Journal of Cardiovascular Disease Research

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 06, 2023

Functional and Radiological Outcome by Various Modalities of Surgical Fixation of Proximal Humerus Fracture

Mohammed Abdul Bari[1], Mohammed Hassan Rafeeq[2], Bandela Venugopal[3], Mohammed Irfan Nagnur[1]

[1]Associate Professor, Department of Orthopaedics, Deccan College of Medical Sciences, Hyderabad, Telangana, India.
[2]Assistant Professor, Department of Orthopaedics, Deccan College of Medical Sciences, Hyderabad, Telangana, India.
[3]Associate Professor, Department of Orthopaedics, Mamata Medical College, Khammam, Telangana, India.

Abstract

Background: In this study, we wanted to test the efficacy and functional outcome of locking compression plate in proximal humerus fractures, evaluate the incidence of complication that may occur with locking compression plate in proximal humerus fractures, study different modalities of fixations in proximal humerus fractures, and assess and compare the functional outcome. **Material and Methods:** This was a hospital based observational study conducted among 20 patients who were diagnosed with proximal humerus fracture attending the Department of Orthopaedics, Deccan College of Medical Sciences, Tertiary Care Centre, Hyderabad, from October 2018 to August 2019 after obtaining clearance from the institutional ethics committee and written informed consent from the study participants. **Results:** ORIF with LCP (35%) was the most common modality of treatment. Percutaneous pinning was done in 20% of the patients. 15% of them had CRIF with IM nails. ORIF with k wires and ORIF with k wires and cancellous wires were done in 10% of patients each. Shoulder hemiarthroplasty and ORIF with Ethibond suture were done in 5% of patients each. 55% of the patients developed complications in the post-operative period in the form of infections and stiffness. Of the twenty patients, four (20%) had excellent results, thirteen patients (65%) had satisfactory results, one (5%) had unsatisfactory results and one (5%) was a failure. **Conclusion:** Proximal humerus fractures are more common in 30-39 years and 40-49 years. It is more common in females. The most common cause is RTA. 2-part fracture is most common. ORIF with LCP was the most common modality of treatment. About half the patients had complications in the form of infections and stiffness.

Keywords: Efficacy, Functional Outcome, Compression, Proximal Humerus Fractures.

Corresponding Author: Dr Mohammed Irfan Nagnur, Associate Professor, Department of Orthopaedics, Deccan College of Medical Sciences, Hyderabad, Telangana, India.

Introduction

Fractures of the proximal humerus are one of the commonest fractures encountered by an orthopaedician. The incidence of this fracture has significantly increased perhaps due to the increased vehicular traffic & mechanical life. The injury is of great importance when it affects the young & middle age groups of the population. It leads to temporary disability & loss of working hours. Restoration of function of the limb is of paramount importance.[1] These fractures usually do not constitute a major therapeutic problem. For most non-displaced & minimally displaced fractures of the proximal humerus, non-surgical management is preferred because non-union is rare, healing time is short & infection very uncommon. For more displaced fractures & osteopenic bone, techniques of internal fixation, which emphasize less disruptive soft tissue dissection & minimal fixation with wire & non

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 06, 2023

absorbable sutures have been successful with low complication rate. Even AO type buttress plates are being used, but they require more soft tissue dissection & may lead to infection. Severely comminuted & displaced fractures have been treated with hemiarthroplasty.[2] In fractures treated conservatively or surgically, minimal amount of malunion is cosmetically & functionally acceptable. Most studies indicate that for a majority of good results of fractures of this region are obtained by conservative methods. Some studies state that operative treatment is better, depending on type of fracture & quality of the bone. Management of these fractures is associated with some morbidity & undesirable sequelae. They include complications like avascular necrosis, malunion, non-union, infection, neurovascular injury, loss of motion of shoulder from adhesive capsulitis, chronic oedema, elbow stiffness & atrophy of the soft tissues of the immobilized limb causing significant disability during healing & afterwards.[3] Hence, this study was taken up to assess the management of fracture of proximal humerus.

Aims and Objectives

- To test the efficacy and functional outcome of locking compression plate in proximal humerus fractures.
- To evaluate the incidence of complications that may occur with locking compression plate in proximal humerus fractures.
- To study different modalities of fixations in proximal humerus fractures.
- To assess and compare the functional outcomes.

