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RESEARCH ARTICLE

OUTCOME OF PROXIMAL HUMERUS LOCKING PLATE FIXATION FOR PROXIMAL HUMERUS FRACTURES USING THE NEER SHOULDER SCORE

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ABSTRACT

Proximal humerus fractures are difficult to treat from the first evaluation to final outcome. Much controversy and confusion still exist, and no single treatment protocol or algorithm has been proved to be universally effective. From the time that they were traditionally conservatively managed, to now when more and more operative treatment is being done for these fractures. The types of fixation—transosseous suture fixation, percutaneous pinning, intramedullary nailing, or plate fixation—used depends on the patient's age, activity level, and bone quality; the fracture type and associated fractures; and the surgeon's technical ability. A retrospective study of 30 case records of proximal humerus fractures fixed with an angle stable device was done (Philos locking plate) to analyse the results of Proximal humerus locking plate osteosynthesis in proximal humerus fractures and using the Neer Shoulder Score. A review of the relevant literature was also done.

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INTRODUCTION

Proximal humerus fractures are common fractures presenting to any orthopaedic department. From the time that they were traditionally conservatively managed, to now, when more and more operative treatment is being done for these fractures. These fractures are difficult to treat from the first evaluation to final outcome. Much controversy and confusion still exist, and no single treatment protocol or algorithm has been proved to be universally effective. Nonoperative treatment can obtain a functional, painless extremity in most proximal humeral fractures. The range of motion of the shoulder joint accommodates moderate angular deformity without significant functional loss. Neer described acceptable angulation as less than 45 degrees and less than 1 cm of displacement. Although these criteria are not absolute, they do provide a guide. The decision that operative treatment is appropriate is complicated by the numerous and varied techniques described for fixation of proximal humeral fractures. Generally, fracture displacement is used as the indicator of stability. The type of fixation—transosseous suture fixation, percutaneous pinning, intramedullary nailing, or plate fixation—used depends on the patient's age, activity level, and bone quality; the fracture type and associated fractures; and the surgeon's technical ability.

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The most common complication of proximal humeral fractures is loss of motion (stiffness). Impingement from high-riding tuberosities or subacromial scarring also can limit motion. Nonunion rates have been decreasing with the use of new technologies such as locking plates. Malunion, osteonecrosis, axillary nerve injury and hardware failure are some of the other complications reported.

Aim

To analyse the results of Proximal humerus locking plate osteosynthesis in proximal humerus fractures.

MATERIALS AND METHODS

A retrospective study of 30 case records of proximal humerus fractures fixed with an angle stable device (Philos locking plate) was done.

Inclusion criteria-1. Displaced two-part surgical neck fractures 2. displaced (>5 mm) greater tuberosity fractures 3.displaced three-part fractures, and 4.displaced four-part fractures in young patients.

Exclusion criteria-1. Low demand elderly patients 2. Polytrauma 3. Associated head injury 4.Open injuries

From the follow up records 6 months after surgery the results were analysed using the Neer Shoulder Score. This clinician-base outcome measure has four subscales: Pain (35 points), function (30 points), range of motion (25 points) and anatomy (10 points).

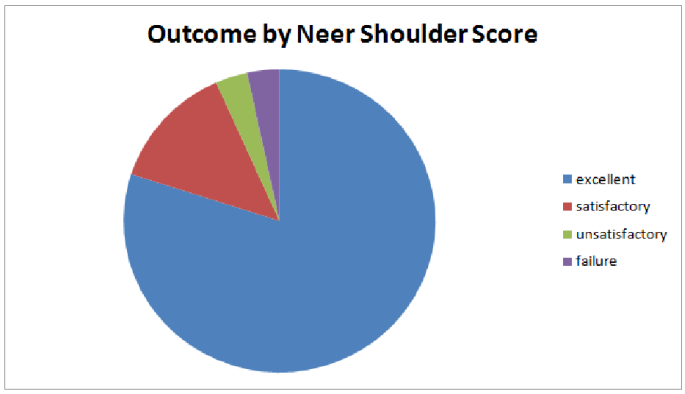
Scores between 90–100 are interpreted as excellent, 80–89 satisfactory, 70–79 unsatisfactory, and < 70 points denotes failure.

