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Open reduction and internal fixation in proximal humerus fractures by proximal humerus locking plate: A study of 60 cases

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Abstract

Introduction: With respect to approach of proximal humerus fractures there has been a wide variation in optimum modality of treatment ranging from conservative treatment to total and reverse shoulder arthroplasty. We have evaluated the outcome of efficacy of proximal humerus locking plate in displaced proximal humerus fractures.

Methods: A total of 60 patients with displaced proximal humerus fractures were included in the study after careful inclusion and exclusion criteria. All fractures were fixed with proximal humerus locking plate and patients were followed up at regular intervals. Final evaluation was done based on Constant and Murley shoulder scoring system.

Results: According to Constant and Murley shoulder scoring system there were excellent results in 56.66% cases, good in 18.66%, fair in 13.33% and poor in 11.66% cases. There was no incidence of superficial or deep infection. There were 3 cases of AVN, 4 cases of varus collapse and 2 cases each of implant failure and non-union.

Conclusion: Proximal humerus locking plate provides better fixation in proximal humerus fractures particularly in elderly and osteoporotic patients. Calcar screw placement is vital for prevention of varus collapse of fracture.

Keywords: proximal humerus fracture, avascular necrosis, varus collapse

Introduction

The incidence of proximal humerus fractures account for upto 4-5% of all fractures and are second most common injuries of upper limb [1]. There are wide range of treatment options for proximal humerus fractures ranging from conservative treatment in form of strapping and immobilization, close k-wiring, tension band wiring, open reduction and plating, intramedullary nailing, to prosthetic replacement, total shoulder replacement and reverse shoulder replacement [2-4]. With advancing age and osteoporosis the risk of poor results keeps on increasing irrespective of the modality of treatment [5-7]. Each technique is associated with varying incidence of post-operative stiffness and restriction of movements to implant failure, osteonecrosis, non-union, mal-union and rotator cuff weakness. Ponce *et al.* based on their cadaveric study concluded that medial comminution significantly decreased the stability of proximal fixation constructs and calcar restoration with screw fixation was vital in improving the stability of repaired fracture [8]. Conservative treatment of stable, minimally displaced fractures has consistently given good results. It is the displaced and unstable fractures and those with dislocations that require operative management. Long term results of close reduction and k-wiring have been consistently giving good results probably due to preservation of soft tissue injury and preserving the vascular supply [2]. ORIF has distinct advantages of anatomical reduction and early mobilization but it also increases the incidence of avascular necrosis, and wound infection [4]. Sproul *et al.* have found a complication rate of as high as 49% in a series of 514 patients and a re-operation rate of upto 14% [9]. Locked plates act as internal-external fixators thereby acting as angle-stable constructs and provide higher pull out strength of locked screws. Final outcome is largely dependent on severity of injury, age, medical condition, activity level, osteoporosis, post-operative rehabilitation programme, use of appropriate locking plates with restoration of rotator cuff anatomy.

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Proximal humerus locking plate provides greater angular stability than other conventional implants, by providing better anchorage in porotic bones [8]. Present study was performed to assess the efficacy of proximal humerus locking plate for displaced proximal humerus fractures.

Material and Methods

A prospective study of 60 cases of open reduction and plating in displaced proximal humerus fractures was done at GMERS Medical College and Hospital Gotri, Vadodara, a tertiary care centre, from January-2014 to January-2018. Approval from the Ethics Committee of the institution was taken for the study. A total of 60 patients were included in the study after written informed consent based on the inclusion and exclusion criteria.

Inclusion Criteria: Age 18 to 80 years. Displaced 2 part, 3 part and 4 part fractures. Medically fit patients.

Exclusion Criteria: Undisplaced fractures. Open injuries. Pathological fractures. Severe osteoporosis. Other associated fractures. Pre-existing medical morbidity.

All patients were evaluated on outdoor basis. Other systemic and bony injuries were ruled out. Plain X-rays of the affected shoulder were taken in antero-posterior plane and axillary plane. Depending upon the extent of comminution and/or associated dislocation of humeral head some patients were further evaluated by computed tomography. Fractures were

classified based on NEER’S classification of proximal humerus [10]. All pre-operative investigations were done and once patient was fit to undergo surgery he or she was posted for surgery.

