



STUDY OF PROXIMAL HUMERUS FRACTURES TREATED BY ANATOMICAL LOCKING PLATES

Orthopaedics

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ABSTRACT

Background: It is controversial to debate on the treatment of the proximal humerus fracture; in literatures various operative modalities have been tried. There are multi-factorial difficulties in open reduction and internal fixation including osteoporotic bone, implant impingement, angular instability, loss of reduction and backing out of screws. Objectives of our study were to evaluate the results of proximal humerus anatomical plate in various groups like Neer's type 2, 3 & 4 fractures, young and old patients.

Methods: The study analyzed 15 men and 10 women aged 26 to 75 (mean, 46.64) years with Neer's 2, 3 or 4 part proximal humerus fractures treated by anatomical locking plate. Shoulder range of movements and Functional outcomes were assessed based on the Constant and Murley scoring system.

Observation & Results: In our study, 13 cases had 2 part fractures as per Neer's classification, while 11 cases had 3 part and 2 had four part fractures with the mean follow up of 11.8 (range 6-18) months. Out of 26 cases, 3 (11.54%) had excellent outcome, 12 (46.15%) had good outcome, 8 (30.77%) had fair outcome and 3 (10%) had poor outcome. Results were satisfactory in patients younger than 60 years, while unsatisfactory results were seen in more than 60 years of age.

Conclusion: Anatomical locking plate leads to satisfactory functional outcomes in 2 & 3 part fractures but results are unsatisfactory in 4 part fractures and in older age group. This study teaches us that in fractures of proximal humerus, restoration of joint congruity is vital for restoration of joint function. Restriction of external rotation abduction suggests that greater tuberosity fragment must be anatomically reduced. Strict adherence to shoulder mobilisation protocols and compliance of patient can improve the results.

KEYWORDS

Proximal humerus fractures, Anatomical locking plate, Constant and Murley score, Neer's classification

INTRODUCTION

Proximal humerus fracture presents an existent challenge to surgeons. Fractures of the proximal humerus signify roughly 4% of all fractures and 26% of humerus fractures.^[1]

Proximal humeral fractures have a bimodal distribution occurring either in younger age group following high velocity injuries or in older people with low velocity injuries like simple fall.^[2] In elderly individuals, fracture of the proximal humerus is the 3rd most common fracture, following hip fracture and Colles' fracture. 80 % of these are osteoporosis related, more common in females as compared to males (3:1)^[3,4]. Initially there was a common agreed conservative approach to proximal humerus fractures and internal fixation became more prominent after Neer's classification. Following which Neer's prosthesis was also used for comminuted fractures. However, with availability of modern plates like PHILOS (Proximal Humeral internal locking osteosynthesis) the interest in osteosynthesis again came up. The present day treatment goal would be to achieve fracture union with painless shoulder and restoration of function.^[5]

These anatomical plates are pre-shaped and pre-contoured locking compression plates, with an aiming device for insertion of the locking screws and positioning of the plate to prevent impingement. Fixed angle relationship between the screws and plate is the key to this technology. The threaded screw heads are locked into the plate holes to prevent slide and pull out, screw toggle and thus diminishing the possibility of primary or secondary loss of reduction following fixation. Locking the screw to the plate mechanically recreates a point of cortical bone contact,^[6] which may be useful in the poor cancellous bone of the proximal humerus.

Multiple holes in the proximal part of the plate are also available for suture anchors passed through rotator cuff and soft tissue attached to

tuberosities which gives additional stability.^[7] The anatomical locking plate can therefore provides an excellent stable construct even in multi-fragmented osteoporotic proximal humerus fractures.

Our study was planned to evaluate functional outcome of proximal humeral fractures treated with open reduction and internal fixation with anatomical locking plate with view to evaluate range of movement, possible return of functions around shoulder girdle, radiological outcome and remaining disability, to evaluate the complications and to identify the predictors of loss of fixation of such an implant.

MATERIAL AND METHOD

The study was conducted in our institute on a consecutive series of patients for the treatment of displaced 2-part, 3-part, and 4-part proximal humerus fractures (as defined by Neer's criteria). The study consist of total of 25 patients. The study was approved by the Ethical and Research Committee of SumandeepVidyapeeth, Pipariya, Vadodara.

INCLUSION CRITERIA

1. Proximal humerus fractures due to trauma (excluding pathologic fractures)
2. Patients greater than 18 years of age.
3. Closed two part fracture with a major displacement of the humeral diaphysis or three or four part fracture.