A review of the relevant literature was also done.

RESULTS

The results were as follows- the age range was 23 years to 72 years with most of the patients belonging to the age decade bracket of 50 to 60 years. The patients were mostly male (22 males and 8 females) and fall at home was the most common injury followed by road traffic accident and sports injury with preponderance of the right side involvement (18 out of 30). 3 patients presented within 24 hours of the fracture and 25 within 5 days and 2 within 10days with 15 cases of two part, 11 cases of three part and only 4 four part fracture according to the Neer's classification. According to the Neer's shoulder score, there were 24 cases with excellent result and 4 cases of satisfactory, 1 each of unsatisfactory result and failure.

Neer Shoulder Score	Number
Excellent(90-100)	24
Satisfactory(80-89)	4
Unsatisfactory(70-79)	1
Failure (<70)	1

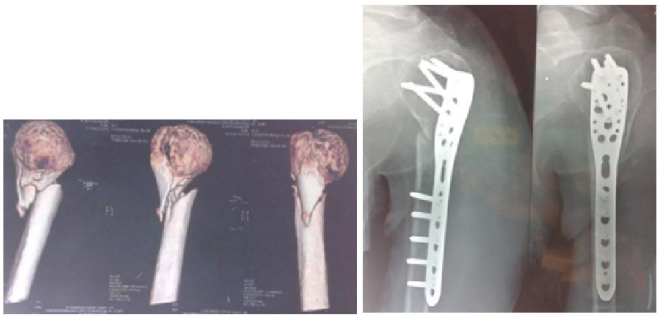


We had our share of complications too. There was superficial infection in 3 patients which resolved uneventfully. Intraoperative bleeding requiring postoperative transfusion was recorded in 3 patients. 1 case went into hardware failure (Neer's shoulder score -failure).The presence of osteonecrosis in one patient at 6 months post operative (based on X ray features) did not result in a poor outcome and caused minimal symptoms (Neer's shoulder score- satisfactory). ORIF adequately stabilized four-part fractures and restored the humeral anatomy and in none of our cases did we have to look at hemiarthroplasty in this period of follow up.

Limitations of the study

This study is a retrospective study.

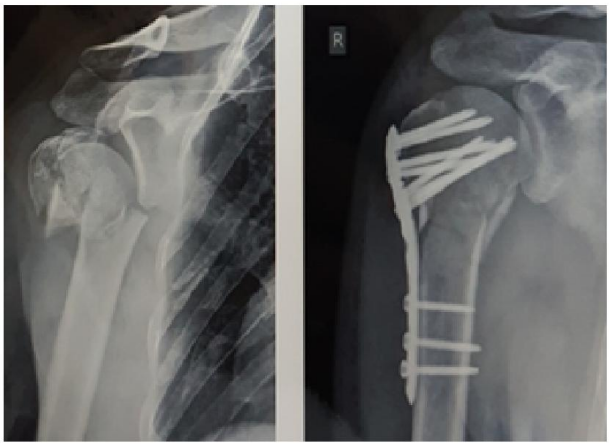
Clinical photographs



Case 1. Preoperative and postoperative

Case 2. Preoperative and postoperative

Case 3. Preoperative and postoperative



Case 4. Preoperative and postoperative

Case 5. Preoperative and postoperative

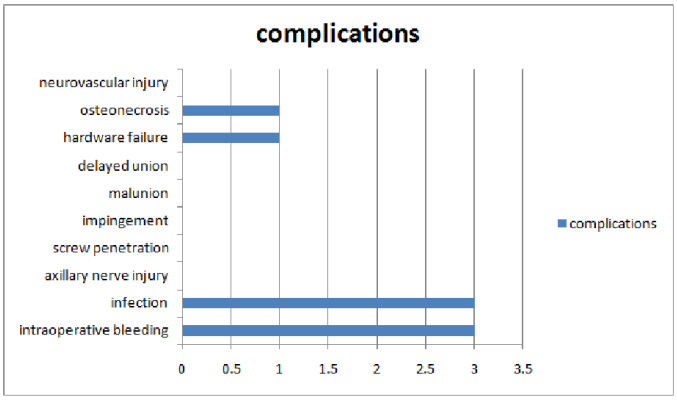
Implant failure

It is limited in the number of cases and a follow up period of 6 months. A larger pool of cases with a longer follow up is being planned.