Methodology

This was a hospital based observational study conducted among 20 patients who were diagnosed with proximal humerus fracture attending the Department of Orthopaedics, Deccan College of Medical Sciences, Tertiary Care Centre, Hyderabad, from October 2018 to August 2019 after obtaining clearance from the institutional ethics committee and written informed consent from the study participants.

Inclusion Criteria

- Diagnosed patients with proximal humerus fracture.
- Patients who were willing to give an informed written consent.
- Children (<18 years).
- Neer's classification: Grade 2 and grade 4.

Exclusion Criteria

- Patients who were not willing to participate in the study.
- The patients having any one of the following:
- Skeletal immaturity.
- Pathological fractures.
- Neurovascular deficit.
- Polytrauma patients with Injury Severity Score > 16

Statistical Methods

The data was entered in Microsoft excel 2010 version. Data was analysed using Microsoft excel 2010 and Epi Info 7.2.1.0. Descriptive and inferential statistical analyses were used in the present study. Results on continuous measurements were presented in Mean ± SD (Min-Max) and results on categorical measurements were presented in Numbers (%). The level of significance was assessed at 5%

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 06, 2023

RESULTS

Table 1: Type of surgery.

Neer's classification	Frequency	Percentage
2 part	10	50
3 part	6	30
4 part	2	10
Fracture and dislocation	2	10
Total	20	100
The Neer classification		
Mechanism of Injury	Frequency	Percentage
Road Traffic Accident	14	70
Fall	6	30
Total	20	100
Mechanism of Injury		
Type of surgery	Frequency	Percentage
ORIF with LCP	7	35
Percutaneous pinning	4	20
CRIF with IM nails	3	15
ORIF with k wires	2	10
ORIF with k wires and cancellous wire	2	10
Shoulder hemiarthroplasty	1	5
ORIF with Ethibond suture	1	5
Total	20	100

50% of the study population had 2-part fracture, 30% of them had 3-part fracture. 4-part fracture, fracture and dislocation contributed to 10% each.
70% of the study population suffered Road Traffic Accident and 30% of them had suffered fall. ORIF with LCP (35%) was the most common modality of treatment. Percutaneous pinning was done in 20% of the patients. 15% of them had CRIF with IM nails. ORIF with k wires and ORIF with k wires and cancellous wires were done in 10% of patients each. Shoulder hemiarthroplasty and ORIF with Ethibond suture were done in 5% of patients each.

Table 2: Radiological Union.

Time after injury and surgery	Frequency	Percentage
</= 12 hours	6	30
12-24 hours	6	30
>24 hours	8	40
Total	20	100
Time after injury and surgery		
Clinical Union	Frequency	Percentage
11 weeks	1	5
12 weeks	6	30
13 weeks	2	10
14 weeks	6	30
15 weeks	5	25
Total	20	100
Clinical Union		
Radiological Union	Frequency	Percentage
16-18 weeks	13	65
19-20 weeks	5	25
>20 weeks	2	10
Total	20	100

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 06, 2023

40% of the surgeries were done after 24 hours. The surgeries done within 12 hours and between 12-24 hours were 30% each.
Clinical union was achieved at 12 weeks and 14 weeks in 30% of cases each. 25% of the cases achieved union at 15 weeks. 10% of the study population achieved clinical union at 13 weeks. 5% of the study population achieved union at 11 weeks.
Radiological union was achieved by 16-18 weeks in 65% of cases. One quarter of patients achieved radiological union by 19-20 weeks and 10% of the study population achieved radiological union by 10%.

Table 3: Neer's score

Neer's score	1st week	4th week	8th week	Final
<70	20(100%)	17(85%)	5(25%)	1(5%)
70-79	0	3(15%)	12(60%)	5(25%)
80-90	0	0	3(15%)	10(50%)
>90	0	0	0	4(20%)
Total	20(100%)	20(100%)	20(100%)	20(100%)

By the end of 1st week, all the patients had score of <70. At the end of 4th week, 15% had a score of 70-79.
By the end of 8th week, 15% had a score of 80-89, 60% had a score of 70-79 and 25% had a score of <70.
At the time of final assessment, 20% of them had a score of >90, 50% had a score of 80-89, 25% had a score of 70-79 and 5% had a score of <70.

