SURGICAL MANAGEMENT OF PROXIMAL HUMERUS FRACTURES BY PHILOS LOCKING PLATE

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ABSTRACT

BACKGROUND

Proximal humerus fractures remain challenging to the treating orthopaedist in both their initial diagnosis and classification and in their corresponding management. They account for approximately 5% of all fractures,^{1,2} and their incidence is expected to increase secondary to an ageing population and the associated osteoporosis.^{3,4,5,6} These fractures are the third most common type of fragility fractures after distal radius and hip fractures in patients aged 65 years and above.

MATERIALS AND METHODS

In our study, 42 patients were treated and followed for a period of 2 years from July 2014 to July 2016 in Department of Orthopaedics, Siddhartha Medical College, Vijayawada, Andhra Pradesh. In our study, 42 patients were treated with PHILOS locking plate and their intra and postoperative period followup done for 2 years; outcome of patients, complications studied throughout this period.

RESULTS

In our study, 42 cases treated with locking plates, age incidence most common in 41-50 years age group, more common in males (34 cases), more common on right side (31 cases). In our study, maximum number of cases belong to Neer's 2-part surgical neck of humerus fractures (24 out of 42 cases) followed by fracture dislocations (9 out of 42 cases) and three-part fractures (8 out of 42 cases). Mean followup of our study was 18.9 months ranging from 9 months to 24 months. Average time for union was 12.5 weeks in our study ranging from 12 weeks to 14 weeks. Out of 42 cases we have operated 28 cases within 7 days of injury and 8 cases within 7-14 days and remaining 6 cases after 14 days due to delay in presentation to us. Adequate reduction is achieved in 32 cases out of 42 cases. Mean Neck shaft angle calculated on immediate postoperative radiographs was 136.3 degrees and mean angle after fracture healing was 131.6 degrees. There was a mean 4.7 degrees varus collapse (mean fall of Neck shaft angle) from initial fixation to fracture healing in our study. Range of motion was affected by increasing age in our study, best range of motion was found in age group of 20-30 years with a mean of 136 degrees forward flexion, 133 degrees abduction, 85 degrees of external rotation and 86 degrees of internal rotation. Range of motion reduced with advancing age in our study can be explained by the age related rotator cuff dysfunction. Results were evaluated based on the Constant Murley Score and DASH shoulder scoring systems. In 86% of cases, there was excellent to good results & fair results in 12% cases. There were two percent poor results in our study.

CONCLUSION

In our study, we conclude that locking plates minimise the possible complications like screw loosening, screw back-out and varus collapse associated with traditional plates. Significant improvement in functional outcome is seen with locking plates due to early mobilisation of shoulder. Functional outcome is directly proportional to the reconstruction and functioning of rotator cuff and proper rehabilitation.

KEYWORDS

Proximal Humerus Fractures, Percutaneous Pinning, Open Reduction and Internal Fixation, Constant-Murley Score, Neer's Classification.

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BACKGROUND

Proximal humeral fractures are the second most common upper extremity fracture and the third most common fracture, after hip fractures and distal radial fractures, in patients who are older than sixty-five years of age. The prevalence of the proximal humeral fracture can be found in between 4-6% of all fractures. Recent epidemiologic analysis estimating the incidence at 63/100,000 per year.

Traditional internal fixation stabilisation methods for proximal humeral fractures include percutaneous K-wiring, screw fixation, tension band wiring and conventional plates and screws and intramedullary nailing.^{8,9} Surgical treatment

either by open reduction and internal fixation or prosthetic replacement has been reported being successful; however, there have been concerns with regard to poor bone quality in elderly population.

Angle-stable plates assure high primary fixation stability. The pitch difference between the wide shaft thread of an angle-stable screw against the fine thread of the screw head has a limited compression effect during final screwing home. Loosening of the screw from the plate is theoretically not possible when correctly anchored. Thus, angle-stable locking plates have biomechanical advantages over conventional plates.

MATERIALS AND METHODS

Study Design

Prospective Study.

Study Place

Department of Orthopaedics.
Siddhartha Medical College, Vijayawada, Andhra Pradesh.

Study Period

July 2014 to July 2016.

Study Population

People attending Outpatient Department of Orthopaedics & Emergency Care Department, Siddhartha Medical College, Vijayawada during the study period.

