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ORIGINAL RESEARCH

To study the functional outcome of proximal humerus fractures treated with locking plates

[1]Dr. Varun Chatrabhuj Shelke, [2]Dr. Nitin Machhindra Ghule, [3]Dr. Anuja Patil, [4]Dr. Swapnil Vasudeo Sonar

[1,2,4]Assistant Professor, Department of Orthopedic, Dr. BVPRMC, Loni B.K., Maharashtra, India
[3]Assistant Professor, Department of Pathology, Bharati Vidyapeeth Medical College, Pune, Maharashtra, India

Corresponding author
Dr. Swapnil Vasudeo Sonar
Assistant Professor, Department of Orthopedic, Dr. BVPRMC, Loni B.K, Maharashtra, India

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ABSTRACT

Introduction: Fractures of proximal humerus account for about 4 - 5 % of all the fractures. There frequency increases in relation to the presence of Osteoporosis. In undisplaced and stable fracture pattern, conservative treatment yields a fairly good result. In this retrospective study, we will focus on the early results and the functional outcomes of the Locking plates for the proximal humeral fractures, with specific respect to fracture and soft tissue healing, radiological union, immobilisation period, infection rates and other complications encountered. **Materials and Methods:** Patients admitted under Orthopedic department those who suffered proximal humerus fractures in whom operative line of management was considered, in the form of plate osteosynthesis with locking plates. These were assessed for functional outcome using the UCLA (University of California and Los Angeles) score, VAS score and radiological union. **Results:** Functional outcome seems to be better in 2 part and 3 part fractures compared to 4 part and fracture dislocation and better in younger age group compared to older.60.86% had excellent-good results while 8.69% had fair and 30.43% had poor results. Fair or poor results were mostly seen in 4-part fractures and fracture-dislocation. **Conclusions:** Open reduction and Internal fixation of proximal humerus fractures with Locked Compression Plates gives good early functional results with union in all fractures.
Keywords: humerus, undisplaced, proximal, osteosynthesis.

INTRODUCTION

Fractures of proximal humerus account for about 4 - 5 % of all the fractures.[1] They are the second most common upper-extremity fracture and the third most common fracture, after hip fractures and distal end radial fractures, in patients who are older than sixty-five years of age [2,3] There frequency increases in relation to the presence of Osteoporosis.[4] Although the overwhelming majority of proximal humeral fractures are either non-displaced or minimally displaced and can be treated with sling immobilization and physical therapy,[5] approximately 20% of displaced proximal humeral fractures may benefit from operative treatment.[5,6] In undisplaced and stable fracture pattern, conservative treatment yields a fairly good result, but unstable and displaced fractures especially in young individuals require anatomical reduction and stable fixation.[7]

Plate osteosynthesis as a modality of treatment is used in unstable displaced two, three and four part fracture (according to Neer's classification). The type of plate used is highly variable and surgeon specific. Standard proximal humerus buttress plate gives good stability but needs good bone stock for adequate purchase.[8] Angled blade plate fixation is effective in two and three part fractures.

There has been increasing trend towards the use of locking plates (LCP) in recent times. Locking plate technology has been developed as a solution to the problems encountered during conventional plating to treat fractures in osteoporotic bone particularly with metaphyseal comminution.[9] They have been called the "locked internal external fixators".[10] The key to this technology is fix angle relationship between the screws and plate. The threaded screw heads are locked into the threaded plate holes to prevent screw toggle, slide and pull out, thus diminishing the possibility of primary or secondary loss of reduction. Even biomechanical analysis studies have showed the superiority of such a fixation when compared to a standard proximal humerus buttress plate fixation.[11] Therefore In this retrospective study, we will focus on the early results and the functional outcomes of the Locking plates for the proximal humeral fractures, with specific respect to fracture and soft tissue healing, radiological union, immobilisation period, infection rates and other complications encountered.

MATERIALS AND METHODOLOGY

This was a retrospective study in which 23 cases of proximal humerus fracture admitted under Orthopedic department those treated surgically with open reduction and internal fixation with locking plate were studied. There were certain inclusion criteria followed in the study that include all patients with proximal humerus fractures with age more than 20 yrs (physis closed), all displaced unstable fractures with or without comminution not amenable for conservative treatment and treated with plate osteosynthesis with TCP. Exclusion criteria include all open fractures, fractures associated with neurovascular deficits; other associated severe fractures of the same extremity, associated severe medical co-morbidities that might influence the outcome of this study, pathological fractures, previous surgeries on the affected shoulder and head splitting fractures.

