants, general condition and any associated soft tissue injury were evaluated. The severity of the injury was assessed to assess local injury and axillary nerve was assessed by examining any anaesthetic patch over lateral aspect of the shoulder.

Inclusion Criteria

All the cases with proximal humerus fractures above 18 years of age and consenting for the study were included. [Neer's classification: grade 2 to Grade 4]. [7]

Exclusion Criteria

Cases with Pathological fractures, with distal neuro vascular deficit, poly trauma patients with injury severity score >16, shaft humerus fractures with proximal extension.

Radiological evaluation of all the included cases were done as per the Neer's trauma series which include, AP view of the scapula, lateral "Y" view of the scapula, axillary view and occasionally the velpeau view was taken.

All the routine surgical investigations were done on the included cases and anaesthetic fitness was also evaluated. The modality of the treatment was decided based upon the following factors: Neer's classification [grade 2 to grade 4]; presence of humeral head dislocation and comminution; valgus impaction, quality of bone, open or compound fracture and age of the patient. General anaesthesia was used in all the patients. One of the following methods was used as treatment in all the cases.

- Closed reduction and percutaneous K-wires fixation.
- Open reduction and Internal fixation with K - wire.
- Open reduction and internal fixation with ethibond sutures.
- Open reduction and internal fixation with locking compression plates.
- Closed reduction and internal fixation by Intramedullary nail.
- Shoulder hemiarthroplasty.

Postoperative Care and Follow-Up

The operated limb was immobilized in arm pouch and mobilization was started in 2nd week with shoulder wheel exercises as per patient's tolerance. Post-operative radiological evaluation was done to assess reduction and stability of fixation. Gentle passive forward flexion and internal and external rotation exercises by end of 3rd week and active exercises by 4th to 6th week were done. Patients were followed on OPD basis at the end of 6 weeks to one year and full functional evaluation with range of movements and function was assessed and recorded. Results were evaluated for each case based on Neer's shoulder score based on pain, function, range of motion and anatomy. The maximum points are 100 and on overall score the patient's outcome was grouped as excellent >89 units; satisfactory 80-89 units; unsatisfactory 70-79 units and failure <70 units.

The data was analysed using microsoft excel and presented in number and percentages.

Results

Table 1: Demographic data among the cases in the study

Distribution of cases	N	%
Age wise (years)		
≤18-40	16	32
41-60	23	46
>61	11	22
Gender		
Male	24	48
Female	26	52
Side of fracture		
Right	18	36
Left	32	64
Type of fracture		
Closed	42	84
Open	8	16
Neers's type of fracture		
2 part	20	40
3 part	13	26
4 part	12	24
Fracture with dislocation	5	10
Cause of injury		
Road traffic accident	30	60
Fall	16	32
Others	4	8

46% of the cases were between 41-60 years with 32% between <18-40 years and 22% of cases >60 years of age. The age range was from 19 to 68 years with a mean age of 48.2 years. 52% of cases were females and 48% were males. 64% of the cases sustained fracture on the left side and 36% on right side. 84% of fractures were of closed type and 16% were open. As per Neer's type of fracture classification, the most common type of fracture observed in our study cases was two-part fracture accounting to 40% of cases followed in order by three part (26%), four part observed in 24% of cases. 5 cases (10%) had fracture dislocation. Road traffic injury was the most common mechanism for injury in 60% of cases and next was a history of fall in 32% of cases and one case was electric shock and other was hit by an iron rod.

Table 2: Distribution of surgical management among the cases in the study

Surgical treatment	N	%
ORIF with LCP	23	46
ORIF with K-wire	6	12
ORIF with K-wire andcancellous screws	3	6
Percutaneous pinning	10	20
Shoulder hemiarthroplasty	2	4
CRIF with intramedullarynailing	4	8
ORIF with ethibond suture	2	4

23 cases (46%) were managed by open reduction and internal fixation with locking compression plate using 4.5 mm cortical screw plates and 6.5 mm cancellous screws. Percutaneous pinning was done in 10 cases (20%). Open reduction with K-wire was done in 6 cases (12%) and open reduction with K-wire and cancellous screws in 3 cases (6%). Closed reduction with intramedullary nailing was done in 4 cases (8%).