Inclusion Criteria

- Patients with closed displaced proximal humerus fractures 2-part, 3-part, 4-part and fracture dislocations according to Neer's classification.
- Age group >18 years.
- Intact neurology and vascularity.

Exclusion Criteria

- All Compound fractures were excluded from the study.
- Undisplaced fractures of proximal humerus.
- Patient presenting to our hospital after 3 weeks of injury.
- Skeletally immature patients.
- Patients with pathological fractures.
- Patients with brachial plexus injury.
- Patients with medical contraindications for surgery.

RESULTS

The study of treatment of metaphyseal fractures of upper end of humerus was conducted in the Department of Orthopaedics, Siddhartha Medical College from July 2014 to July 2016. During this period, 42 cases were treated surgically with locking plates and followed up.

In present study, injury more commonly occurred in 41-50 years age group in the study group of 11 years to 70 years age.

80.9% male incidence observed in this study. 73.8% right side incidence observed. 78% of patients came with road traffic accident mechanism of injury, 22% from trivial trauma like slip and fall.

Sl. No.	Type	No. of Cases	%
1	2-part Fracture Surgical neck	20	47.6 %
2	2-part Fracture Greater tuberosity	4	9.5%
3	3-part Fracture Surgical neck + Greater tuberosity	8	19%
4	4-part fracture	1	2.3%
5	Fracture dislocation	9	21.4 %
Table 1. Type of Fracture and Number of Cases			

Significant associated injuries occurred in 13 cases, 5 cases had Colles' fracture, 3 cases had clavicle fracture, 2 cases had blunt injury chest, 1 case had blunt injury abdomen, 1 case with crush injury lower limb, 1 case with fracture neck of femur.

Radiograph 1

Radiograph 2

Intraoperative and postoperative x-ray photographs (radiograph 1 & 2).

Postoperative clinical Photos as below (Four images)

28 cases treated <7 days of injury, 8 cases treated 7-14 days of injury, 6 cases treated >14 days of injury. All 42 patients were treated on deltopectoral approach, 41 cases were treated by PHILOS locking plate, 1 case was treated with cloverleaf locking plate.

Average time of union was 12.5 weeks. Mean followup period was 13.8 months.

Movement	Range of Motion
Forward flexion	116 degrees
Abduction	113 degrees
External rotation	77 degrees
Internal rotation	79 degrees
Table 2. Mean Range of Motion	

Results were evaluated based on the Constant-Murley Score and DASH shoulder scoring systems. In 36 cases, there was excellent to good results and fair results in 5 cases, 1 case had poor result in our study.

DISCUSSION

The result is related to restoration of anatomical alignment and if fracture is treated only with rest followed by early motion, a functional deficit will certainly develop and may be associated with pain. The external support is difficult to apply effectively because fracture site is adjacent to trunk.

Many studies have shown that the displaced fractures of the proximal humerus have a poor functional prognosis when left untreated because of severe displacement of fragments.¹⁰⁻¹³

Numerous investigators have described the various surgical treatment for displaced proximal humerus fracture. There is no consensus on optimal treatment of displaced proximal humeral fractures which account for about 20% of fractures.

In some studies, the objective functional results of conservative treatment have been unsatisfactory. The fractures are defined by variety of classification systems. The difficulty in accurately classifying the fracture creates problems in reporting outcome and also none of the system gives clear prognosis and direction of treatment.

Overall, open reduction and internal fixation, although not in all institution, have yielded satisfactory results. The best results are obtained if the fracture is well reduced and planned rehabilitation program followed. It must be the goal to select fractures for open reduction and internal fixation which can be anatomically reduced. This is dependent on various factors such as type of fracture, the quality of the bone and the technique of reduction and fixation.

The present study was undertaken to know the functional outcome of surgically treated proximal humerus fractures with locking plates. 42 patients with regular follow-up were studied in detail.

In our study, Maximum number of patients i.e. 19 out of 42 cases belong to 41-50 years of age group. Fractures that require surgical management were much more common in men than in women where men constitute 34 out of 42 cases.

According to previous studies, proximal humerus fractures are much more common in woman and those more than 60 years of age. But most of these are low velocity injuries without

significant displacement which can be managed conservatively. So, if we were to take into account the proximal humerus fractures that require surgical intervention, they are more common in adult males. Ours being a tertiary referral centre, those cases requiring surgical intervention are referred to us. These are mostly high velocity injuries with significant displacement and hence need surgical intervention.