Conclusion

The goal of proximal humerus fractures is restoration of proximal humeral anatomy with stable fixation that allows early functional range of motion. Chronic malunions and nonunions that are subsequently treated surgically are associated with poor outcomes.

Complications	Number
Intraoperative bleeding	3
Superficial infection	3
Axillary nerve injury	0
Screw perforation	0
Impingement	0
Malunion	0
Delayed union	0
Hardware failure	1
Osteonecrosis	1
Neurovascular injury (other than axillary nerve injury)	0



Consequently, it is imperative to re-create the normal proximal humeral anatomy with respect to tuberosity reduction and the head-neck relationship. The advantage of ORIF with a locked plate is an ability to reduce the fracture fragments into an anatomical position and stabilize them rigidly to allow early motion. Plate-and-screw constructs provide the most stable fixation of the three fixation methods. Locked plates (as used by us) add stability, especially in osteoporotic bone. An open reduction and rigid fixation allow accurate reduction and stabilization of the tuberosities, which is important because malunion of the tuberosities is poorly tolerated and is associated with poor outcomes in posttraumatic reconstructive shoulder arthroplasty. In view of the findings of our study we advocate the use of Proximal humerus locking plates (Philos) for proximal humerus fractures for excellent outcomes and acceptable complications.

REVIEW OF LITERATURE AND DISCUSSION

R.H. Cofield advocated in 1988 the use of adequate radiograms to understand the traumatic lesion, to be careful denying older patients effective treatment, to use a safe and simple surgical approach, to know the options for internal fixation, and recognize the value of prosthetic replacement, avoiding technical pitfalls, and thoughtfully supervising the postoperative patient care. All these areas are still in question. Numerous authors have suggested that nonoperative treatment may be preferable for two-, three-, and four-part proximal humeral fractures in elderly patients, but pain and loss of function have been reported in high percentages of patients after this treatment approach. Court-Brown *et al*. reported good or excellent results, however, in 81% of impacted valgus fractures in elderly patients treated non operatively, and in a comparison of operative and non operative treatment of

displaced two-part fractures, these authors found similar results in the two treatment groups. In a study of the geographical incidence and treatment variation of common fractures in elderly patients, Sporer *et al*. found large variations in the percentage of proximal humeral fractures treated operatively, ranging from 6.4% to 60%; in eight regions of the United States, at least 40% were treated operatively, whereas in 35 regions, fewer than 20% were treated operatively. The fact that 10 different fixation techniques were evaluated for a single fracture type (fractures of the surgical neck of the humerus) is further indication of the complexity of treating proximal humeral fractures.

Other than conservative treatment, transosseous suture fixation techniques are well defined in the orthopaedic literature. Park *et al*. reported 78% excellent results in patients with two-part and three-part proximal humeral fractures treated with suture fixation. The use of strong nonabsorbable suture provides the advantage of incorporating the rotator cuff insertion to increase fixation in patients with poor bone quality. Percutaneous pinning has the advantage of avoiding further damage to the soft tissue envelope and the blood supply to the humeral head. It also is a relatively inexpensive technique, and several series have reported good results in two-part, three-part, and valgus-impacted four-part fractures. The procedure is technically challenging and requires a satisfactory closed reduction, adequate bone stock, minimal comminution (particularly of the tuberosities), an intact medial calcar, and a compliant patient. In their series of 74 older patients (average age, 71 years), Calvo *et al*. demonstrated that reduction was associated with outcome. If satisfactory closed reduction cannot be obtained, another form of reduction and fixation should be used. Loss of fixation, pin track infections, and axillary nerve injuries are common complications. Terminally threaded Schanz pins and bicortical pins inserted from the greater tuberosity to the medial humeral shaft add stability to the overall construct. Percutaneous pinning is contraindicated for fractures with metaphyseal comminution.