Table 3: Distribution of clinical and radiological union among the cases in the study

Distribution of cases	N	%
Clinical union (in weeks)		
11	2	4
12	25	50
13	6	12
14	12	24
15	5	10
Radiological union (in weeks)		
16-18	36	72
19-20	10	20
>20	4	8

Clinical union was observed in 50% of cases by 12 weeks and the average time taken was 13.7 weeks.72% of cases (36/50) developed radiological union between 16-18 weeks and the average time was 17.93 weeks.

Table 4: Distribution of Neer's score of cases and result in the study

Neer's score	1st week (%)	4th week (%)	8th week (%)	Final (%)	Result
<70	50 (100)	36 (72)	6 (12)	2 (4)	Failure
70-79	0	14 (28)	5 (10)	3 (6)	Unsatisfactory
80-89	0	0	36 (72)	6 (12)	Satisfactory
>90	0	0	3 (6)	38 (76)	Excellent

In the present study, Neer's score was done on patient every 1st week, 4th week, 8th week and finally at 14th week. All the cases (50/50) had score <70 during 1st week, 36 cases (72%) in 4th week, 6 cases (12%) in 8th week and 2 cases (4%) in 14th final week which was considered as a failure outcome in our study as per Neer's criteria. In 4th week, 14 cases (28%) had score between 70-79, 5 cases (10%) in 8th week and only 3 cases (6%) in final 14th week which was considered as unsatisfactory outcome. 80-89 score was observed in 36 cases (72%) in 8th week and 6 cases (12%) in 14th week which was considered as satisfactory outcome. >90% score was observed in 3 case (6%) in 8th week and 38 cases (76%) at the final 14th week which was considered as an excellent outcome in the study.

Table 5: Average score of pain, function, ROM and anatomy of cases in the study

Modalities	Min-max	Mean	Median	SD
Pain	29-35	34.6	35	1.68
Function	12-30	23.5	24	3.7
Range ofMotion	14-19	16.55	16	1.88
Anatomy	4-10	6.9	8	1.70
Total	59-90	79.65	82	7.63

The mean scores observed on Neer's score were pain (34.6 units), function (23.5 units), range of motion (16.55 units) and anatomy (6.9 units).

Discussion

Proximal humerus fractures comprise nearly 4%-5% of all fracture types and nearly 25% of fracture humerus. These fractures are commonly seen in the elderly population (people aged 60 years or more). The proximal humerus typically breaks into four fragments along the physeal lines of fusion - two tuberosities, the humeral head, and the shaft. Most tuberosity fractures take place secondary to the displacement of the head fragment and their degree of spatial displacement is initially minimal, relative to their normal anatomic position. [8] With non-operative management, progressive displacement may occur because of the unopposed pull of the rotator cuff muscles. Hence, the non-operative management of these displaced fractures is more controversial. Non-operative treatment may result in complications like non union, osteonecrosis, and malunion. Hence, in the majority of cases, operative management becomes mandatory for better outcomes. [9] Over the past 10 years, there has been considerable expansion in the range of reconstructive implants available to treat these injuries. There are different methods of internal fixation using, locking compression plates and screws, percutaneous fixation with metallic k wires and screws, tension band, external fixation, fixed-angle blade plates, transosseous suture fixation, intramedullary device shoulder arthroplasty, but none of these methods have been successful. [10] The management of these fractures can be a significant challenge, especially in the presence of poor cancellous bone due to osteoporosis and

multiple fracture segments resulting in failure of fixation with conventional plating systems. The major goal in the treatment of this fracture is to promote complication-free healing to recreate a pain-free mobile, stable and functional shoulder joint. [11,12]

46% of the cases were between 41-60 years with 32% between <18-40 years and 22% of cases >60 years of age. The age range was from 19 to 68 years with a mean age of 48.2 years. Court-Brown et al reported in their epidemiological study with an average of 66 years, for men 56 and women 70 years.[1] 52% of cases were females and 48% were males. Similar reports were observed in the studies of Nwachukwu et al with male to female sex ratio of 8:12. [13] Road traffic injury was the most common mechanism for injury in 60% of cases and next was a history of fall in 32% of cases and one case was electric shock and other was hit by an iron rod. This finding of our study was consistent to many studies in the literature which also revealed other mechanisms like electric shock, assault by a rod as other mechanisms of injury. In our study, fracture was more common on left side (64%) than right (36%) which was similar to finding of Gerber et al [14] and contrary to the findings of Björkenheim et al. [15] As per Neer's type of fracture classification, the most common type of fracture observed in our study cases was two-part fracture accounting to 40% of cases followed in order by three part (26%), four part observed in 24% of cases which was similar to the findings in the study of Vijayvargiya et al [16] 3 and 4 part fractures were more common than 2 part fractures.