In our study, the fracture was more common on right side. Out of 42 cases, there were 31 cases of right side and 11 of left side. Road Traffic accident constituted the majority of cases (32 out of 40 cases) followed by fall from height (6 cases) & trivial trauma (4 cases).

In our study, maximum number of cases belong to Neer's 2-part surgical neck of humerus fractures (24 out of 42 cases) followed by fracture dislocations (10 out of 42 cases) and 3-part fractures (8 out of 42 cases).

Mean followup in our study was 18.9 months ranging from 4 months to 36 months. Average time for union was 12.5 weeks in our study ranging from 12 weeks to 14 weeks.

Out of 42 cases, we have operated 28 cases within 7 days of injury and 8 cases within 7-14 days and remaining 6 cases after 14 days due to delay in presentation to us.

We have operated all our cases through deltopectoral approach where instead of developing deltopectoral plane we go through the substance of deltoid leaving a 1 cm of deltoid intact adjacent to deltopectoral groove. This modification enabled us for the proper lateral placement of plate and also to reduce the displaced greater tuberosity fracture.

We have used locking PHILOS plate (Indian version) in 41 out of 42 cases and Clover leaf locking plate used in one patient. Bone grafting was not used in any of our cases.

Adequate reduction was achieved in 32 cases out of 42 cases. Mean Neck shaft angle calculated on immediate postoperative radiographs is 136.3 degrees and mean angle after fracture healing is 131.6. There is a mean 4.7 degrees varus collapse (mean fall of Neck shaft angle) from initial fixation to fracture healing in our study which is comparable to other studies such as Aditya C Pawaskar et al 2012 reported mean varus collapse of 5.3 degrees in their study using locking plates.

Average range of motion in our study for forward flexion - 116 degrees, abduction - 113 degrees, external rotation - 77 degrees and internal rotation was 79 degrees.

As per our study, range of motion was affected by increase in age, severity of fracture pattern, delay in surgery from time of injury, adequacy of fixation and poor compliance to rehabilitation.

Range of motion was affected by increasing age in our study, best range of motion was found in age group of 20-30 years with a mean of 136 degrees forward flexion, 133 degrees abduction, 85 degrees of external rotation and 86 degrees of internal rotation. Range of motion reduced with advancing age in our study can be explained by the age related Rotator cuff dysfunction.

Range of motion was also influenced by fracture pattern with best results in isolated greater tuberosity fractures and with least in fracture dislocations.

Adequacy of reduction and delay in surgery (late presentation) has significantly influenced the range of motion

with good outcome in adequate fixation and cases operated within 1 week of injury.¹⁴⁻¹⁹

The average clinical result obtained in our study, with a mean Constant-Murley score of 76 points is satisfactory. Correct anatomical reduction with proper plate positioning led to a significantly better result with Constant-Murley score of 81. Whereas the Constant-Murley score was significantly lower i.e. 67 if anatomical reconstruction did not succeed or a non-anatomical reconstruction was accepted intra-operatively.

Functional outcome was also influenced by pattern of fracture with best results in isolated 2-part greater tuberosity fracture (Constant-Murley score - 90) followed by 2-part surgical neck fractures (77.6) and 3-part greater tuberosity fracture +surgical neck fracture (77).

Best functional outcome seen in cases operated within 7 days from time of injury with Constant-Murley score of 77.8.

In our study for the cases operated after 14 days of injury (due to delayed presentation), the mean Constant- Murley score was 73.6.

There were total seven complications in five patients. Three cases had shoulder stiffness and another case had screw penetration (screw removal was done after 2 months). Three more cases developed avascular necrosis of humeral head, implant removal was done after fracture union.

We did not encounter even a single case of screw loosening or screw back-out within these 42 cases, signifies the stability of locking plate construct.