EXCLUSION CRITERIA

1. Skeletally immature patients (less than 18 years).
2. Patients with open fractures
3. Pathological fractures,
4. Patients with distal neurovascular deficit
5. Patients with nonunion, malunion or delay in surgery (>10 days),

- Displaced 3 or 4 part fractures with significant bone loss (as seen on CT scan) suggesting insufficient screw purchase and thus treated by humeral arthroplasty.

All the patients were treated according to a protocol which consisted of standard antero-posterior and axillary view digital X-ray and pre-operative CT scan if need Standard deltopectoral approach was used with the patient in the beech-chair position. As per bone quality and type of fixation, post operative rehabilitation was carried out. Elbow and wrist range of movements were started in all the patients within 7 days of surgery. Pendulum and circumduction exercises were started at 0-4 weeks while passive abduction exercises were started at 4-8 weeks. Assisted ROM was started at 8- 12 weeks, while full range of movements and strengthening exercises were allowed only after 12 weeks in most of the cases.

Functional assessment

The functional assessment was done using **Constant and Murley scoring system** devised in 1985 and published in 1987. It has four basic parameters to be assessed.

- Pain (15points)
- Activities of daily living (20points)
- Range of motion (40points)
- Power (25points)

Total score is 100 for each shoulder

Final evaluation was graded as follow:

Poor- 0 to 55, Fair- 56 to 70, Good- 71 to 85, Excellent- 86 to 100.

OBSERVATION AND RESULT

This study was carried out in Dhiraj Hospital, SBKS Medical Institute and Research Centre; there were total no of 25 patients out of whom 1 patient had bilateral fractures, so there were total 26 fractures. In age group of 21-30 years and above 60 years there were only 6 patients. However, majority of the patients were between 31-60 years. The mean age in our study was 46.64 years. In the present study, 15(60%) patients were male while 10(40%) patients were female. In the present study, 14(56%) patients had road traffic accident as mode of injury. 11 (36%) patients were injured by domestic fall.

The most common type of fracture encountered in the present study were 2 part surgical neck fracture (11 patients, 42.3%) and 3 part fracture (Surgical Neck + Greater tuberosity) (11 patients, 42.3%) with equal incidence. 2 (7.7%) patients had 2 part Anatomical Neck fracture, while 2 (7.7%) patients had 4 part fracture (Surgical Neck + Greater tuberosity + Lesser tuberosity). In our study, 1 (3.85%) patient had infection, 1 (3.85%) patients had impingement of implant, one patient (3.85%) had implant loosening (failure of implant) and one (3.85%) had screw perforation into head. There was no incidence of neurovascular deficit.

During the follow up period 5 patients had shoulder stiffness (19.23%), 3(11.54%) patients had malunion. Revision surgery was required in two patients. In 1 patient there was implant failure, so implant removal and re fixation with intramedullary rush pin and tension band wiring was done. While in other patient loosening of implant was treated by refixation of plate and additional insertion of intramedullary rush pin. Most of the fractures were united by 12-14 weeks post operatively. The mean time for union was 13.69 weeks. The average union time for two part fracture was 13.54 weeks, three part fracture was 12.36 weeks and 14 weeks for four part fractures with overall average union time of 13.07 weeks.

In our study, most of the patients (65%) pain was relieved by the end of 1 month, 19 (73.07%) cases were able to perform their daily work, but Full recreation was possible in only 15 (57.69%) fractures. Above head movement was possible in 4 cases while 11 cases (42.31%) were able to elevate shoulder up to 120 degree. In present study, 13 cases (50%) were able to abduct shoulder more than 90 degree.

In our study almost all the cases were able to place the hand behind the head with elbow held forward and elbow held back. 15 cases (57.69%) were able to place the hand on the top of the head with elbow held forward while 5 cases (19.23%) were able to place the hand on top of the head with elbow held back. In our study almost 13 cases (50%) were able to place the dorsum of the hand up to 12th dorsal vertebrae, while 3

cases (11.54%) were able to place the dorsum of hand up to interscapular region. In present study 17 cases (65.38%) were able to lift up to 5-7 kg weight while 5 cases (19.24%) were able to lift up to 8-10 kg weight.

Out of 25 patients (26 shoulders) 3 (11.54%) had excellent outcome [FIGURE 1], 12 (46.15%) cases had good outcome, 8 (30.77%) cases had fair outcome and 3 (10%) cases had poor outcome. type 2 fractures results were good to excellent, in type 3 fractures results were fair to good, while 4 part fractures had poor to fair results. In our study good to excellent results were seen in most of the patients younger than 60 years, while in patients elder than 60 results were fair to poor in most of the cases.

