



## TREATMENT OF PROXIMAL HUMERUS FRACTURES AND OUTCOME – A PROSPECTIVE STUDY

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**ABSTRACT** **BACKGROUND:** Proximal humerus fractures are commonest fractures account for about 4 – 5% of the fractures. Complicated fracture pattern in proximal humerus are increasing due to increase incidence of high velocity trauma. Because of inconsistency in fracture classification, treatment and evaluation method, comparison of these fractures are impeded. This study determines and compare the results of different modalities of fixations in proximal humerus fractures and outcome.

**MATERIALS AND METHODS:** This study was done from August 2018 to February 2020 in King George Hospital, Visakhapatnam. Total 32 patients with proximal humerus fractures were operated with different modalities depend on fracture pattern. The results were evaluated using the Neer's Shoulder Scoring System.

**RESULTS:** The results show that most Neer's two part fracture had excellent to satisfactory results (85%). Neer's three part fracture also had 73% excellent to satisfactory results. Neer's four part fracture which went into failure. This study results were compared with other studies by using chi square test.

**CONCLUSION:** The management modality depended on the pattern of the fracture and the quality of the bone. The patient's goals with treatment options for these displaced fractures included closed reduction and percutaneous screws fixation (13% cases), closed reduction and percutaneous k-wires fixation (9% cases), open reduction and internal fixation (78% cases).

**KEYWORDS :** Proximal humerus fracture, treatment, outcome.

#### BACKGROUND

Proximal humerus fractures are the commonest fractures occurring in the skeleton. About 4 – 5% of the fractures of all extremities are represented by proximal humeral fracture<sup>11,13</sup>. They occur more commonly in elderly patients due to osteoporosis but these fractures are seen in patients of all ages & merge with epiphyseal separations. Increase in road traffic accidents, complicated fracture pattern in proximal humerus are becoming increasing. Management is difficult because of numerous muscles attachment and less space for fixing implant in fracture of proximal humerus. The preferred treatment varies depending on the patient's age and bone quality, the expertise, surgical team and the patients expectations.

Although a number of reports have described the outcome of treatment of proximal humeral fractures, comparison of these fractures are impeded by inconsistency in fracture classification, treatment and evaluation method.

The surgery should be carried out as soon as the patients general condition permits. A delay of several days causes absorption of bone and makes reduction more difficult. Secure internal fixation becomes impossible<sup>25</sup>.

The object of the osteosynthesis is to reduce the displacement of each fragment and hold it in place with an implant. Thus the greater tuberosity fragment which was usually been displaced proximally and rotated upward by rotator cuff muscles inserted into it, is replaced and fixed to the major humeral head fragment, similarly lesser tuberosity fragment displaced by subscapularis was replaced and fixed.

Three & four part fractures represent 13 to 16% of proximal humeral fractures. Treatment options for these displaced fractures include open reduction and fixation. Neer recommended open reduction and internal fixation for displaced two and three part fractures.

Most of the poor results following open reduction and internal fixation of three part fractures are due to imperfect technique. In a three or four part fracture dislocation when the head of the humerus is entirely devoid of any blood supply it can be replaced by a humeral prosthesis.

This study tries to bring out the salient features of all operable fractures of proximal humerus which require open reduction and fixation. Thus the requirement of early mobilization without any undue risk of loss of fixation and reduction.

#### MATERIALS AND METHODS

This study was conducted at department of orthopaedics, King George Hospital, Visakhapatnam from August 2018 to February 2020. Patients were taken for study who were fitted into inclusion criteria and given consent. Ethical clearance was obtained from institutional ethical committee.

32 patients of proximal humerus fractures who attended in the casualty and OPD were admitted in this hospital and were treated surgically.

#### Inclusion Criteria:

All adults patients admitted with proximal humerus fractures. [Neer's classification : grade 2 to grade 4], who has given consent and are surgically fit.

#### Exclusion Criteria:

- A] Medically unfit patients.
- B] Pathological fractures.
- C] Fractures in paediatric age group.
- D] Shaft humerus fractures with proximal extension.
- E] Neer's one part fracture and conservatively managed fractures.

Sample size: 32 patients.

After the patients with proximal humerus were admitted to the hospital, all the necessary clinical details were recorded in a case sheet. Radiographic evaluation of the shoulder were done according to Neer's trauma series which consists of:

1. A true anteroposterior (AP) view of the scapula,
2. A lateral 'Y-view' of scapula, and
3. An axillary view.

Fractures were classified according to the Neer's classification and initial temporary immobilization with shoulder immobilizer/U Slab & Bandage were applied.