Surgical Procedure: Patient was positioned in beach chair position and general anesthesia was given in most of the patients. Free movement of image intensifier was checked before starting the procedure. Fracture site was opened by standard Delto-Pectoral approach and fragments were fixed provisionally with k-wires and assessed under flouroscopy. Once final reduction was acceptable, plate of appropriate size was placed over the lateral surface of humerus about 1 cms distal to upper end of greater tuberosity and fixed to humeral shaft with screws. Rotator cuff tendons were anchored and tied through plate using non-absorbable sutures. Plate was fixed to bone using locking screws and or cortical screws of appropriate size. Final reduction was confirmed using flouroscopy. Wound was closed in layers and sterile dressing was applied. Limb was supported in arm-sling pouch. Depending upon the pain tolerance of patient pendulum exercises were started on 3rd or 4th day. Stitches were removed on the 9th day. Patients were encouraged to do exercises at home and called for follow-up at one month, two months, three months and six months. At each follow-up, patients were assessed clinically and radiologically and final assessment was done using the Constant and Murley shoulder score.



Image 1: Preop X-Ray AP View



Image 2: Axillary view



Image 3: CT Scan Image



Image 4: Intraop View After ORIF

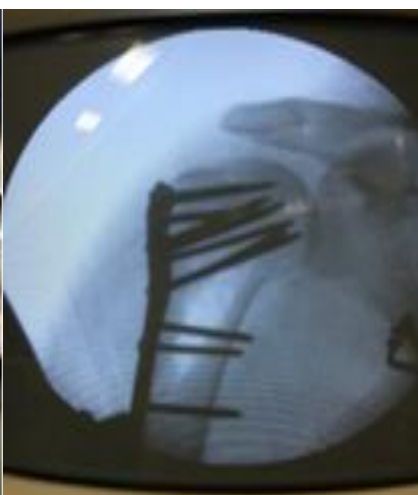


Image 5: Post OP AP View



Image 6: Posto Op Lateral View



Image 7: varus collapse

Results

A total of 66 patients with isolated proximal humerus fracture were enrolled in the study. Out of this 6 patients did not turn up at final follow-up and were excluded from the study. Finally 60 patients could be evaluated and included in the study. Average age of presentation was as per table no 1. There was a higher pre-ponderance in males. Mode of injury was 63.33% due to road traffic accident and 36.66% due to fall on out-stretched hand as per table no 2. 30 patients had left sided injury and 30 patients had right sided injury. Average admission- operation interval was 5.8 days with a range of 1 to 13 days. Average post-operative stay in hospital was 5.7 days with a range of 2 to 14 days. All patients underwent stitch removal on 9th or 10th post-operative day. Based on Neer's classification system, there were 20 cases of two -part fracture, 35 cases of three-part and 5 cases of four-part fracture. There was no case of superficial or deep infection in our series. In our study we observed that flexion and internal rotation were the earliest movements to recover followed by external rotation and finally abduction. Incidence of complications in our series was as per table no 3. Based on Constant and Murley scoring system we had excellent results in 56.66%, good in 18.33% patients, fair in 13.33% patients and poor results in 11.66% patients as per table no 4. Relation between type of fracture and results were as per table no 5.

Table 1

Age	Number	Percentage
20-40 years	16	26.66%
41-60 years	27	45%
>60 years	17	28.33%

Table 2

Nature	Number	Percentage
R.T.A	38	63.33
FOOSH	22	36.66
TOTAL	60	100

Table 3

Complications	Incidence	Percentage
Infection	0	0%
Non-union	2	
Varus collapse	4	6.6%
A.V.N	3	5%
Implant failure	2	3.3%

Table 4

Results	Number	Percentage
Excellent	34	56.66%
Good	11	18.33%
Fair	08	13.33%
Poor	07	11.66%

Table 5

Fracture Type	Excellent	Good	Fair	Poor
2 part	14	04	02	-
3 part	20	06	06	3
4 part	-	01	-	4

Discussion

Proximal humerus fractures have been an enigma with regards to their management due to lack of consensus regarding conservative versus open reduction and internal fixation methods. There are ample studies strongly suggesting conservative treatment of undisplaced and minimally displaced fractures. However the treatment of displaced fractures with or without dislocation have been controversial and challenging [11-13]. Proximal humerus fractures account for 4% to 5% of all fractures and upto 45% of all humeral fractures [1, 14]. It is the third most common fracture in people above 65 years of age after hip and distal radius fractures [15]. Close reduction and pinning is a good option for minimally displaced fractures as it entails minimal soft tissue disruption and preserves vascular supply [16-18]. However this method gives inadequate cortical purchase in osteoporotic fractures and those with comminution. Intra-medullary nailing with POLARUS nail was biomechanically stronger than plates. However it was associated with a failure rate of as high as 45% [19]. Martinez *et al.* had reported sub-acromial impingement or rotator cuff injury at the nail entry with antegrade nailing [20]. Jabran *et al.* found a wide variation by studying the clinical and biomechanical impact of Blade plate and came to a conclusion that it was difficult to derive a generalised conclusion [3, 21-23]. Blade plates became less popular as they were unable to counter the large coronal plane bending moment. The role of T-butress plate was inconclusive as different studies reported different results. Kristiansen and Christensen reported a high rate of fixation failure using these plates in proximal humerus fractures [24]. However Wijnman *et al.* reported good, intermediate and long term results in 87% of patients with 3 and 4 part fractures fixed with T-plate [25]. The PLANTAN plate was bulky, required wide surgical exposure and had a high rate of infection and fixation failure particularly in osteoporotic patients [26]. Siffri P C *et al.* in their cadaveric study suggested that locking plates had better torsional stability compared to non-locking plates [27]. In order to achieve optimum fixation and achieve maximum stability the implant should be of low profile, preferably anatomical in shape with provision of locking screws and additional holes for repair and restoration of rotator cuff anatomy. The proximal humerus locking plate used in our study had the possible advantages of being low profile, anatomical and providing stable fixation and angular