Vitals were recorded and thorough general examination to rule out other injuries was done. Attitude of the limb was noted. Local examination of the shoulder was done to note swelling, ecchymosis, tenderness, abnormal mobility, neurovascular deficits. Injection diclofenac 50 mg i.m was given for pain relief to the suitable patients and shoulder was stabilized with shoulder arm pouch. Radiographs were taken after splinting the limb temporarily in an arm sling. In the post-operative period patients were given intravenous antibiotics of the 3^{ld} generation Cephalosporin group and Aminoglycosides for at least 2 days. The analgesics were given subject to pain tolerance. Drains were removed at 2nd post-operative day, followed by dressings of wound on 2,5 day and suture removal done on 12th or 14th day. Immobilisation of the shoulder was done with either the Universal shoulder immobilizer or an arm sling for at least 2 weeks duration. All the patients were followed up at 2 weeks for suture removal. Later at around 4, 8, 12, 16, 20 weeks followed by 1 year. At every visit clinical assessment regarding union, pain, range of movements and rotator cuff strength was done.

RESULTS

Table 1 summarized the gender-wise distribution of all the study participants wherein this study clearly showed male predominance. And in table – 2 which displayed age-wise distribution where increased number of patients 30.4% was reported in age group of more than 70 years, followed by 41 – 50 years. Table – 3 compiled the mode of injury which

showed a majority of 65.2% met with road traffic accidents. Also the affected side is dominant in more than 60.9% and considering the comorbidities, diabetes was observed in 30.43% followed by hypertension in 17.3%.

Table – 4 revealed the rotator cuff strength grade which observed that type-II, III showed strength grade of 4.5. Considering the visual analogue scale (VAS), median VAS of 0.5 seen in type – II and 1 in type – IV as given in table – 5. Table – 6 reported the patients distribution based on UCLA (University of California and Los Angeles) scale and showed that excellent score was observed in type – II and type – III fracture. High number of poor outcome cases was reported in type – IV fracture.

Table 1: Gender wise distribution of patients

Gender	Number of patients	Percentage (%)
Male	13	56.5
Female	10	43.5
Total	23	100.0

Table 2: Age wise distribution of patients

Age group	Number of patients	Percentage (%)
<30	3	13.0
31-40	3	13.0
41-50	4	17.4
51-60	3	13.0
61-70	3	13.0
>70	7	30.4
Total	23	100.0

Table 3: Patient distribution with respect to mode of injury, affected side, associated co-morbidities

Mode of injury	Number of patients	Percentage (%)
Domestic fall	8	34.8
RTA	15	65.2
Total	23	100.0
AFFECTED SIDE		
Dominant	14	60.9
Non-dominant	9	39.1
Total	23	100.0
COMORBIDITIES		
Diabetes	7	30.43
Hypertension	4	17.39
Stroke	1	4.35
Nil	14	60.87

Table 4: Comparison of rotator cuff strength grade with respect to type of fracture

Fracture type	Number of patients	Rotator cuff strength grade	p-value
Type II	6	4.5	0.005
Type III	12	4.5	
Type IV	4	3.5	

Table 5: Comparison of visual analogue score (VAS) with respect to type of fracture

Fracture type	Number of patients	Median VAS	p-value
Type II	6	0.5	0.002
Type III	12	0	
Type IV	4	1	

Table 6: Distribution of patients with respect to UCLA score and type of fracture

UCLA score	Type of fracture			Total	p-value
	Type II	Type III	Type IV		
Excellent	4(66.67%)	5(41.66%)	0	9	0.026
Fair	1(16.67%)	1(8.33%)	0	5	
Good	1(16.67%)	4(33.33%)	0	2	
Poor	0	2(16.66%)	4(100%)	4	
Total	6	12	4	22	

Table 7: Outcome comparison according to the age

Age group	Number of patients	UCLA		p-value
		Mean	SD	
<60	13	30.77	6.73	0.149
>60	10	26.40	6.78	

Table 8: Age-wise comparison of range of motion

outcome	Degree (Mean ± SD)		p-value
	<60	>60	
Flexion	153.08 ± 13.62	127.50 ± 19.47	0.003
Abduction	144.23 ±21.97	110.50 ±24.55	0.003
Internal rotation	83.08 ±8.05	67.50 ±20.31	0.042
External rotation	76.15 ±7.68	56.00 ± 18.07	0.007

