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Study of Functional Outcome of Osteosynthesis of Proximal Humerus Fractures in Adult By Different Modalities.

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Abstract: *Fracture of proximal humerus accounts for 5% of all fractures.Proximal humerus fractures are the third most frequent fractures in elderly patients after hip and colle's fracture. Most of the patients are of more than 60 years and 75% are women.Different modes of fixation for proximal humerus fracture are percutaneous k wire fixation, percutaneous cancellous screw fixation and locking proximal humeral plate application.Locking proximal humeral plate is newer implant, which is based on the principle of locking compression plates,it provides better angular stability and is a low profile plate which will prevent subacromial impingement.Two and Three part fracture represent almost majority of the proximal humerus fracture.Percutaneous screw fixation was done in 3 (6.97%)cases,Percutaneous k wire fixation was done in 16(37.2%) cases and open reduction and internal fixation with plate was done in 24(55.83%) cases.The Neer's scoring system of the severity of pain,function,range of movement, anatomy was used to determine the end results. In our study 19 cases were treated with percutaneous k wire/screw fixation.The functional outcome comprised of 5(26%)excellent,6(31.6%) satisfactory,3(15.8%) unsatisfactory and 5(26.3%) failure cases.24 cases were treated by the locking proximal humeral plate,75% patients were having good result and 25% patients were having poor result.Overall results was good in 67.5% and poor in 32.6% of the patients.The result was excellent in 10(23.3%) cases, satisfactory in 19(44.2%) cases, Unsatisfactory in 7(16.3%) cases and failure in 7(16.3%) cases.Overall locking plate had better results than percutaneous k wires/screws in our study.*

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I. Introduction

Fracture of proximal humerus accounts for 5% of all fractures. Proximal humerus fractures are the third most frequent fractures in elderly patients after hip and colle's fracture. Most of the patients are of more than 60 years and 75% are women.According to various studies it is agreed that undisplaced fractures which constitute 80% of all humeral fractures should be treated conservatively.However there is considerable controversy concerning the treatment of displaced and comminuted proximal fractures.Non operative treatment of these fractures often result in malunion and stiffness of the shoulder.An increasing number of older patients with osteoporotic and severe comminuted fracture,which represent about 13-16% of proximal fractures present additional challenges to treatment.Conventional implants might have insufficient anchorage for screws leading to early loosening and failure.

The different modes of fixation for treating proximal humerus fracture are Tension Band Fixation,Percutaneous pinning , Bone sutures,T plate ,Intramedullary fixation,Fixed angle blade fixation,Two 1/3 tubular plate fixation, Locking proximal humeral plate or primary hemiarthroplasty.

The risk of humeral head necrosis by extensive exposure and insertion of implants, malunion,nonunion ,subacromial impingement and screw loosening after open reduction and internal fixation and insufficient primary stability after minimally invasive treatment of proximal humeral fracture have lead to the development of Locking proximal humeral plate.It is based on the principle of locking compression plate, it works as an internal fixator as it has fixed angle screws in the head.Locking plate is a low profile plate which will also prevent subacromial impingement and as screws are locked into the plate,the screws do not backout when metaphyseal fractures collapse during healing.This study compares the functional outcome of osteosynthesis of proximal humerus fracture in adult by different modalities i.e. percutaneous k wires, percutaneous screw and internal fixation with locking compression plate.

II. Aims and Objectives

The aim and objectives is to study different modalities of the fixation in proximal humerus fractures and to assess and compare the results of various modalities of treatment.

III. Material and Methods

Design of the study:This is a prospective study.
Place of study: Patna medical college and hospital, Patna
Period of study:August 2013 to November 2015.

Methods of Treatment:

Patients admitted were operated on elective basis by one of the following methods:

- Closed reduction and percutaneous k wire fixation.
- Closed reduction and percutaneous screw fixation.
- Open reduction and Internal fixation with Locking compression plate.

Inclusion Criteria for closed reduction and percutaneous fixation :

- Undisplaced two, three or four part fractures defined as < 45 degrees of angulation of articular surface or less than 1 cm of displacement between major fragments.
- Where fracture can be reduced close and is stable.
- Maintained glenohumeral congruity.
- Poor general or medical condition of the patient especially where short procedure is required .
- Two, three,four part valgus impacted fracture without lateral displacement.

Exclusion Criteria for closed reduction and percutaneous fixation:

- Severely displaced 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:

- Absence of communition of head.
- Good bone quality.
- An angulation of the articular surface of more than 45 degrees.
- Displacement between the major fragments of more than 1 cm and in case of greater tuberosity 0.5 cm.

Exclusion criteria for open reduction and internal fixation:

- Open fractures.
- Presence of severe head communition.

