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A Study of Minimally Invasive Plate Osteosynthesis with Locking Compression Plates for the Treatment of Proximal Humerus Fractures

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Abstract: The principle of the minimally invasive technique is to implant specific bony plate which is fixed across fractures via small incisions of the skin, muscle, and periosteum. The aim of the study was to find the functional outcomes in patients treated with proximal humerus fractures with a minimally invasive technique using locking compression plates. Methods: The cross-sectional study was conducted in the Department of Orthopedics, Prathima Institute of Medical Sciences, Nagunur, Karimnagar. A total of 39 patients were included in the study. The patients were selected using the inclusion criteria and they underwent operations under general anesthesia followed by early mobilization and follow up at the intervals of 3 months, 6 months and 12 months to evaluate functional outcomes according to Constant-Murley criteria. Results: The fractures were classified according to the NEER/AO/ASIF classification of fractures of the humerus. The type A fractures were found in 20 out of 39 patients 51.28% A1 fractures were in 8 patients A2 in 5 patients and A3 in 7 patients and 19 fractures were type B 48.72% and B1 and B3 had in 7 patients each and B2 had 5 patients. The mean Constant-Murley score was 89.25 points at the end of one year follow up in 2 part fractures. According to Constant-Murley score, 85% had an excellent outcome, 10% had a good functional outcome and 5% had moderate outcomes. All the fractures were united on an average time of 19 weeks (14-24). In the Three-part fractures, the average Constant-Murley score at the end of one year was 81 points. The Constant-Murley score showed 78.94% had excellent outcomes, 15% had a good functional outcome and 5.26% had a moderate outcome. Conclusion: Within the limitation of the present study it can be concluded that minimal invasive plate osteosynthesis with locking compression plate is a good technique for the treatment of proximal humerus fractures. It provides good stability, functional outcomes and minimal post-operative complications.

Keywords: minimally invasive plate osteosynthesis, Locking compression plates, proximal humerus fractures.

INTRODUCTION

The Proximal humerus fractures are increasing in the recent years and represent a growing burden on the health-care system. Proximal humerus fractures are the third most common type of fragility fracture accounting for nearly 6% of all adult fractures [1, 2]. The incidence of this type of fractures in the older age group is increasing especially in females [3]. Approximately 75% of these fractures shows only minor displacements and are treated non-operatively [4]. However displaced and unstable humeral head fractures are regarded as unsolved fractures because existing surgical treatment modalities and implants have limitations. Among the different techniques, conventional angular stable plates, intramedullary nails, minimally invasive K-wire and screw osteosynthesis and hemiarthroplasty are treatment options [5]. An understanding of fracture pattern and its anatomical aspects is necessary to achieve satisfactory outcomes. The proximal humerus is fixed to the body by the scapulohumeral and thoracohumeral muscles. The thoracohumeral muscles consist of latissmis Dorsi muscle, pulls the humeral shaft medially and rotates it internally. The scapulohumeral rotatory muscles result in medial and caudal directed force whereas the deltoid and biceps muscle antagonize the proximal humerus against caudally vectored force and gravity [6]. The fractures depend on the type of injury, number of and muscular forces on fracture fragments and connection of fragments to the periosteum. The main mechanisms of fractures are by avulsion and impression, the impression fractures are caused by fall on the abducted arm with glenoid consequently depressing the humeral head into the shaft thereby bowing out the minor tubercle ventrally and the greater tuberosity laterally resulting in valgus impacted four-part fractures. The two or three part fractures mainly originate from avulsion mechanism with disruption of periosteum and

subsequently more pronounced dislocation of the affected tuberosities as well as rotational and usually varus malpositioning of the humeral head [7]. Treatment of proximal humerus fractures usually emphasizes the restoration of shoulder functions [8-11]. Since the fractures are common in older patients these fractures in older patients results in loss of bodily functions, face enormous difficulties in fracture healing and shoulder functional recovery and sustaining proximal humerus fractures [12]. Surgical fixation with locking plates is the most common type of intervention for displaced proximal humerus fractures. Locking compression plates represents a relatively new technology that theoretically supports fixation [13]. Its biomechanical properties made it promising in the setting of proximal humerus fractures. We in the present study tried to evaluate the results of treatment of proximal humerus fractures with locking compression plates.