DISCUSSION

The treatment objective in proximal humerus fractures is to achieve bone and soft tissue healing, to maximize function of the upper extremity. Most fractures are extra-articular and are minimally displaced.[1] Therefore, these fractures may be treated with conservative treatment and good results obtained when rehabilitation is started as early as 3 weeks after injury.[12] Persons with stable fractures can begin early rehabilitation and have superior functional outcomes.[12] Percutaneous pinning, although avoiding extensive soft-tissue stripping, requires prolonged period of immobilization and suffers from problems of pin migration, loss of reduction and infection. Hemiarthroplasty allows early range of motion and provides pain relief but suffers from limited functional outcomes, caused partly by non-union or mal-union of the greater or the lesser tuberosity fragment.[7]

Plate osteosynthesis is one of the modality where accurate reduction of the fractured fragments can be achieved giving a chance to satisfactory results in displaced fractures. However, this method has been limited by difficulty obtaining both adequate exposure and stable fixation without compromising soft tissue structures.[13] Various modalities of internal fixation have been tried which includes k-wires and screws, bent semitubular plate, buttress T-plate, clover leaf plates, proximal humeral locking nails, fixed angle locking plates, etc.[7]

In our study, the number of patients in the age group of <60 years were 13(56.52%) and those >60 years were 10(43.47%).Most of the patients above 60 years of age sustained fracture

after trivial domestic fall and had osteoporotic bones. The mean range of motion and UCLA achieved in patients <60 years was greater compared to those >60 years but there was no statistical significant difference between the two age groups. This was comparable to the studies by *Moonot* et al (2007)[9] and *Kettler* et al (2006)[14] as against other studies like *Owsley* et al (2008)[15], *Siebler* et al,[16] *Mehmet* et al[17] showed less favourable results in aged patients. The sex ratio in our study was 1.3:l (male: female). The increased incidence of displaced fracture requiring plate osteosynthesis in males was due to more incidences of high energy trauma and subsequent displaced fractures in males compared to females.

In this study, 65.2% of the patients who underwent plate osteosynthesis with LCP for displaced proximal humerus fractures had sustained RTA and 34.8% of the patients had domestic trivial fall. This was comparable to study by *Esser* et.al[18] in whom more than eighty percent of the patients with displaced three-part or 4-part fractures had sustained high energy trauma. Thus it can be inferred from this study that high energy trauma may cause more incidence of displaced fractures requiring plate osteosynthesis as the modality of treatment. In the present study 60.9% sustained injury to the dominant limb and 39.1% sustained to the non-dominant limb. This is in comparison to the series reported by Gerber et.al in which 47% sustained injury to left non-dominant side and 5.3% to dominant right side. Thus in present study dominant side is involved in the majority of the patients.

The average Visual analogue scale score in our study group was 0.91 points (0-3 points). *Zhang* et al[19] in his study of humeral head replacement and internal fixation for the 3 parts and 4 parts fractures of proximal humerus in 58 elderly patients showed that VAS score in LCP group and humeral head replacement group were (2.2 +/- 1.5) and (2.6 +/- 1.9) respectively with statistically significant difference (P = 0.002). Emanuel et al" in his study of PHILOS plate fixation for displaced proximal humeral fractures in 28 patients showed a mean VAS score of 2.3 at the end of 2 years follow up.

The average UCLA score in our group was 28.21 (range of 11 - 35) with good to excellent result in 60.86% of cases and fair to poor result in 34.78% of cases at the end of our study. There was significant difference between the UCLA scores with respect to the type of fracture. *Handschin* et al[20] in his study of 31 patients showed that the UCLA scores were excellent in 10%, good in 67%, and fair in 23% of the patients treated with PHILOS plate fixation at the end of 19 months of follow up. *Helwig* et al[21] in his prospective series of 87 patients treated with fixed angle plates showed that the UCLA score was excellent to good in 52% of cases. Mean UCLA score was better in <60 years (30.77%) compared to >60 years (26.40%).

CONCLUSION

Open reduction and internal fixation of proximal humerus fractures gives good early functional results with union in all fractures. Open reduction and plate fixation with locked plates achieves stable fixation in most of the cases thus permitting early joint mobilization exercises and avoid possible stiffness of the shoulder joint. This remains the biggest advantage of this technique over other modalities of osteosynthesis.

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