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ORIGINAL ARTICLE

A PROSPECTIVE STUDY ON TREATMENT OF PROXIMAL HUMERUS FRACTURES IN ADULTS

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ABSTRACT: BACKGROUND: Treatment of proximal humerus has been subject of much controversy and confusion with diversity of opinion regarding the care of fractures of proximal end of humerus. The aim of this study was to review the outcome, results and complications of the operative procedure in a series of thirty patients. **INTRODUCTION:** Proximal humerus fractures are one of the commonest fractures occurring in the skeleton. They account for approximately 4-5% of the fracture attendance at the hospital.[1,2] They occur more commonly in elderly patients, after cancellous bone of the humeral neck has weakened by senility but these fracture are seen in patients of all ages & merge with epiphyseal separations. The most serious fractures and fracture dislocations are often seen in active, middle aged patients. These fractures can be extremely disabling and their management often demands experienced surgical skills and judgment.[2] Because of increasing incidence of high velocity trauma, complicated fracture pattern in proximal humerus are becoming increasingly common. It has been always engima of management because of numerous muscles attachment and paucity of space for fixing implant in fracture of proximal humerus. Voluminous literature is available on this topic and treatment pattern differs very much. The preferred treatment varies depend 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 is hampered by inconsistence in fracture classification, treatment and evaluation method. The surgery should be carried out as soon as the patient's general condition permits. A delay of several days makes reduction more difficult and a significant delay results in absorption of bone, making secure internal fixation impossible.[3] The object of the osteosynthesisis is to reduce the displacement (usually rotation) of each fragment and hold it in place with an implant. Thus the greater tuberosity fragment which has usually been displaced proximally and rotated upward by rotator cuff muscles inserted into it, is replaced and fixed to the major humeral head fragment, lesser tuberosity fragment similarly displaced by subscapularis is 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 parts fractures. Most of the poor results following open reduction and internal fixation of 3 three part fracture 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 dissertation tries to bring out the salient features of all operable fractures of proximal humerus which require open reduction and fixation especially in adult patients in whom the duration of stay in hospital reflect on the earning capacity of the person and in elderly patients in whom immobilization of upper

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limb is associated with reflex sympathetic dystrophy, stiffness and shoulder hand syndrome. Thus the requirement of early mobilization without any undue risk of loss of fixation and reduction.
KEYWORDS: Proximal humerus, Philos Plate, Internal Fixation.

INTRODUCTION:

AIMS AND OBJECTIVES: My study "Treatment of Proximal Humerus Fractures and outcome. A Prospective Study" has been done with an aim to:

1. Study different modalities of the fixations in proximal humerus fractures and outcome.
2. Assess and compare the results.
3. To suggest the preferred modality of treatment of proximal humerus fractures.

MATERIAL AND METHODS: This study was carried out in King George Hospital, Visakhaptnam from August 2010 to October 2012.Thirty patients of proximal humerus fractures were attended in the casualty and OPD and were admitted in this hospital and were treated surgically. We collected records of the patients by asking the patients history and examining the patients. Essential investigations of all the patients were done. The patients were operated in our institute with our methods of fixation. Patients coming for follow up were studied regularly.

Inclusion Criteria: All adults' patients admitted with proximal humerus fractures. [Neer's classification: grade 2 to grade 4].

Exclusion Criteria:

A. Medically unfit patients.
B. Pathological fractures.
C. Fractures in pediatric age group.
D. Shaft humerus fractures with proximal extension.
E. Neer's one part fracture.
F. Conservatively managed Fractures

Sample Size: 30 patients.

After the patients with proximal humerus were admitted to the hospital, all the necessary clinical details were recorded in a trauma sheet comprising of:

1. Age of the patient.
2. History of trauma whether injury was due to fall or road traffic accident.
3. Time and place of injury.
4. Time interval between injury and treatment in our casualty department. This period was less than three days in all cases.
5. Occupation of the patient.
6. Associated injuries e.g. neurovascular status, tendon injury.
7. Medical history of the patient.

Then complete clinical examination comprising of local and systemic examination was recorded on trauma sheet itself.

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1. Systemic Examination.
2. Local Examination.
   a) Swelling and Deformity of the shoulder.
   b) Check for circulatory status.
   c) Sensation of the shoulder and arm.
   d) Condition of the skin.

Radiographic evaluation of the shoulder was 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 patients were shifted to the ward after initial temporary immobilization with shoulder immobilizer/U Slab & Bandage.

All the routine investigations were done on all the patients pre-operatively with complete medical and anesthetic fitness of patient for surgery.