FIGURE 1



A. Pre-op Xray B. Follow Up X ray



C. Follow up Movement

DISCUSSION

Treatment of proximal humerus fractures remains a difficult problem for the orthopaedic surgeon. Several techniques and implants have been used for the fixation of these fractures. For the displaced fractures, there is no consensus on the best treatment modality, with some studies favouring prosthetic replacement^[8,9,10] and others are in favor of open reduction and plate fixation^[11,12]. The main goal of treatment is optimal restoration of limb function.

Use of the locking plates yields greater stability to the fixation of fracture. Rose et al. encountered 75% excellent results in their casuistry, considering the stable fixations and early rehabilitation^[13]. Open reduction, in spite of the morbidity of surgical access, allows perfect anatomical reduction of the fracture. Rigid fixation with locking plate favours immediate assisted mobility, avoiding stiffness and pain as sequel of the fracture. Successful osteosynthesis of the proximal humerus can be difficult to achieve, especially in metaphyseal bone of the humeral head that has been described as an egg shell as there is little bone in the centre of the head^[14]. The use of locking plates for osteoporotic fractures has increased greatly in the past decade and has changed management of many fracture types particularly in the proximal humerus. Locking plates allows rigid fixation of proximal humerus fractures that has been suggested to improve mechanical stability and therefore potentially result in better outcomes^[15].

Biomechanical evaluation of proximal humeral locking plates has demonstrated better biomechanical characteristics compared with a locked proximal humeral nail in varus bending and torsion^[15].

In the present study, majority of the patients were between 31-60 years. The average age of patients was 46.64 years, ranges from 26 to 75 years, which was consistent with the age incidence in studies done by Kulkarni S et al^[20] 52.5 (21-76), Annamalai Regupathy^[18] 54.45 (18-81), Sreen S. Et al^[17] 58 (22-78) and Bansal V et al^[19] 49.24 (19-82).

Our study shows that most of the proximal humerus fractures are osteoporotic fractures in women over the age of 50 due to lack of postmenopausal treatment and its awareness that increase the risk

factors for osteoporosis and the second is the risk of falling due to comorbidities.

In the present study, 56% patients had history of road traffic accident, 11 (44%) patients were injured by domestic fall, Western literature^[22,23] has shown proximal humerus fractures to be more common in elderly females. In contrast to majority of western studies that consider low energy falls as a more common cause, road traffic accidents were more common in Indian studies^[19,20] As per **Table No. 1**.

Table No. 1 COMPARISON OF MODE OF INJURY

STUDY	Domestic Fall	Road traffic accident	Fall from height	Total
Sudkamp et al[21]	162(86.63%)	25(13.37%)	0	187
Resch et al[22]	20(74.08%)	4(14.81%)	3(11.11%)	27
Kulkarni S et al[20]	22(36.67%)	38(63.33%)	-	60
Bansal V et al[19]	5(20%)	17(68%)	3(12%)	25
Present Study	9(36%)	14(56%)	2(8%)	25

Table No. 2 COMPARISON OF TYPE OF FRACTURE

Study	2 part	3 part	4 part	Total
Solberger et al[24]	48(46.2%)	38(36.5%)	18(17.3%)	104
Bansal V et al[19]	11(44%)	11(44%)	3(12%)	25
Sreen S et al[17]	11(34.4%)	16(50%)	5(15.6%)	32
Kumar et al[25]	12(29.27%)	18(43.9%)	11(26.8%)	41
Present Study	13(50%)	11(42.3%)	2(7.7%)	26

Postoperatively out of this two diabetic patients one presented superficial infection which was managed by antibiotics and antiseptic dressings. In our study the average radiological union time was 13.07 weeks. Similarly union time observed in Kumar et al^[25] was 12 weeks and in Bansal V et al^[19] was 11.2 weeks. Average union time for 2 part (13.54 weeks) & 4 part fracture (14 weeks) was longer compared to 3 part (12.36 weeks) fractures.