All the routine investigations were done on all the patients pre-operatively with complete medical and anaesthetic fitness of patient for surgery. Following factors were taken into consideration while deciding the modality of treatment to be used: -.Neer's classification two, three or four part fracture with associated displacement, Presence of humeral head dislocation and humeral head comminution, Valgus impaction, Quality of bone, Open or compound fracture, Age of the patient, Associated general and medical condition of the patient, Other

associated lesions e.g. brachial plexus palsy, Functional requirements of the patient.

The functional outcome was evaluated using the Neer's Shoulder Scoring System.

#### Method of Treatment:

All the patients were operated on elective basis after overcoming the avoidable anaesthetic risks.

#### All patients were treated by one of the following methods:

1. Closed reduction and Percutaneous K- wires fixation.
2. Closed reduction and Percutaneous Screws fixation.
3. Open reduction and Internal fixation with various implants e.g. Buttress plate, Locking compression plate.

#### Inclusion criteria for closed reduction and Percutaneous fixation:

- Un-displaced two, three or four part fractures defined as < 45 degree of angulation of articular surface or less than 1 cm of displacement between major fragments<sup>14</sup>
- Where fracture can be reduced close but is stable<sup>16,17</sup>
- Maintenance of glenohumeral congruity.
- Poor general or medical condition of the patient especially elderly where short procedure is required.
- Two, three and four part valgus impacted fractures without lateral displacement<sup>18,19</sup>

#### Exclusion criteria for closed reduction and Percutaneous fixation :

- Severely displaced fractures.
- Comminuted fractures.
- Irreducible two, three and four-part fractures.
- Fractures involving splitting of the articular surface of the Humeral head

#### Inclusion criteria for open reduction and internal fixation :

- Young age.<sup>20</sup>
- Absence of comminution of head (intact humeral head).
- Good bone quality.
- An angulation of the articular surface of more than 45 degree.
- Displacement between the major fragments of >1cm.

#### Exclusion criteria for open reduction and internal fixation :

- Open fracture.
- Presence of severe head comminution.

#### Functional Assessment Key: Neers Scoring System

##### The maximum points are 100 units:

1. Pain : 35 Units
2. Function : 30 Units
3. Range Of Movement: 25 Units
4. Anatomy : 10 Units

#### On overall scores, the patients were grouped into:

##### Results Score

1. Excellent : > 89 units
2. Satisfactory : 80-89 units
3. Un-Satisfactory : 70-79 units
4. Failure : < 70

#### Application of Biostatistics :

To compare results of our study with other standard studies we have used 'Chi-Square' test. By using this test we have calculated P value.

If P value is >0.05, the test result is not significant. That means these two study population are comparable.

If P value is < 0.05, the test result is significant. That means these two study populations are not comparable .

## RESULTS

The study consists of 32 cases of proximal humerus fractures in adult treated surgically who reported in King George Hospital from August 2018 to february 2020. The material for the study was analyzed to the following finding :

#### 1.Age incidence:

Age variation was from 20 to 65years, high incidence in the 50 to 65 age group(16 patients).

#### 2. Neer's Type of fracture:

Two part fractures constituted the most common type.

#### 3. mode of injury

Most common mode of injury was fall onto outstretched hand (13 patients). Followed by high energy trauma (10 patients).

#### 4. Period between injury and surgery

Most of the cases were operated between 1 to 3 days (27 cases) and remaining 5 cases were operated within 24 hrs. All the five were Grade 1 compound fractures.

#### 5.Types of fixations for proximal humerus fractures:

Most proximal humerus fractures were fixed with open reduction and plate fixation. Others were treated with either closed reduction and percutaneous k-wires fixation or close reduction and percutaneous screws fixation.

#### 6. Immobilization:

Each operated patient was given a Universal shoulder immobilizer immediate post-operatively. The dressing was done at third and seventh day and the sutures were removed by 12 day in open surgeries. The patient was also encouraged to exercise the hand, wrist and elbow. After 3 weeks k-wires were removed and pendulum exercises were started (In percutaneous k-wire fixation method). In 3 cases of open reduction and plate fixation bones were severely osteoporotic so fixation was not so rigid, motion was delayed. Gentle passive forward flexion and internal and external rotation exercises were started by third or fourth week. Active or resistive exercises were permitted by 4 to 6 weeks. It usually took about a year to achieve optimum function.