Functional Assessment Key: Neer's Score

A.Pain (Total-35 Units)

No pain	35
Slight or Occasional	30
Mild , No effect in ordinary activity	25
Moderate , tolerable,starting to affect ordinary activity	15
Marked , serious limitation of ordinary activity	5
Total Disablement	0

B.Functional Ability (Total-30Units)

a) Strength		**b)Reach**		**y**	
Normal	10	Above head	2	Lifting	2
Good	8	Mouth	2	Throwing	2
Fair	6	Belt buckle	2	Carrying	2
Poor	4	Opposite axilla	2	Pushing	2
Trace	2	Brassiere	2	Hold over head	2
Zero	0				

C.Range of motion (Total-25Units)

Flexion		**Extension**		**Abduction**		**External Rotation**		**Internal Rotation**	
180	6	45	3	180	6	60	5	90	5
170	5	30	2	170	5	30	3	70	4
130	4	15	1	140	4	10	1	50	3

100	2	<15	0	100	2	<10	0	30	2
80	1			80	1			<30	0
<80	0			<80	0				

D.Anatomy (Radiological Total 10 unit):-Rotation, Angulation, Joint incongruity, Retracted Tuberosities, Non Union, AVN, Metal failure, Myositis.

●	None	10
●	Mild	8
●	Moderate	4
●	Severe	0.2

These criteria were proposed by Neer.The maximum points are 100 units:-
Pain: 35 units
Function: 30 units
Range of Movement: 25 units
Anatomy : 10 units
The patients are grouped on the basis of score :-

Results	**Score**
Excellent	>89 units
Satisfactory	80-89 units
Un-satisfactory	70-79 units
Failure	<70 units

To compare the results of our study with other standard studies, we have used chi square test.By using this test we have calculated p value.

IV. Observation and Results

43 patients of proximal humerus fracture was treated surgically in Patna medical college and hospital Patna from august 2013 to November 2015.Age variation in the series was from 22 to 65 years.Proximal humeral fracture were found to have high incidence in the 51 to 60 years(14 cases).Among 43 cases there were 27 males and 16 females.Right side was involved in 25 patients and 18 patients were having left side fracture.

Types of fracture:
Majority of the cases were closed type of proximal humerus fracture.All of the compound fractures were of Grade -1.

Closed/Compound	**No.of patients**	**Percentage**
Closed	39	90.7
Compound	04	9.3
	43	100

Neer's Type of Fracture:
Two part fractures constituted the most common type.

Types of fracture	**No. of patients**	**Percentage**
Two part fracture	19	44.2
Three part fracture	12	27.9
Four part fracture	12	27.9
Total	43	100

Types of fixation for proximal humerus fractures:
Most proximal humerus fractures(24 cases) were fixed with locking compression plate whereas 16 cases and 3 cases were fixed by the percutaneous k wires and percutaneous screw respectively.

Types of fixation	**No. of patients**	**Percentage**
Open reduction+Internal fixation	24	55.83
Closed reduction+P/C K wires fixation	16	37.20
Closed reduction+P/C screw fixation	03	6.97
Total	43	100

Functional Outcome:
The Neer's scoring system of the severity of pain, Function,Range of Movement,Anatomy was used to determine the end results.In our study the Overall results of surgery was good (Excellent/Satisfactory) in 67.5% and poor in 32.6% of patients.

Grading	No. of patients	Percentage
Excellent	10	23.3
Satisfactory	19	44.2
Un-satisfactory	7	16.3
Failure	7	16.3
Total	43	100

Overall End results according to Neer's classification:

In 2 part fractures 84.21% patients had good results while in 3 part fractures 66.6% patients and in 4 part fractures 41.6% patients had good results.

Result	**2 Part Fracture**	**3 Part Fracture**	**4 Part Fracture**	**Total**
Excellent	8	2	0	10
Satisfactory	8	6	5	19
Un- satisfactory	2	2	3	7
Failure	1	2	4	7
Total	19	12	12	43

End result of open reduction and plate fixation:

Grading	**No. of patients**	**Percentage**
Excellent	5	20.8
Satisfactory	13	54.2
Unsatisfactory	4	16.7
Failure	2	8.3
Total	24	100

End result of Percutaneous K wire fixation:

Grading	**No. of patients**	**Percentage**
Excellent	3	18.75
Satisfactory	5	31.25
Unsatisfactory	3	18.75
Failure	5	31.25
Total	16	100

End result of Percutaneous Screw fixation:

Grading	**No. of patients**	**Percentage**
Excellent	1	33.3
Satisfactory	2	66.7
Unsatisfactory	0	0
Failure	0	0
Total	3	100

Complications:-

Post operative complication after Percutaneous K wire fixation and Percutaneous Screw fixation:

Complication	**No. of patients**	**Percentage**
AVN	2	10.52
Malunion	2	10.52
Nonunion	2	10.52
Joint incongruity	1	5.26
Infected Nonunion	1	5.26

Postoperative complications after open reduction and internal fixation with plate:

Complication	**No. of patients**	**Type of Fracture**	**Percentage**
Superficial infection	1	4 part	4.1
Deep infection	1	4 part	4.1
Malunion	1	4 part	4.1
Impingement	0		
Avascular necrosis	1	4 part	4.1
Primary screw perforation of humeral head	1	4 part	4.1
Screw backout	1	4 part	4.1
Sub acromial impingement	0		
Delayed union	1	3 part	4.1
Stiffness	1	4 part	4.1
Axillary nerve palsy	0		

V. Discussion

Displaced proximal humeral fractures have always posed a challenge to treatment especially when associated with osteoporosis and communication. Such fractures usually require operative intervention to ensure correct positioning of the fracture fragments and to allow early mobilization.

Our study revealed the mean age of patients with such injuries to be 51.19 years with preponderance of the fracture in 5^{th} and 6^{th} decades of life.The mean age group of our study is comparable with other similar studies on similar fractures as follows:

Age related study pattern:

Study	Age of Patients	Mean age in Years
Ronaldo P.Jacob 1991	24-81	49.5
Wijgman,WRoolker 2002	19-79	48
Chen 1998	8-89	43
A.Kumar 2011	18-78	38
G.N Khare 2011	26-72	42.4
P Moonat 2007	18-87	59.9
Jost 2013	20-72	59
Present series	22-65	51.19(SD 12.27)

In our study the overall results of surgery was good in 67.5% and poor in 32.6% of patients.

The results according to Neer's classification: 84.21% patients of 2 part fracture were having good result while 66.6% and 41.6% patients were having good results in 3 parts and 4 part fractures respectively.Thus we can conclude that the results of surgery decreases with increase in the stages of Neer's classification.

Functional outcome :

19 patients were treated with percutaneous K wire and screw fixation.The functional outcome was Excellent in 5 cases,Satisfactory in 6 cases,Unsatisfactory in 3 cases and Failure in 5 cases.Functional result was good in 57.89%(11) patients.These results were comparable to the result obtained by Watford KE et al.

In our study, 75% of patients had good results and 25% had poor results due to fixation by locking plates.

Results pattern of locking plate as compared to other study:

Study	Percentage with good/Excellent result	Percentage with fair or poor result
Ronaldo P Jacob 1991	74	26
Chen 1998	84	16
Wijgman 2002	87	13
A Kumar 2011	79	21
Present series	75	25

VI. Summary

- 43 cases of proximal humerus fractures managed surgically by various techniques.
- The study included 62.8% male patients and 37.2% female patients.
- 60.5% fractures occurred in > 50 years patients.
- Road traffic accidents accounts for 55.8% of the fractures of the proximal humerus.
- According to the Neer's classification there were;

1. Two part fracture – 44.2%
2. Three part fracture – 27.9%
3. Four part fracture – 27.9%

- Fractures occurred more often in older patients.
- Management depends on the pattern of fracture,the quality of the bone,the patients goals and surgeon's familiarity with the techniques.
- Principle of fixation is reconstruction of the articular surface,stable fixation with minimal injury to the soft tissues preserving the vascular supply.
- Treatment options include percutaneous k wire fixation in 16 (37.2%) cases ,percutaneous screw fixation in 3 (6.97%) cases and open reduction and internal fixation with locking compression plate in 24 (55.83) cases.
- According to Neer's scoring system the overall result was good(excellent/satisfactory) in 67.5% and poor in 32.6% of patients.
- In 2 part fracture 84.21% patients were having good result while in 3 parts and 4 part fracture 66.6% and 41.6% patients were having good results respectively.

- Out of 24 patients,those were treated by locking compression plate, 5 patients were having excellent result,13 patients were having satisfactory result,4 patients were having unsatisfactory and 2 patients were having failure.
- 16 patients were treated by percutaneous k wire fixation,8 were having good and 8 patients were having poor results.
- 3 patients were treated by percutaneous screw fixation, all three patients were having good results.
- Most of the complications are associated with degree of comminution.

VII. Conclusion

The treatment options used based on the pattern of fracture,the quality of the bone,the patients goals and surgeon's preference.Biologically the technique of closed reduction and percutaneous pinning is good from the standpoint of retaining the vascularity of the humeral head.In our studies 50% cases had good result.It can be used for undisplaced fractures in the younger age groups with good bone quality.It can be used in the unfit elderly patients.Patients who has two parts greater tuberosity avulsion fracture are best treated by closed reduction and percutaneous screw fixation.In our study 3 cases were having good result.Patients who have metaphyseal comminution are more appropriately treated by open reduction and internal fixation with locking plate.In patients who have three part fracture with appreciable displacement of the greater tuberosity,open reduction,limited dissection and internal fixation with locking plate 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 result.The results of surgery decreases with increase in the stages of Neer's classification.Overall locking plates had better results than percutaneous k wires/screws.

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