stability due to locking screws. The provision of convergent and divergent screws provided additional stability in presence of comminution and osteoporosis. Provision of suture holes made it easy to repair the rotator cuff and provide stabilization of greater and lesser tuberosity fragment ^[17, 27].

The current recommendation for open reduction and internal fixation is an angulation of more than 45 degree and displacement of more than 1 cms. Also it is indicated in displaced unstable fractures with or without dislocation. Displaced three part and four part fractures alter the articular congruity and have a high chance of disruption of blood supply to proximal humerus leading to osteonecrosis ^[28]. Whenever possible osteosynthesis is the preferred option employed since functional results of hemiarthroplasty are not sufficiently satisfactory in most of the cases ^[29]. Aim of osteosynthesis is to provide stability and adequate repair of rotator cuff is of paramount importance to promote early mobilization ^[29].

Western literature has shown proximal humerus fractures to be more common in elderly females ^[30]. However we had equal number of cases in males and females. Road traffic accident was a major cause of three part and four part fractures in this study group (63.33%). Moonot *et al.* demonstrated no significant difference in functional outcome between those below and those above 65 years of age at a mean follow-up of 11 months post PHILOS plate fixation ^[31]. However in our study we had significantly inferior clinical outcome in patients over 65 years of age.

Yang *et al.* had an overall complication rate of 35.9% with screw cut out rate of 7.6% ^[32]. Helwig *et al.* had screw penetration in 11 out of 87 cases with an incidence of 12.6% ^[33]. Thanasis *et al.* had a screw cut out rate of 11.6% in their review of 791 cases ^[34]. Kettler *et al.* had 24 cases of screw penetration out of 176 cases with incidence of 13.63% ^[35]. Charalambous *et al.* had 2 cases out of 17 with screw cut out with incidence of 11.76% ^[36]. There was approximately 10% incidence of screw cut out and subsequent varus collapse in our study which is in line with most of the studies.

Avascular necrosis is one of the most feared complication following open reduction and internal fixation and can be seen as late as and upto 5 years after injury ^[37]. The incidence of avascular necrosis varies from 0% to 68% in different literature ^[38, 39]. The fracture type itself, dorso-medial comminution and restoration of medial hinge were important and relevant predictors of humeral head necrosis as per study of Jost *et al.* ^[40], who in their series had a rate of as high as 68%. This could be because their study included 3 and 4 part fractures only. There was a 5% incidence of avascular necrosis in our study.

The incidence of superficial or deep infection ranges from 0% to 5% in different studies ^[41]. There was no incidence of infection in our study group.

Different evaluation methods have been used in different studies conducted in case of proximal humerus fractures ^[5, 41]. In this study the scoring system by Constant and Murley was used to evaluate the final outcome. It takes into consideration the incidence of pain, power, activities of daily living and range of motion. Scores in the range of 0 to 39 were labelled as poor, 40 -59 as fair, 60 -79 as good and more than 80 as excellent ^[42]. In our study we had 11.66% poor results, 13.33% fair results, 18.33% good results and 56.66% excellent results.

Limitations

We had a small sample size of 60 patients. No comparative

study was done with other modalities of treating these fractures. Six months follow-up duration seems to be too short to come to a definitive conclusion about the merits of this procedure.

Conclusion

Locking of screws to plate in this system provides better purchase in bones particularly those with severe osteoporosis. Proper placement of calcar screw is a must to prevent varus collapse. Restoration of rotator cuff bio-mechanics plays an important role in regaining movements of shoulder post-operatively. Inevitable terminal loss of all movements occurs with this fracture but was not of much significance as near normal functional shoulder movements were achieved resulting in good shoulder function probably due to its ball and socket type of a joint.

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Conflict of interest

The authors have no conflict of interest to declare.

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