#### 7. Complications:

##### Complications after closed reduction and k-wires fixation :

In our series, total 3 patients were treated with closed reduction and k-wire fixation, out of which one had pin infection which was removed at 2 weeks and the rehabilitation postponed and universal shoulder immobilizer was given. The wounds were healed and the patient had satisfactory result. Loss of reduction occurred in one patient, which required repeated closed reduction and percutaneous fixation. Later he had un-satisfactory result.

##### Complications after open reduction and internal fixation with plate:

In our series 25 patients were treated by open reduction and plate fixation. In 5 cases reduction was difficult due to rotation of the fragments but it could be managed intra operatively. There were 3 cases who had abduction between 50-100 degree due to malunion of the fracture fragment. 3 patients had restricted range of movement who were fixed with Cloverleaf plate, due to Impingement, they were treated with plate removal at 8 months when the fracture had united. All three regained good range of movement after good supervised rehabilitation. We did not get complications of impingement in the patients who were fixed with Locking compression plate.

We observed changes of avascular necrosis in two patients at an average follow up of 18 months and the patient went into failure. The reason might be extensive soft tissue dissection.

No complications were observed with CC Screw fixation.

#### 8.Union:

The mean period for Union was 10 weeks ranging from 8 – 12 weeks

#### 9.End Result:

The Neer's scoring system of the severity of Pain, Function, Range of Movement, Anatomy, was done to determine the end results.

**Table 1: End result of percutaneous k-wires fixation**

Grading	No of patients	Percentage
Excellent	1	33%
Satisfactory	1	33%
Un-satisfactory	1	33%

**Table 2: End result of open reduction and plate fixation**

Grading	No of patients	Percentage
Excellent	14	56%
Satisfactory	5	20%
Un-satisfactory	4	16%
Failure	2	8%

## 100% Excellent Results with Percutaneous Fixation with Screws

As per the Neer's scoring system 57% patients had excellent results while 20% patients had satisfactory results. They were all pain free and successfully returned to their pre-injury work. 23% patients had unsatisfactory to failure result (Table 3). These patients had associated factors like older age etc to be the responsible causes.

**Table 3. Overall Results on basis of Neer's Scoring System**

Grading	No of patients	Percentage
Excellent	17	53%
Satisfactory	8	25%
Un-satisfactory	5	16%
Failure	2	6%

**Table 4 : Results according to Neer's different types of fracture on basis of Neer's Scoring System**

Type of Fracture	Total	Excellent	Satisfactory	Unsatisfactory	Failure
2 part	20	11	6	3	0
3 part	11	6	2	2	1
4 part	1	0	0	0	1

The results show that most Neer's two part fracture had excellent to satisfactory results (85%). Neer's three part fracture also had 73% excellent to satisfactory results. In our series there was only one case of four part fracture which went into failure, another case which went into failure was a three part fracture fixed with buttress plate. The major reason for failures was avascular necrosis.

**DISCUSSION**

The incidence of proximal humerus fractures has been increasing in last few years due to increase in road traffic accidents. The best management in these injuries was still uncertain.<sup>14,17</sup> However, with the aim of getting anatomically accurate reductions, rapid healing and early restoration of function, open reduction and internal fixation, is the preferred modality of treatment.

Defining correct treatment guidelines through analysis of current treatment options is becoming increasingly important, as the prevalence of osteoporotic fractures of the proximal humerus are expected to rise in the next three decades, and the functional outcome achieved after treatment may determine a patient's level of independence.

It is studied by *Kojo and Yamamoto* that complex fractures of proximal humerus are better treated with open reduction and internal fixation with adequate bone quality for internal fixation. The use of technique of limited soft tissue dissection and internal fixation achieve good fracture fixation and high percentage of satisfactory results.<sup>6</sup>

Literature supports conservative management and functional treatment in approximately 75% of proximal humeral fractures.

It has been studied by *Szyskowitz* that unstable and significantly displaced fractures or fracture dislocations should be treated by reconstruction of proximal humerus in young patients.<sup>4</sup>

Studies by *Hintermann & Trouiller* have reported that rigid fixation of displaced proximal humeral fractures with blade plate in elderly patients provides primary stability to allow early functional treatment regardless of the age of the patient.<sup>8</sup>

The options as to the surgical approach or type of implant used depend on the pattern of fracture, the quality of bone encountered, patient's goal and surgeon's familiarity with techniques.