Table 4: Range of movements

Complications	Frequency	Percentage
None	9	45
Present	11	55
Post-operative infections	6	54.5
Stiffness	9	81.81
Total	20	100
Complications		
Motion	Maximum ROM	Observed ROM
Abduction	1800	1260
Forward flexion	1800	1340
Extension	450	380
External rotation	600	320
Internal rotation	900	58.50

55% of the patients developed complications in the post-operative period.
54.5% of them had post-operative wound infections and 81.81% of them had stiffness.
At the end of full functional recovery, all the patients assessed by Neer's shoulder score had restriction of abduction, forward flexion and external rotation. The average loss of abduction was 54°, forward flexion 46°, external rotation was 28°, internal rotation 31.5° and extension 7°. The average range of movements observed were abduction 126°, forward flexion 180°, extension 45°, external rotation 32° and internal rotation 58.5º.

Table 5: Results

Modalities	Min-Max	Mean	Median	Standard Deviation
Pain	30-35	34.25	35	1.83
Function	13-30	23.25	22	4.44
ROM	12-19	15.55	15	1.90
Anatomy	4-10	7.9	8	1.52

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 06, 2023

Evaluation of results by Neer's Score		
Results	Frequency	Percentage
Excellent	4	20
Satisfactory	13	65
Unsatisfactory	1	5
Failure	1	5

At the end of clinical and radiological union and full functional recovery, the results were evaluated by the Neer's score.

Of the twenty patients, four (20%) had excellent results, thirteen patients (65%) had satisfactory results, one (5%) had unsatisfactory results and one (5%) was a failure The mean scores observed on the Neer's score were pain (34.25units), function (23.25units), range of motion (15.55units), anatomy(7.9units) and the total Neer's score was 80.95.

DISCUSSION

Proximal humerus fractures account for almost 4 to 5% of all fractures. These fractures have a dual age distribution occurring either in young people following high energy trauma or in those older than 50 years with low velocity injuries like simple fall. Earlier these fractures were considered simple and were managed by plaster cast technique, slings and slabs, but recent advances in understanding of anatomy, good surgical skills and better instrumentation have led to various modalities for the treatment of these fractures like percutaneous pinning, intramedullary nailing, plate fixation or prosthetic replacement. Due to awareness of its complexity and complications, these fractures have stimulated a growing interest in finding the optimal treatment. Most of the proximal humerus fractures are non-displaced or minimally displaced and stable. Early rehabilitation can treat them successfully without the need of operation. But severely displaced and comminuted fractures warrant surgical management for optimum shoulder function. In the present study, ORIF with LCP (35%) was the most common modality of treatment. Percutaneous pinning was done in 20% of the patients. 15% of them had CRIF with IM nails. ORIF with k wires and ORIF with k wires and cancellous wires were done in 10% of patients each. Shoulder hemiarthroplasty and ORIF with Ethibond suture were done in 5% of patients each. The findings of the present study are discussed below:

Age

One quarter of the patients belonged to the age group of 30-39 years and 40-49 years. 20% of the patients belonged to the age group of 50-59 years and 15% of the patients belonged to 20-29 years and >60 years each. The mean age was 42.75 yrs. In the study done by Neer,[4,5] the mean age was 55.3 yrs. In the study done by Dolfi Herscovici,[6] the average age was 52 years. Court-Brown et al,[7] reported in their epidemiological study with an average age of 66 years, for men 56 years and for women 70 years.

Gender

Regarding sex incidence, study of literature reveals predominance of proximal humerus fractures in females in an elderly age group.[8] In the present study, the male to female ratio was 1:2.2, 14 among 20 patients were females. Our study shows that most proximal humerus fractures are osteoporotic fractures in women over the age of 40. The risk of fracture begins to increase linearly in women in their fifties, this is due to lack of post-menopausal treatment and its awareness. The prevalence of PHF increases as the population ages. There are two main types of risk factors for osteoporotic fractures, in particular for PHF. The first risk is fragile bones and the second is the risk of falling. The more fragile the bones are the more severe the fracture is.[9] In the study done by Dolfi Herscovici, the male to female ratio was

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 06, 2023

1:0.8. In the study done by Koji Yamamoto,[10] the male to female ratio was 1:1.3. In the study done by Roland P. Jacob,[11] the male to female ratio was 1:0.5 and in the study done by Court-Brown et al, the male to female ratio was 1:2.3.