Intramedullary nailing provides more stable fixation than percutaneous pinning, although less than locked plate fixation. The Polarus nail has been shown to provide more biomechanical stability than pin fixation, and good clinical outcomes have been reported with this device. Newer nail designs with polyaxial screws have more stability than earlier designs, and the addition of polyethylene bushings may increase stability and prevent screw back-out Insertion of an intramedullary nail into the proximal humerus violates the rotator cuff, which can lead to postoperative shoulder pain. The advantages of the technique include preservation of the soft tissues and the theoretical biomechanical properties of intramedullary nails. A comminuted lateral cortex or fractures involving the tuberosities may be a contraindication to intramedullary nailing. A recent prospective randomized trial by Zhu *et al*. found that at 1-year follow-up patients treated with locking plates had better outcomes than those treated with locked intramedullary nailing, but at 3-year follow-up outcomes were equal. The locking nail group had a significantly lower complication rate (4%) than the locking plate group (13%). Konrad *et al*. also reported similar outcomes in three-part proximal humeral fractures treated with intramedullary nailing (58 fractures) or plate fixation (153 fractures). Historically, plate fixation of the proximal humerus has been fraught with complications, with malunion and nonunion caused by poor fixation in the humeral head. In addition, extensive soft tissue dissection increases the possibility of osteonecrosis of the humeral head, leading to a painful and functionally limited shoulder joint. The development of locked proximal humeral plates was expected to improve treatment of these complex injuries greatly. Numerous outcome studies are now available because the locked proximal humeral plate has been widely used for more than 10 years; however, as was pointed out in a Cochrane review, there is little level I or II evidence. A recent randomized controlled trial comparing locked plating to conservative treatment of three- and four-part fractures in elderly patients found no difference in outcomes at 1-year follow-up. Despite the lack of a large body of supporting literature, the locked proximal humeral plate is considered by most fracture surgeons to be a great improvement in the management of proximal humeral fractures, and it has become the implant of choice for these fractures. Some issues with open reduction and locked plating include the extensive exposure required for plate application that carries a risk of damage to neurovascular structures, especially the ascending branch of the lateral circumflex artery. The complication and reoperation rates do remain high with this technique. Screw perforation through the humeral head is the most frequently reported complication. Perforation can occur as cutout from fracture settlement or from poor initial technique. Other complications include arthrofibrosis, impingement, malunion, nonunion, osteonecrosis, infection, and hardware failure. Poor outcomes are associated with initial varus displacement of three- and four part fractures.

In an attempt to decrease complications with plate fixation, Gardner *et al*. used an anterolateral acromial (Mackenzie) approach in which the axillary nerve is identified and protected, anterior dissection near the critical blood supply is avoided, substantial muscle retraction is minimized, and the lateral plating zone is directly accessed Laflamme *et al*. reported no axillary nerve injuries and no loss of reduction in fractures treated with percutaneous humeral plating through two minimal incisions (a lateral deltoid split and a more distal shaft incision). As our understanding of the anatomy of the proximal humerus and our instruments improve, less invasive techniques appear promising. The most common complication of proximal humeral fractures is loss of motion (stiffness). Early physical therapy is associated with improved motion, but many patients do not recover full motion even with early physical therapy. Impingement from high-riding tuberosities or subacromial scarring also can limit motion. Nonunion also is fairly common, but nonunion rates have been decreasing with the use of new technologies such as locking plates and improved intramedullary nails. Malunion can result from unstable or delayed fracture fixation, patient factors, and poor surgical technique. In older patients with limited functional demands, malunion generally is well tolerated, but it may be debilitating in younger patients because of poor shoulder function, impingement, or rotator cuff tears. Osteonecrosis is relatively uncommon after non displaced or unoperated two-part and three-part fractures; functional outcome is improved if the

proximal humeral anatomy has been restored. The presence of osteonecrosis does not always result in a poor outcome; osteonecrosis may be evident radiographically but cause minimal symptoms. Because late hemiarthroplasty has poorer results than early hemiarthroplasty, it is important to be sure that ORIF can adequately stabilize four-part fractures and restore humeral anatomy before this option is chosen.

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