MATERIALS AND METHODS

The cross-sectional study was conducted in the Department of Orthopedics, Prathima Institute of Medical Sciences, Nagunur, Karimnagar. A total of 39 patients were included in the study. The protocol of the study was approved by the Institutional Ethical committee and a written consent was obtained from all the patients involved in the study after explaining them the treatment plan, cost, and expected complications. The inclusion criteria were all the closed humeral proximal fractures, patients above 20 years old, No history of morbid medical conditions. The exclusion criteria were Open fractures, patients with diabetes mellitus, hypertension, cardiovascular disorders, Pathological fractures. The patients were operated in General Anesthesia and administration broad-spectrum antibiotic prophylaxis was given to all the patients. An anterolateral deltoid-splitting approach was utilized and the tip of acromion was palpated and used as a landmark. A longitudinal incision was made on the lateral side of the humerus starting from the lateral acromial border and ending distally 5 cm was to access the proximal humerus, the greater tuberosity, and the humeral head. The distal screws were inserted by the distal incision made 7cm distal to acromion and in most cases; the good reduction was achieved by applying axial traction on the humerus and pulling the rotator cuff [14-17]. In some cases indirect reduction such as ligamentotaxis were used. Plate reduction was performed in cases of valgus displaced fracture configuration. The LCP was placed proximally below the apex of the greater tuberosity to maintain reduction [16, 18]. The plate was anchored proximally with multiple angled stable screws into the humeral head fragment. After removing the aiming arm, the non-absorbable sutures were tightened to the LCP [18, 19]. The patient's arm was placed in a sling for a maximum of two weeks. Passive and active ranges of exercises were encouraged depending on the pain and tolerance of the individual. The patients were followed up with clinical and radiographic assessments at the end of 3 months, 6 months and 12 months. Each time the constant score was used to assess the function of the shoulder. Complications were evaluated based on the radiographs and clinical examinations.

RESULTS

Table-1 shows the age wise and sex wise distribution of cases involved in the study. Most of the cases in male patients were from the age group of 40-60 yrs (n=14) 51.85%, followed by 20-40 (n=8) 29.63 % and > than 60 (n=5) 18.52%. Similarly in females most of the cases were from 40-60 yrs (n=7) 58.33%, followed by (n=3) 25% and (n=1) 8.33% case from >60 yrs and 20-40 yrs respectively.

Table-1: Age wise distribution of the patients involved in the study

Age in Years	Male		Total	Female		Total
	Right	Left		Right	Left	
20 – 40	5	3	8	2	1	3
40 – 60	8	6	14	5	2	7
> 60	3	2	5	1	1	2
Total	16	11	27	8	4	12

The fractures were classified according to the NEER/AO/ASIF [20] classification of fractures of the humerus. The type A fractures were found in 20 out of 39 patients 51.28% A1 fractures were in 8 patients A2 in 5 patients and A3 in 7 patients and 19 fractures were type B 48.72% and B1 and B3 had in 7 patients each and B2 had 5 patients shown in table-2.

Table-2: Classification according to Neer and AO/ASIF of the proximal humeral fractures

NEER	AO TYPE		NUMBER OF PATIENTS	TOTAL
2 PART	TYPE A	A1	8	20
		A2	5	
		A3	7	
3 PART	TYPE B	B1	7	19
		B2	5	
		B3	7	

Table-3: Functional outcomes of the patients at the end of 3 months, 6 months and 12 months of the study

NEER	3 Months	6 Months	12 Months
2 Part (n=20)	71.5 (65-78)	80.2 (73-88)	89.25 (84-94)
3 Part (n=19)	70.7 (62-79)	73.4 (65-76)	81 (73-86)