Studies of *Michael Robinon & Richard Page* have revealed that functional results associated with non-operative treatment of severely impacted valgus fractures of proximal humeral fractures are poor.<sup>10</sup>

Operative treatment is recommended for active individual with three part proximal humeral fractures and best results was seen using tension band wiring. A prolonged closely monitored, well defined rehabilitation program is necessary to obtain best functional results.<sup>15</sup>

Closed reductions rarely may be successful in treating three part fracture dislocations. It was not at all useful in three and four part

proximal humeral fractures. Proximal humeral hemiarthroplasty was useful in four part injury and in occasional three part injury in older people when internal fixation was inadequate.<sup>2</sup>

As per literature closed reduction and percutaneous pinning of unstable proximal humeral fractures minimizes soft tissue dissection and reduces operative morbidity. This also preserves the blood supply to the humeral head.<sup>3,7,9</sup>

In young patients open reduction and internal fixation seems preferable to replacement of humeral head. Fractures that require prosthetic replacement as definitive treatment include four part fractures, fracture dislocations, head splitting fractures >40% articular surface involvement and selected three part fractures.

Of the seventy cases treated by *Catherine Compito, Edward Self & Louis Bigliani* thirty one had excellent results and satisfactory in twenty two. Successful outcome depends on gentle soft tissue technique, secure placement of prosthesis, tuberosity reconstruction and rigorous post operative rehabilitation.<sup>15</sup>

In a study by *AA Martinez, J Cuenca, A Herrera*, they concluded that the locking plate fixation was suitable for 3- and 4-part proximal humeral fractures. Its complication rate was low, probably because their patients were relatively young, and both the bone quality and the surgical technique were good.<sup>11</sup>

Finally, prosthetic arthroplasty remains a good treatment for severe fractures in older patients and for classic four part fractures in patients of any age. Proximal humerus fractures occur more commonly in older age group.<sup>5,1</sup>

Of the thirty two patients in our study, twenty nine were closed fractures and three were open fractures. All open fractures were grade-1 two part fracture.

Twenty patients had two part fracture. At surgery more than 60% of them had soft tissue interposition at the fracture site.<sup>22</sup> Four cases of greater tuberosity avulsion fracture (Two part fracture) were treated with closed reduction and percutaneous screws fixation. Thus cancellous screws proved to be very effective in proximal humerus fracture fixation.<sup>24</sup>

Eleven patients had three part fracture. Restoration of greater and lesser tuberosity was a particular difficulty in these cases (Seven cases had surgical neck with greater tuberosity fracture and four had surgical neck with lesser tuberosity fracture). Nine of them were fixed with Cloverleaf plate, and rest two with Locking compression plate.<sup>12,15,21,23</sup>

One patient had four part fracture who was treated by open reduction and Cloverleaf plate fixation.

Different studies, which have used the Neer's scoring system for assessment of results, demonstrate a fairly similar pattern of results with 70 - 80% patients having satisfactory to excellent results and 20 - 30% having un-satisfactory to failure results.

**Table 5. Comparisons of result pattern with other study**

Result	Roland P.Jacob <sup>18</sup>	Present series
Excellent	21%	53%
Satisfactory	53%	25%
Un-satisfactory	10%	16%
Failure	16%	6%

As P value is >0.05 in study according to Chi-square test. It is not significant so these study groups are comparable. In our series 78% patients had satisfactory to excellent results and 22% had unsatisfactory to failure results. These results are comparable with the other studies.

**CONCLUSION**

- Two and three-part fracture represented almost more than 95% of proximal humeral fractures.
- In younger patients, proximal humeral fractures usually were caused by high-energy trauma.
- They occurred more frequently in older patients after the cancellous bone had become weakened by senility and osteoporosis.
- The options as to the management modality used depended on the

pattern of the fracture, the quality of the bone encountered, the patient's goals and the surgeon's familiarity with the techniques.

- Principles of fixation used were reconstruction of the articular surface, including the restoration of the anatomy, stable fixation, with minimal injury to the soft tissues preserving the vascular supply.
- Treatment options for these displaced fractures included closed reduction and percutaneous screws fixation (13% cases), closed reduction and percutaneous k- wires fixation (9% cases) open reduction and internal fixation (78 % cases).
- Biologically the technique of closed reduction and percutaneous wiring is good from the standpoint of retaining the vascularity of the humeral head. The results of study is comparable with other series done by different authors by using bio-statistical method (chi-square test).

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