Mode of injury

The mode of injury commonly observed in the present study was road traffic accident accounting for 14 (70%) and 6 (30%) patients had a history of fall, thus showing high velocity injury as the main mechanism. These observations were found to be consistent with the studies in literature, which revealed 19(45%) road traffic accidents, 20(50%) history of falls and 01(5%) history of assault out of the forty cases studied. In another study, 12(75%) had road traffic accidents and 04(25%) had history of falls in a series of 16 cases studied. Comparing the present study with the published series, it was observed that the emergence of high velocity injury due to road traffic accidents had changed the complete outlook towards these fractures. In the study done by Dolfi Herscovici, 47.5% were RTAs, 50% were falls and 2.5% were assaults. In the study done by Koji Yamamoto, 75% were RTAs and 25% were falls.

Type of fracture

The study of type of fracture in the present study revealed that 10(50%) were 2 part fractures, 6(30%) were 3 part fractures, 02 (10%) were 4 part fractures and 02(10%) were fractures with dislocation. Neer,[12,13] study showed that 31(26.5%) were 2 part fractures, 43(36.8%) were 3 part fractures and 43(36.8%) were 4 part fractures. In the study done by Dolfi Herscovici, 20(50%) were 2 part fractures, 16(40%) were 3 part fractures and 4(10%) were 4 part fractures indicating that the incidence of type of fracture is nearly consistent with the studies in literature. In two-part surgical neck fractures, the head was in the neutral position as both the tuberosities were attached to it, and the shaft was pulled medially due to the pull of the pectoralis major. Traction, with flexion and some adduction was required to reduce the fracture. In the case where reduction was not possible, there was a soft tissue interposition which was blocking reduction, on open reduction.[14-16]

Displaced two-part greater tuberosity fractures were usually found retracted posteriorly and superiorly and closed reduction was difficult. They were reduced anatomically, however, a malunion could have occurred that would have later blocked glenohumeral motion. Hence, open reduction and cancellous screw transfixation were carried out with good results.[17]

Displaced three part fractures were difficult to reduce and still more difficult to hold reduced (unstable fracture), probably because if the greater tuberosity was attached to the head, it was pulled into external rotation with the humeral articular surface facing forward. If lesser tuberosity was attached to it, the articular surface was facing posteriorly. The shaft was pulled medially by the pectoralis major and probably the long head of biceps was caught between the fracture fragment and prevented reduction. Moreover, since the fracture usually occurred in osteoporotic bone, vigorous manipulation and repeated attempts at reduction could cause further comminution at the fracture site. The similar finding has been found in literature published by various authors. In the present study, similar results were obtained.

Modes of internal fixation

Various modes of internal fixation were employed in our series of 20 patients 7(35%) who underwent open reduction and internal fixation with LCP, 08(40%) underwent fixation with K-wires and cancellous screws, 01(5%) underwent hemiarthroplasty and 01(5%) underwent ethibond sutures. In study of literature, study done by Neer, 43(36.8%) underwent open reduction and internal fixation with buttress plate and tension band wiring, 43(36.8%) of 4 part fractures and selected 3 part fractures underwent prosthetic replacement. In another

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 06, 2023

series of 15 patients, 14(93.3%) underwent internal fixation with K-wires/cancellous screws and only one underwent fixation with AO buttress plate.[18] Many authors in their published literatures have mentioned that, in the management of displaced proximal humerus, good reduction was mandatory and stable fixation gave good results. They also reported that open reduction and internal fixation in young adults gave better outcome. In older persons, the quality of bone and soft tissue disruption should be given importance, and it is better to fix percutaneously.

Comparison of present study with other studies

	OR & IF	**Pinning/Wiring**	**CR & IF**	**Prosthesis**
NEER'S(117cases)	43(36.8%)	00	00	43(36.8%)
Richard J Hawkins	01(6.7%)	14(93.3%)	00	00
Present Study	8(40%)	8(40%)	3(15%)	1(5%)

Complications

In our series, 9(45%) had shoulder stiffness and 6(30%) had post-operative infection. Compared to other series, stiffness was seen in 30 % of the patients, most of these patients were elderly and were unwilling to undergo rigorous rehabilitation programme. 30% of the patients had post-operative infection, 03 of them had superficial infection which subsided with systemic antibiotics, 02 patients had pin tract infection, which subsided after the removal of 'K' wires, but one patient had deep seated infection, for which repeated debridement and systemic antibiotic was given and infection got under control, but later went for arthritis and failure outcome. In patients complicated with stiffness, phase-wise physiotherapy was started after clinical union was confirmed. They ended up with satisfactory results. In the complications in other series like the study done by Neer, 03 had post-operative infection, 04 had malunion, 07 had non-union and 08 had avascular necrosis of the humeral head. In another series of 15 patients, 02 had implant loosening and 02 had avascular necrosis of the humeral head.