Following factors were taken into consideration while deciding the modality of treatment to be used:

1. Neer's classification two, three or four part fracture with associated displacement.
2. Presence of humeral head dislocation and humeral head comminution.
3. Valgus impaction.
4. Comminution.
5. Quality of bone.
6. Open or compound fracture.
7. Age of the patient.
8. Associated general and medical condition of the patient.
9. Other associated lesions e.g. brachial plexus palsy.
10. Functional requirements of the patient.

The functional outcome was evaluated using the Neers Shoulder Scoring System.

Method of Treatment: All the patients were operated on selective basis after overcoming the avoidable anesthetic 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:

1. 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.[4]

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2. Where fracture is un-displaced or displaced, but there is no comminution.[5]
3. Where fracture can be reduced close but is stable.[6,7]
4. Maintenance of glenohumeral congruity.
5. Poor general or medical condition of the patient especially elderly where short procedure is required.
6. Two, three and four part valgus impacted fracture without lateral displacement.[8,9]

Exclusion criteria for closed reduction and percutaneous fixation:

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

Inclusion criteria for open reduction and internal fixation:

1. Young age.[10]
2. Absence of comminution of head (intact humeral head).
3. Good bone quality.
4. An angulation of the articular surface of more than 45 degree.
5. Displacement between the major fragments of >1cm.

Exclusion criteria for open reduction and internal fixation:

1. Open fracture.
2. Presence of severe head communication.

IMPLANTS USED:

Figure 1

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Functional Assessment Key: Neers Scoring System		
1.	**Pain**	**Total 35 Units**
A.	No Pain	35
B.	Slight or Occasional	30
C.	Mild, No effect in ordinary activity	25
D.	Moderate, tolerable, starting to affect ordinary activity	15
E.	Marked, serious limitation of ordinary activity	5
F.	Total Disablement	0

2.	**Functional Ability**					**Total 30 Units**	
Strength			Reaching			Stability	
ƒ	Normal	10	Above head	2	ƒ	Lifting	2
ƒ	Good	8	Mouth	2	ƒ	Throwing	2
ƒ	Fair	6	Belt buckle	2	ƒ	Carrying	2
ƒ	Poor	4	Opposite axilla	2	ƒ	Pushing	2
ƒ	Trace	2	Brassiere hook	2	ƒ	Holdover head	2
ƒ	Zero	0					

3. **Range of Motion:**

Flexion Scoring	
180°	6
170°	5
130°	4
100°	2
80°	1
<80°	0

Abduction Scoring	
180°	6
170°	5
140°	4
100°	2
80°	1
<80°	0

4. **Anatomy Total 10 Units:** Rotation, Angulation, Joint incongruity, Retracted Tuberosities, Non-union, AVN.

ƒ	None	10
ƒ	Mild	8

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f	Moderate	4
f	Severe	0 – 2

These criteria were proposed by Neer. 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 population are not comparable.

OBSERVATIONS & STATISTICAL ANALYSIS: The study consists of 30 cases of proximal humerus fractures in adult treated surgically who reported in King George Hospital from August 20 10 to October 2012. The material for the study was analyzed to the following finding:

1. **Age incidence:** Age variation in the series were from 2 0 to 65 years. Proximal humerus fractures were found to have high incidence in the 50 to 65 age group. The incidence of the study was as follows:

Age of patients (yrs)	**No of patients**
20-30	2
31-40	6
41-50	6
51-60	8
>60	8
Total	**30**

Table 1: Age incidence

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2. **Sex incidence:** From 30 cases there were 17 m ales and 13 females i.e. 57% males and 43% females. Males predominated over females in our study. Ratio of ma les to female was 1. 30:1.

Sex of patients	No. of patients
Male	17
Female	13
Total	**30**

Table 2: Sex incidence

3. **Side of fracture:** Right sided was involved in more patients. 18 cases had right side involved. None had both the sides involved in the same patient.

Side of in jury	No. of patients
Right	18
Left	12
Total	**30**

Table 3: Side distribution

4. **Mode of Injury:** Most of the injuries w ere cause d by domestic fall du e to minor fall, slipping, or agricultural injury and another cause w ere road traffic accident due to vehicular accident especially in younger age group.