Shoulder stiffness observed in 5 (19.23%) patients) who were elderly and unwilling to undergo vigorous rehabilitation program. 3(11.54%) patients had malunion, Implant loosening (failure of implant) was seen in 1 (3.85%) patient that required refixation of plate and intramedullary rush pin. Postoperatively impingement was observed in 1 (3.85%) patient who had severe limitation of overhead abduction initially associated with severe pain. He got his plate removed at 5 months postoperatively with re-fixation by intramedullary rush pin and tension band wiring and good functional score was seen. Re-surgeries were required in 2 (7.7%) patients, comparable to 10% revision surgery rate in Wright et al^[26]

Evaluation According to Constant criteria, we found that sleep was not disturbed due to shoulder pain in any of the patients. For their day to day activities like putting on clothes, eating, etc. 7 patients had complaint of some restrictions in recreational sports activity especially in throwing of objects. Almost 90% of the patients could position the hand up to the head or top of the head. If we analyze all the patients put to gather, it has been observed that forward flexion or elevation are usually satisfactory in all the patients, only 1 patient had unsatisfactory result.

Abduction is one of the prime importance and almost 50% shoulders had abduction less than 90 degree, at the time of final follow up. External rotation is another prime function, following proximal humerus fractures, especially in 3 part fractures associated with greater tuberosity fractures. Almost 21 shoulders did not have full external rotation. 15 cases (57.69%) were able to place the hand on the top of the head with elbow held forward while 5 cases (19.23%) were able to place the hand on top of the head with elbow held back. In present study, 17 cases (65.38%) were able to lift up to 5-7 kg weight while 5 cases (19.24%) were able to lift up to 8-10 kg weight.

The mean constant score at final follow-up in our study was 68.78 that is comparable to 72.08 in Aggarwal et al^[27] and 72.3 in Kumar et al^[25] We found that the highest constant score was 91.5 for Neer's type 3 fracture and the lowest constant score that was 40 in type 4 fracture. In our study also the mean Constant score for 4-part fractures was 47.75 which were inferior as compared to 2-part and 3-part fractures (71.07 and 64.14 respectively). These results are comparable to other studies like Aggarwal et al^[27] and Kumar et al^[25] in which the mean Constant

score for 4-part fractures was significantly inferior to other types. These results were expected as these fractures are more complex and open reduction and internal fixation is tougher.

Table No. 3 COMPARISON OF RESULTS

Study	Excellent	Good	Fair	Poor
Bansal V et al ^[19]	4(16%)	11(44%)	4(16%)	6(24%)
Tingjun Ye et al ^[28]	2(2.2%)	32(36%)	40(44%)	15(16.9%)
M.H. El Sayed et al ^[29]	14(23.8%)	27(45.7%)	15(25.5%)	3(16.9%)
Aggarwal et al ^[27]	8(17.2%)	18(38.3%)	16(34.04%)	5(10.64%)
Present Study	3(11.54%)	12(46.15%)	8(30.77%)	3(11.54%)

We found considerable difference in outcome between patients of age group less than or more than 60 years of age. Those patients more than 60 years of age group showed more unsatisfactory results, while similar findings have been reported by Aggarwal et al^[20] who found the Constant scores to be higher in younger patients as compared to older patients (>65). This may be due to secondary degenerative changes as well as age related osteoporosis. Finally, although this study suggested that fixation of 3 and 4 part high energy fractures using the anatomical locking plate is preferred method of treatment, and when well performed is expected to give relatively favourable results. It is worth to mention that this type of treatment was found to be of special value in young active patients due to the early rehabilitation.

This study teaches us that in fractures of proximal humerus, restoration of joint congruity is vital for restoration of joint function.

CONCLUSION

The present study on 25 patients with proximal humerus fractures treated by anatomical locking plates was conducted at our Institute. Average union time of 13 week, ranging from 10 to 18 weeks. We observed that 3 part fractures united earlier compared to 2 & 4 part fractures. Restriction of function for their activities of daily living was observed in 7 patients. Following this fracture fixation we have observed that 3 movements are compromised to a large extent, that are abduction, external rotation & internal rotation. There were 10 satisfactory results and 3 unsatisfactory results in 2 part fractures. In 3 part fractures, 5 results were satisfactory and 6 were unsatisfactory. While in 4 part fractures, both the results were unsatisfactory.

Finally, this suggested that fixation of 2, 3 and 4 part fractures using the anatomical locking plate is preferred method of treatment, and when well performed is expected to give relatively favourable results. We have observed that shoulder protocol exercises, if applied correctly can give good outcomes in any type of fractures and compliance on patient's part is necessary. This study teaches us that in fractures of proximal humerus, restoration of joint congruity with rotator cuff stability is vital for restoration of joint function. Restriction of external rotation and abduction suggests that greater tuberosity fragment must be reduced anatomically.

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