23 cases (46%) were managed by open reduction and internal fixation with locking compression plate using 4.5 mm cortical screw plates and 6.5 mm cancellous screws. Percutaneous pinning was done in 10 cases (20%). Open reduction with K-wire was done in 6 cases (12%) and open reduction with K-wire and cancellous screws in 3 cases (6%). Closed reduction with intramedullary nailing was done in 4 cases (8%). In the present study, Neer's score was done on patient every 1st week, 4th week, 8th week and finally at 14th week. All the cases (50/50) had score <70 during 1st week, 36 cases (72%) in 4th week, 6 cases (12%) in 8th week and 2 cases (4%) in 14th final week which was considered as a failure outcome in our study as per Neer's criteria. In 4th week, 14 cases (28%) had score between 70-79, 5 cases (10%) in 8th week and only 3 cases (6%) in final 14th week which was considered as unsatisfactory outcome. 80-89 score was observed in 36 cases (72%) in 8th week and 6 cases (12%) in 14th week which was considered as satisfactory outcome. >90% score was observed in 3 case (6%) in 8th week and 38 cases (76%) at the final 14th week which was considered as an excellent outcome in the study. A different study from Gujarat found that excellent results occurred in 54% of instances, satisfactory results in 24% of cases, unsatisfactory results in 12% of cases, and failures occurred in 10% of cases. [17] Ganesan et al [18] also observed excellent results in 50% of the instances, satisfactory results in 30% of the cases, unsatisfactory results in 10% of the cases, and failure results in 10% of the cases. According to a study by Jagiasi et al [19], the results were outstanding in 40% of the instances, very good in 6.66%, good in 30%, fair in 20%, and poor in 3.33% of the cases. The results of a study by Vijayanand et al [20] were excellent outcomes in 23 cases, satisfactory in four, unsatisfactory in two, and in one case a failure. According to a study by Bansal et al [21], the results were excellent in 16% of the instances, good in 44%, fair in 16%, and poor in 24% of the patients. The mean scores observed on Neer's score were pain (34.6 units), function (23.5 units), range of motion (16.55 units) and anatomy (6.9 units).

Thanasas et al [22] reported an impingement rate of 5.5% in a comprehensive review of 12 studies on proximal humerus fractures. Seven per cent (3/41) of respondents reported stiffness. All of these patients were over 65, had diabetes, and were discovered to have neglected to perform the recommended postoperative physical therapy exercises. Only one patient (2%) out of the total had a surface infection that needed to be treated with intravenous antibiotics. Brunner et al [23] and Agudelo et al [24] observed infection rates of 2% and 4.5%, respectively, in their trials.

Conclusion

The present study concluded that good surgical skills, surgeons experience in selection of the type of surgery depending upon the factors like type of fracture are necessary to achieve correct and best outcome. Clinical evaluation, obtaining proper radiological views, age of the patient and activity holds the key for realistic approach and surgical management of complex humerus fractures. Proper patient selection and thorough knowledge of the anatomy and biomechanical principles are the pre-requisites for a successful surgery and good functional outcome.

References

1. Court-Brown CM, Caesar B. Epidemiology of adult fractures: a review. Injury. 2006;37(8) :691–7.
2. Baron JA, Karagas M, Barrett J, Kniffin W, Malenka D, Mayor M, Keller RB. Basic epidemiology of fractures of the upper and lower limb among Americans over 65 years of age. Epidemiology. 1996 Nov 1;7(6):612-8.
3. Palvanen M, Kannus P, Niemi S, Parkkari J. Update in the epidemiology of proximal hu-