The treatment of complex humeral 3- or 4-part fractures represents a challenge. It is must to obtain an exact anatomical reduction and stable fixation and at the same time minimize the iatrogenic risk of avascular head necrosis by maximal protection of the periarticular soft tissues. Poor results in these complex fractures are often attributable to one of three causes or all:

1) Inadequate fracture reduction especially of the tuberosities and medial calcar support. 2) Unstable fixation or incorrect positioning of the fixation devices. 3) Osteoporosis 4) Poor compliance to rehabilitation. The development of aseptic Humeral head necrosis (3 patients) significantly affected the clinical result; these patients achieved a mean Constant-Murley score of 52.8. In the literature the rate of necrosis for 3-and 4-part fractures has been between 0% and 50%, depending on the osteosynthesis procedure. The rate of Humeral head necrosis (7 %) in our study is acceptable and lies in the lower range reported in the literature.

The functional outcome after angle-stable locking plating at present is comparable to other studies in literature and functional outcome convincingly better than other fixation options.

Sl. No.	Investigator	Result
1	Wijgman et al	87% good to excellent
2	Chen et al	84% good to excellent
3	Park et al	89% good to excellent
4	Court-Brown et al	80.6% good to excellent
5	Our Study	86% good to excellent

Table 3. Comparison of Various Investigator Results

Sl. No.	Investigator	Method of Treatment	Constant Score
1	Robinson And Page	Minimally invasive screw fixation	68
2	Wijgman et al	ORIF with cerclage wires or T-plate	67
3	Hessmann et al	ORIF with T-plate $\pm$ bone cement or bone graft	69
4	Wanner et al	ORIF with Double one-third tubular plate	61
5	Koukakis et al (2007)	Angle-stable locking humerus plate	73.6
6	Fankhauser et al (2005)	Angle-stable humerus	74.6
7	Our study	ORIF with locking plates	76
Table 4. Comparison of Various Methods by Constant Moore Score			

In all cases pendulum exercises were started as early as possible, as tolerated by patients. Assisted motion exercises were started at around 2-3 weeks and active exercises were started at around 3 weeks (based on the radiological picture). Some shoulder stiffness was present in most of the cases initially, but it responded to physiotherapy.

In a study conducted by Fazal et al it was seen that PHILOS plate fixation provided stable fixation with minimal implant problems and enabled early range of motion exercises to achieve acceptable functional results. In the present study, it was concluded that PHILOS plate provides an excellent stable construct even in multifragmented osteoporotic proximal humerus fractures with the advantages of accurate reduction and early mobilisation. Fixation with percutaneous K-wires may present an efficient treatment option for 2- or 3-part proximal humerus fractures with its advantages of minimal invasiveness and less soft tissue dissection. Better functional results were seen in patients treated with PHILOS plate than those treated with percutaneous K-wire fixation.

In a recent research done by Dr Inayat Panda, Dr Harshad G. Argekar, Volume-5, Issue-8, August - 2016 ISSN No 2277 – 8160, in their study, they found 9 out of 34 (26%) patients to have suffered complications. The most common complication was found to be subacromial impingement and varus malalignment (in 9% of the cases each; 3 out of 34 cases), the proximal humerus locking plate system was effective in maintaining fracture reduction in proximal humerus fractures. Due to stable restoration, early functional aftercare was possible and allows the patient to regain good shoulder function and return to work earlier. Loss of reduction was rarely seen compared with other implants. Complication incidence proportions increased in older patients due to higher rates of secondary impaction, screw perforations, and humeral head necrosis. Patients older than 50 years had a higher incidence of developing any type of complication. Osteonecrosis was mostly seen in severe fracture types. Fixation with the proximal humerus locking plate is a near ideal technique with a high union rate in the treatment of proximal humeral fractures.

CONCLUSION

1. Proximal humerus fractures associated with high velocity injuries require surgical intervention, and are more common in adult males.

2. Road traffic accidents constitute the most common mechanism of injury.
3. Two-part fracture involving the surgical neck of humerus is the most common type of fracture.
4. Adequate reduction and correct placement of plate are key to obtain good functional outcome.
5. Range of motion is adversely affected by increasing age, severity of fracture pattern, inadequate reduction and delay in surgery from the day of injury.
6. Isolated greater tuberosity fracture yields good functional outcome when compared to other fracture patterns.
7. Locking plates minimise the possible complications like screw loosening, screw back-out and varus collapse associated with traditional plates.
8. A final image intensifier check with rotation of head to verify correct placement of screws is recommended in all cases.
9. Significant improvement in functional outcome is seen with locking plates due to early mobilisation of shoulder.
10. Functional outcome is directly proportional to the reconstruction and functioning of rotator cuff and proper rehabilitation.

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