Mode of injury	No of patients
Domestic	17
Vehicular	13
Total	**30**

Table 4: Mode of injury

5. **Residence:** More patients were from rural population.
6. **Socio-economic status:** Majority of the patients were from low socioeconomic status.
7. **Mechanism of Injury:** In our series of proximal humerus fractures, the most common mechanism of injury were fall onto the outstretched hand from a standing height or less, the trauma was minor in degree, because bone were osteoporotic. High energy trauma was more frequently involved in younger Patients. Excessive rotation of the arm, especially in the abducted position was another mechanism of injury, especially in older patients with osteoporotic bone. Direct blow to the side of the shoulder in the lateral position was another mechanism of injury, result in fracture of the greater tuberosity.

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Mechanism of injury	No. of patients
Fall on outstretched hand(minor fall)	13
High energy Trauma	10
Excessive rotation of arm in abduction	5
Direct blow	2
Total	**30**

Table 5: Mechanism of Injury

8. **Closed or Compound Injury:** Majority of the cases were closed type of proximal humerus fracture. All of the compound fractures were of Grade-1.

Type of Fracture	No. of patients
Closed	27
Compound	3
Total	**30**

Table 6: Types of Fractures

9. **Neer's Type of fracture:** Two part fractures constituted the most common type.

Neer's type	No. of Patients	Percentage
2 part	18	60%
3 part	11	37%
4 part	1	3%
Total	**30**	**100%**

Table 7: Neer 's type of Fracture

10. **Period between injury and surgery:** Most of the cases were operated between 1 to 3 days (27 cases) and remaining 3 cases were operated within 24 hrs. All the three were Grade 1 compound fractures.

Time period	No. of patients	Percentage
0-6 hrs	0	0%
6-24 hrs	3	10%
1-3 days	27	90%
Total	**30**	**100%**

Table 8: Period between injury and surgery

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11. Types of fixations for proximal humerus fractures: Most proximal humerus fractures were fixed with open reduction and plate fixation. Others were treated with either close reduction and percutaneous k-wires fixation or close reduction and percutaneous screws fixation.

Type of fixation	No. of Patients	Percentage
CR+P/C K WIRES	3	10%
CR+P/C SCREWS	2	7 %
OR+PLATE FIXATION	25	83%
Total	**30**	**100%**

Table 9: Fixation of Proximal humerus fractures

12. Immobilization: Each operated patient was given a Universal shoulder immobilizer immediate post-operatively. The dressing was done accordingly 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. This is continued for six weeks. After 3 weeks k-wires were removed and pendulum exercises were started (In percutaneous k-wire fixation method). In the 3 cases of open reduction and plate fixation bone 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 the 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.

13. Associated injuries: One patient had associated bicondylar tibial fracture. Remaining 29 patients had isolated fracture of proximal humerus.

14. Complication: Complications after closed reduction and k-wires fixation: In our series, total 3 patients were treated with closed reduction and k- wires fixation. All patient treated by k-wire fixation were having compound fracture grade-1. K-wire was fixed after debridment, out of which one had pin infection which was subsequently removed at 2 weeks and the rehab postponed and universal shoulder immobilizer was given. The wound healed and the patient had satisfactory result. Loss of reduction occurred in another one patient. He required repeated closed reduction and percutaneous fixation. He had un-satisfactory result.

Complication	No of Patients	Percentage
Pin Infection	1	33%
Loss of reduction	1	33%

Table 10

Complications after open reduction and internal fixation with plate: In our series 25 patients were treated by open reduction and plate fixation, in three cases reduction was difficult due to rotation of the fragments but it could be managed intra operatively. Intra-operative

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bleeding was managed by adequate blood transfusion in the cases which had considerable bleeding. There were three cases who had abduction between 50-100 degree due to malunion of the fracture fragment. Three 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 complication 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 20 months and the patient went into failure. The reason might be extensive soft tissue dissection.

Complication	No. of Patients	Percentage
Rotation of fragment intraoperatively	3	12%
Intra operative bleeding	4	16%
Malunion	3	12%
Impingement	3	12%
Avascular Necrosis	2	8%

Table 11

No complications observed with CC Screw fixation.

15. Union: The mean period for Union was 10.57 weeks ranging from 8 – 12 weeks.

16. End Result: The Neer's scoring system of the severity of Pain, Function, Range of Movement, Anatomy, was done to determine the end results. The end results of 30 patients of proximal humerus fractures which were surgically treated could be categorized as;

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

Table 12: End result of percutaneous k-wires fixation

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

Table 13: End result of open reduction and plate fixation

100% Excellent Results with Percutaneous Fixation with Screws.