Table-3 shows the functional outcomes as per Constant-Murley scores [21] at the end of 3 months, 6months and 12 months. The mean Constant-Murley score was 89.25 points at the end of one year follow up in 2 part fractures. According to Constant-Murley score, 85% had an excellent outcome, 10% had a good functional outcome and 5% had moderate outcomes. All the fractures were united on an average time of 19 weeks (14-24). In the Three-part fractures, the average Constant-Murley score at the end of one year was 81 points. The Constant-Murley score showed 78.94% had excellent outcomes, 15% had a good functional outcome and 5.26% had a moderate outcome. The incidences of complications like axillary nerve paresis, vascular injuries or implant failure were not seen in any of the patients during the study. The Incidence of non-union was seen in (n=2) 5.12% of the patients that were corrected using the bone graft. 1 case had malunion and delayed union was seen in 4 cases. In 3 cases there was the superficial infection that has resolved after treatment with antibiotics and regular dressing.

Table-4: Percentage of cases that had unions, delayed unions, malunion, and non-union

Fracture union	Total	Percentage
Union	32	82.05
Delayed union	4	10.25
Malunion	1	2.56
Non-union	2	5.12

DISCUSSION

There are differences in opinion regarding the best treatment of proximal humerus fractures, while the majority of cases are still treated conservatively still surgical options are preferred in many cases. Some studies have shown that fixation of the proximal humeral fractures with plates and screws are associated the complications such as pullout of screws especially in osteoporotic bone because these kind of fractures are common in old age individuals. Sometimes subacromial impingement and avascular necrosis of humeral head due to excessive periosteal stripping are seen [19, 22]. The newer surgical option in the management of these fractures combines the principles of fixation with conventional plate and those of locking screws. The plate is preshaped and contoured for the proximal humerus. The benefits of this implant are that it gives an enhanced purchase in the osteopenic bone and there is no loss of reduction or varus/valgus angulations, the locking screws into the plate provide angular and axial stability of the construct and it is low-profile plate [23]. In the present study the function outcomes by the mean Constant-Murley score was 89.25 points at the end of one year follow up in 2 part fractures. According to Constant-Murley score, 85% had an excellent outcome, 10% had a good functional outcome and 5% had moderate outcomes. This was in agreement with the results by Sahu RJL using minimally invasive plate osteosynthesis for the treatment of proximal humerus fractures in osteoporotic bones the mean Constant-Murley scores were 86. The overall functional outcomes according to Murley scores were Excellent in 85.15% of cases, Good in 9.25% of cases, Fair in 5.55% of cases. In the present study in the Three-part fractures, the average Constant-Murley score at the end of one year was 81 points. The Constant-Murley score showed 78.94% had excellent outcomes, 15% had a good functional outcome and 5.26% had a moderate outcome. In another study by Tao Lin *et al*., comparing the minimally invasive plate osteosynthesis with locking compression plate with open reduction and internal fixation found use of MIPO with a locking compression plate in the management of proximal humerus fractures is a safe and superior option compared to ORIF. One of the advantages of minimally invasive plate osteosynthesis provides good visualization of the posterolateral aspect of the shoulder through a small incision and without extensive soft-tissue dissection of

forcible retraction. It is relatively easy to perform a reduction of a large greater tuberosity fragment under direct vision and significantly reduces the intra-operative times [16, 18, 24, 25]. Locking compression plate can be used as a dynamic compression plate as a pure internal fixator using locking head screws. It is seen that LCP has good stability and induces less damage to the periosteum it is therefore beneficial for bone healing and functional recovery [26]. The complication rate in this study was 12.82 % compared to other previous studies [16, 19, 27]. The complication was related to superficial infection, non-union which were treated accordingly. The overall outcomes and wound healing were good in all cases and one of the advantages observed with minimally invasive plate osteosynthesis was minimal scarring following surgery.

CONCLUSION

Within the limitation of the present study, it can be concluded that minimal invasive plate osteosynthesis with locking compression plate is a good technique for the treatment of proximal humerus fractures. It provides good stability, functional outcomes and minimal post-operative complications.

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