meral fractures. Clinical Orthopaedics and Related Research (1976-2007). 2006 Jan 1;442: 8 7-92.
4. Südkamp NP, Audigé L, Lambert S, Hertel R, Konrad G. Path analysis of factors for functional outcome at one year in 463 proximal humeral fractures. Journal of shoulder and elbow surgery. 2011 Dec 1;20(8):1207-16.
5. Clement ND. Management of Humeral Shaft Fractures; Non-Operative Versus Operative. Arch Trauma Res. 2015;4(2):e28013.
6. Kumar A, Waddell JP. Non-operative Management of Proximal Humerus Fractures. In: Biberthaler P, Kirchhoff C, Waddell J, eds. Fractures of the Proximal Humerus. Strategies in Fracture Treatments. Springer: Cham; 2015.
7. Neer C.S: Displaced Proximal humeral fractures Part –I Classification and Evaluation JBJS (am) 1970:52:1077-1089.
8. Frima H, Michelitsch C, Beks RB, Houwert RM, Acklin YP, Sommer C. Long-term follow-up after MIPO Philos plating for proximal humerus fractures. Archives of orthopaedic and trauma surgery. 2019 Feb 12; 139:203-9.
9. Robinson CM, Stirling PH, Goudie EB, MacDonald DJ, Strelzow JA. Complications and long-term outcomes of open reduction and plate fixation of proximal humeral fractures. JBJS. 2019 Dec 4;101(23):2129-39.
10. Oldrini LM, Feltri P, Albanese J, Marbach F, Filardo G, Candrian C. PHILOS synthesis for proximal humerus fractures has high complications and reintervention rates: a systematic review and meta-analysis. Life. 2022 Feb 19;12 (2):311.
11. Geiger EV, Maier M, Kelm A, Wutzler S, Seebach C, Marzi I. Functional outcome and complications following PHILOS plate fixation in proximal humeral fractures. Acta Orthop Traumatol Turc. 2010 Jan 1;44(1):1-6.
12. Erasmo R, Guerra G, Guerra L. Fractures and fracture-dislocations of the proximal humerus: a retrospective analysis of 82 cases treated with the Philos® locking plate. Injury. 2014 Dec 1;45:S43-8.
13. Nwachukwu BU, Schairer WW, McCormick F, Dines DM, Craig EV, Gulotta LV. Arthroplasty for the surgical management of complex proximal humerus fractures in the elderly: A cost-utility analysis. J Shoulder Elbow Surg. 2016;25(5):704-13.
14. Gerber C, Worner CM, Vienne P. Internal fixation of complex fractures of the proximal humerus. J Bone Joint Surg (Br). 2004;86(60): 848-55.
15. Björkenheim JM, Pajarinen J, Savolainen V. Internal fixation of proximal humeral fractures with locking compression plate: A retrospective evaluation of 72 patients followed for a minimum of 1 year. Acta Orthop Scand. 2004; 75:741-5.
16. Vijayvargiya M, Pathak A, Gaur S. Outcome analysis of locking plate fixation in proximal humerus fracture. J Clin Diag Res. 2016;10 (8) :1-5.
17. Pandya D, Soni K. Analysis of Functional Outcome in Proximal Humerus Plating (PHILOS) in Displaced Proximal Humerus Fracture. Acta Scientific Orthopaedics (ISSN: 2581-8635). 2020 Nov;3(11).
18. Ganesan RP, Palaniappan M, Anbu S, Kolundan K, Kannan K, Karunanithi S. Elastic stable intramedullary nailing of femoral and tibial shaft fractures in children. J Evol Med Dent Sci. 2016 Sep 5;5(71):5196-201.
19. Jagiasi JD, Patel MR, Daliya SG, Bochare A, Vora M. Assessment of functional outcome of surgical management of proximal humerus fracture treated with PHILOS plate. Int J Res Orthop. 2018 Sep; 4:736-40.
20. Vijayanand A, Jayasomeswar N. Study of functional outcome of surgical management of proximal humerus fracture by various modalities: a two-year study at a tertiary care hospital. Int J Res Orthop. 2020 Mar; 6:242-6.
21. Bansal V, Sohal HS, Bhoparai RS. Philos plate in proximal humerus fracture–its functional outcome and complications. Int J Orthop. 20 15;2(3):317-22.
22. Thanasas C, Kontakis G, Angoules A, Limb D, Giannoudis P. Treatment of proximal humerus fractures with locking plates: a systematic review. Journal of Shoulder and Elbow Surgery. 2009 Nov 1;18(6):837-44.
23. Brunner F, Sommer C, Bahrs C, Heuwinkel R, Hafner C, Rillmann P, Kohut G, Ekelund A, Muller M, Audigé L, Babst R. Open reduction and internal fixation of proximal humerus fractures using a proximal humeral locked plate: a prospective multicenter analysis. Journal of orthopaedic trauma. 2009 Mar 1;23(3):163-72.
24. Agudelo J, Schürmann M, Stahel P, Helwig P, Morgan SJ, Zechel W, Bahrs C, Parekh A, Ziran B, Williams A, Smith W. Analysis of efficacy and failure in proximal humerus fractures treated with locking plates. Journal of orthopaedic trauma. 2007 Nov 1;21(10):676-81.