Complication Related Study Pattern

	Neer's	**Richard J Hawkins**	**Present Study**
Stiffness	00	00	09
Post op infection	03	00	06
Implant loosening	00	02	00
Malunion	04	00	00
Non-union	07	00	00
Osteonecrosis	08	02	00

CONCLUSION

Proximal humerus fractures are more common in 30-39 years and 40-49 years. It is more common in females. The most common cause is RTA. 2-part fracture is most common. ORIF with LCP was the most common modality of treatment. About half the patients had complications in the form of infections and stiffness. Majority of the patients were happy with the treatment.

REFERENCES

1. Trumble T, Cornwall R, Budoff J, Core knowledge in orthopedics-hand, elbow, and shoulder. Philadelphia, Pa, USA: Mosby Elsevier 2005.
2. Rockwood C, Matsen IF, Wirth M, Lippitt. S. The Shoulder. 4th edn. Philadelphia, Pa, USA: Saunders Elsevier 2008: p. 1124.

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 06, 2023

3. Terry GC, Chopp TM. Functional anatomy of the shoulder. Journal of Athletic Training 2000;35(3):248.
4. Neer CS. Displaced proximal humeral fractures: Part I. Classification and evaluation. JBJS 1970;52(6):1077-89.
5. Neer CS. Displaced proximal humeral fractures Part-II Treatment of three and four part displacement JBJS (am) 1970;52(6):1090-101.
6. Herscovici D, Saunders DT, Johnson MP, Sanders R, DiPasquale T. Per-cutaneous fixation of proximal humeral fractures. Clin Orthop 2000:375:97-104.
7. Kyle RF. Current techniques in proximal fractures. JBJS 1997;79B: Supp IV.
8. Rose SH, Melton LJ, Morrey BF, Ilstrup DM, Riggs BL. Epidemiologic features of humeral fractures. Clinical Orthopaedics and Related Research® 1982;168:24-30.
9. Court-Brown CM, Garg A, McQueen MM. The epidemiology of proximal humeral fractures. Acta Orthop Scand 2001;72(4):365-71.
10. Ko JY, Yamamoto R. Surgical treatment of complex fracture of the proximal humerus. Clinical Orthopaedics and Related Research® 1996;327:225-37.
11. Jakob RP, Miniaci AN, Anson PS, Jaberg HA, Osterwalder AN, Ganz RE. Four-part valgus impacted fractures of the proximal humerus. The Journal of Bone & Joint Surgery British 1991;73(2):295-8.
12. Gruson KI, Ruchelsman DE, Tejwani NC. Isolated tuberosity fractures of the proximal humerus: current concepts. Injury 2008;39(3):284-98.
13. Lefevre-Colau MM, Babinet A, Fayad F, Fermanian J, Anract P, Roren A, Kansao J, Revel M, Poiraudeau S. Immediate mobilization compared with conventional immobilization for the impacted nonoperatively treated proximal humeral fracture: a randomized controlled trial. JBJS 2007;89(12):2582-90.
14. Pritsch M, Greental A, Horoszowski H. Closed pinning for humeral fractures. The Journal of Bone and Joint Surgery British 1997;1997:79.
15. Lill H, Korner J, Glasmacher S, Hepp P. Crossed screw osteosynthesis of proximal humerus fractures. Der Unfallchirurg 2001;104(9):852-9.
16. Resch H, Povacz PA, Fröhlich R, Wambacher M. Percutaneous fixation of three-and four-part fractures of the proximal humerus. The Journal of Bone and Joint Surgery. British volume 1997;79(2):295-300.
17. Darder A. Darder AJ, Four part displaced proximal humerus fractures; operative treatment using Kirschner wire and a tension band. J Orthop Trauma 1993;7(6):497-505.
18. Hawkins RJ, Bell RH, Gurr K. The three-part fracture of the proximal part of the humerus. Operative treatment. JBJS 1986;68(9):1410-4.