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SUMMARY: All the fractures treated united clinically by 6 weeks and radiologically by 12 weeks. There were no problems of delayed union or non-union. The fractures were more common in men with a gender distribution of 1.30: 1 and were also more common in the age group of 50 to 65 years (53%). They were more common in the age group of 30-50 years in men and 50 - 65 years in women. The right side was affected more than the left Domestic falls were the most common cause of fractures and involved the older age groups. Motor vehicle accidents were the next cause of injury and involved the younger ages. Open fractures were also common after such accidents. Most common mechanism of injury was fall on an outstretched hand in the older age group (44%), next common was high energy trauma (33%) Closed fracture accounted for most of the cases (90%), followed by open fracture (10%) Two part fracture (commonly surgical neck) accounted for most of the cases (60%), followed by three part fracture (37%) and then four part fracture (3%) Closed, displaced, avulsion fractures of greater tuberosity (Two part) were treated with closed reduction and percutaneous screws (cancellous-screws). Open two part fracture however was stabilized with k-wires alone, fearing infection problems. On the other hand 83% of two, three and four part fracture were stabilized with plate and screws.

RESULTS: 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 14). These patients had associated factors like older age etc to be the responsible causes.

Grading	No. of patients	Percentage
Excellent	17	57%
Satisfactory	6	20%
Un-satisfactory	5	16%
Failure	2	7%

Table 14: Overall Results on basis of Neer's Scoring System

Type of Fracture	Total	Excellent	Satisfactory	Unsatisfactory	Failure
2 part	18	11	4	3	0
3 part	11	6	2	2	1
4 part	1	0	0	0	1

Table 15: Results according to Neer's different types of fracture on basis of Neer's Scoring System

The results show that most Neer's two part fracture had excellent to satisfactory results (84%). Neer's three part fracture also had 72% 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 (Table 15). The major reason for failures was avascular necrosis.

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The study had its own set of complications. In our series 25 patients were treated by open reduction and plate fixation. In three cases reduction was difficult due to rotation of the fragments but it could be managed intra-operatively. Intra-operative bleeding was managed by adequate blood transfusion, in the cases which had considerable bleeding.

There were three cases who had abduction between 50-100 degree due to malunion of the fracture fragment. Three 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 patients after plate removal regained good range of movement under 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 20 months who went into failures.

DISCUSSION: The incidence of proximal humerus fractures has increased in last few years due to changes in life style and increase in road traffic accidents. The best management in[4,11] these injuries is still uncertain. Studies have shown non-operative and operative treatments, both give favorable results, and the uncertainty remains.[12,8] However, with the aim of getting anatomically accurate reductions, rapid healing and early restoration of function, which is a demand of today's life, open reduction and internal fixation, is the preferred modality of treatment. It is to be noted that the risk [13,6]of complications although is low after internal fixation, it is higher when compared with fractures which are managed per cutaneously or conservatively.[14]

Proximal humerus fractures occur more commonly in older age group. This is due to senile osteoporosis. Numerous age related studies point towards this and our study is consistent with this finding.

Study	Age of patients studied	Mean age
Roland P. Jacob	24-81	49.5
C.Gerber, C. M. L. Werner	16– 73	44.9
Wijgman, W. Roolker	19 – 79	48
Evan L. Flatow, Francis Cuomo [14]	34-72	53
P.Moonot, N. Ashwood, M. Hamlet	18-87	59.9
Present series	**21 – 70**	**49.3**

Table 16: Age related study pattern

Further as with other studies, our study showed a higher incidence of fractures in men than in women. The gender ratio was 1.30:1. This higher ratio can be explained by a higher involvement of male in day to day activities in compare to female.

Study	M:F
Roland P. Jacob [8]	1.57
C. Gerber, C. M. L. Werner [15]	1.35

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Wijgman, W. Roolker [16]	0.94
Evan L. Flatow, Francis Cuomo [14]	1.40
Present series	**1.30**

Table 17: Gender related study pattern

As P value is >0.05 in all series according to Chi-square test. It is not significant so these study groups are comparable.

Motor vehicle accidents constitute a major cause of musculoskeletal trauma worldwide. In our country too, it happens to be very common and is reflected in our study as second most common cause after the domestic fall.[17,18] 57% of our patients had suffered a domestic fall and 43% were involved in vehicular accidents.

As P value is >0.05 in all series according to "Chi-square test". It is not significant so these study groups are comparable.

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

Eighteen patients had two parts fracture. At surgery more than 60% of them had soft tissue interposition at the fracture site.[19] Two 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.[20]

Three cases of grade-1 compound, two part fracture were treated with closed reduction and percutaneous k-wires fixation. Rest thirteen cases of two part fracture were treated by open reduction and buttress plate fixation.[21]

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.[5,15,21,22]

In our study, one case of three part fracture was also having bicondylar tibia fracture, cause of injury was road traffic accident. He underwent a Locking compression plate for proximal humerus and simultaneously Locking hockey stick plate for lateral condyle and L-plate for medial condyle tibia. One patient had four parts 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.

Result	Roland P. Jacob	Present series
Excellent	21%	57%
Satisfactory	53%	20%
Un-satisfactory	10%	16%
Failure	16%	7%

Table 18: Comparisons of result pattern with other study

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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 77% patients had satisfactory to excellent results and 23% had un-satisfactory to failure results. These results are comparable with the other study.

Our poor results have shown strong association with;

1. Open injuries, which developed infection.
2. Three, four part severely displaced fracture in which articular head is devoid of soft tissue attachment which are unstable.
3. Avascular necrosis of humeral head.[22,23]

Results were consistently better in closed, less displaced two and three part fracture patterns.

Complications: The study had its own set of complications.

1. Pin infection in one case.
2. Loss of reduction occurred in one patient operated by percutaneous k-wires fixation.
3. Rotation of fragment intraoperatively in three cases.
4. Intraoperative bleeding in four cases.
5. Malunion noted in three cases.
6. Restricted range of movement due to impingement was noted in three cases.
7. Avascular necrosis in two patients.

Follow up and Final Result: In this study maximum period of follow up was 25 months and minimum of 5 months.

Open fractures were treated immediately by IV antibiotics, debridement and percutaneous k-wires fixation. Of our three patients with open fractures, one had excellent result, another had loss of reduction (33%) which gave satisfactory result and rest one had infection (33%), which did resolve with adequate treatment but gave un-satisfactory result.

SUMMARY: 30 cases of proximal humerus fractures managed surgically by various techniques and rigid fixation achieved. Post-operative mobilization i.e. pendulum exercises were started after 3 weeks in cases in whom fixation was good and in others it was delayed for 6-8 weeks.

The study included 57% of male patients and 43% of female patients. 54% of the fracture occurred in 50 to 65 years age group. Domestic fall accounts for 57% of the cases.

According to the Neer's classification there were;

- Two part fracture - 60%.
- Three part fracture - 37%.
- Four part fracture - 3%.

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Associated injury to the tibia (Bicondylar fracture) in 1 case was noted. It did not affect the treatment. Surgical techniques used were closed reduction and percutaneous k-wires fixation, closed reduction and percutaneous cancellous screws fixation, open reduction and internal fixation with Cloverleaf/T buttress plates and locking compression plates. Closed reduction and percutaneous cancellous screws fixation showed excellent results in all two cases of two-part greater tuberosity avulsion fracture. Open reduction and internal fixation with locking compression plates showed good results among all implants used.

CONCLUSION:

- Fractures of the upper end of humerus accounted for 6% of all fractures.
- Two and three-part fracture represented almost more than 95% of proximal humeral fractures.
- In older patients with osteoporosis, even less severe trauma (fall in 57%) produced significant injury.
- In younger patients, proximal humeral fractures usually were caused by high- energy trauma (43%).
- They occurred more frequently in older patients after the cancellous bone has become weakened by senility and osteoporosis.
- Fractures of the proximal humerus are complex injuries involving two articulating surfaces, the glenohumeral joint and the subacromial arch.
- 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.
- Principle of fixation used was 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 (7% cases), closed reduction and percutaneous k- wires fixation (10% cases) open reduction and internal fixation (83 % cases).
- Biologically the technique of closed reduction and percutaneous pinning is good from the standpoint of retaining the vascularity of the humeral head.
- In our series 33 % cases had excellent functional results. It can be used for un-displaced or displaced two, three or four part fracture of the proximal humerus without communition, in the younger age groups with good bone quality. It can be used in the elderly who are unfit for surgery.
- It can be useful as an alternative to open -reduction and internal fixation of un-displaced and displaced fractures of the proximal humerus.
- Patients who has two part greater tuberosity avulsion fracture are best treated by closed reduction and percutaneous screw fixation.
- Patients who have metaphyseal comminution are more appropriately treated by open reduction and internal fixation with a plate (83% cases).
- In patients who have a three-part fracture with appreciable displacement of the greater tuberosity, open reduction, limited dissection and internal fixation should be performed.

- An adequate surgical technique will minimize complications and an aggressive rehabilitation regime will ensure the best possible result.
- Malunion and restriction of movement were associated with poor results.
- In case of compound fractures, immediate wound debridement and rigid fixation give better results.
- The results of our study is comparable with others series done by different authors by using bio-statistical method (Chi-square test).

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