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ORIGINAL ARTICLE

Retrospective analysis of proximal humeral fracture-dislocations managed with locked plates

Vivek Trikha, MS (Ortho)[a,*], Vivek Singh, MS (Ortho)[b], Buddhadeb Choudhury, MS (Ortho)[a], Saubhik Das, MS (Ortho)[a]

[a]*Department of Orthopaedics, Jai Prakash Narayan Apex Trauma Centre, All India Institute of Medical Sciences, New Delhi, India*

[b]*Department of Orthopaedics, All India Institute of Medical Sciences, Rishikesh, Uttarakhand, India*

Background: Fracture-dislocation is the extreme variant of injury to the proximal humerus that occurs more commonly in young adults as a result of high-velocity trauma. We evaluated the functional and radiologic outcome of fixation of proximal humeral fracture-dislocations with locked plates.

Methods: This was a retrospective review of 33 proximal humeral fracture-dislocations in 29 patients with a mean age of 35 years (range, 19-60 years) treated by open reduction and internal fixation with locked plates between January 2009 and December 2013. The fracture-dislocation in 85% was the result of high-energy trauma resulting in 3- or 4-part fracture-dislocation. The fracture-dislocation was anterior in 27 and posterior in 6.

Results: The average delay from injury to surgery was 7 days (range, 1-35 days), with a mean follow-up of 40 months (range, 24-66 months). All of the fractures united at an average of 15 weeks after surgery. At the final follow-up, the mean forward flexion was 129° (range, 100°-160°), and mean abduction was 128° (range, 100°-150°). The mean Constant score at the final follow-up was 78 points (range, 68-88 points). One case of complete osteonecrosis of the humeral head and 1 case of partial osteonecrosis of the humeral head were noted. Two cases of screw perforation of the humeral head were seen, with subsequent restricted range of motion improving after removal of the offending screws.

Conclusions: Most young patients with 3- and 4-part proximal humeral fracture-dislocations can achieve good functional outcome after fixation with locked plates.

Level of evidence: Level IV; Case Series; Treatment Study

Keywords: Proximal humerus; fracture-dislocation; open reduction; internal fixation; locked plate; outcome

Fractures of the proximal humerus are common injuries and generally follow a bimodal age distribution pattern.[3,26] In younger patients they generally result from high-energy traumatic injuries that cause severely displaced fractures, which are often accompanied by dislocation of the humeral head.[10,19] The fractures in elderly individuals are usually osteoporotic and associated with minor trauma, resulting mostly in an undisplaced fracture that can be managed conservatively.[26,35] Although many studies have been published reporting the

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*Reprint requests: Vivek Trikha, MS (Ortho), Department of Orthopaedics, JPN Apex Trauma Centre, All India Institute of Medical Sciences, Room No. 318 Casualty Block, 3rd Floor, Ring Road, 110 029 New Delhi, India.

Email address: vivektrikha@gmail.com (V. Trikha).

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management of 3- and 4-part displaced proximal humeral fractures, very few studies have concentrated on the management of fracture-dislocations.[29,32]

Fracture-dislocation is the extreme variant of injury to the proximal humerus where the head fragment is dislocated anteriorly or posteriorly, with little or no soft tissue attachments.[2] Optimal management rationale is still debated despite the evolution of several techniques to manage these difficult injuries. Humeral head arthroplasty has been cited as the most preferred approach, especially in elderly patients.[6,13,14,32] Inclination toward arthroplasty over the conventional open reduction and internal fixation (ORIF) is because of the concern of potential risk of osteonecrosis or nonunion reported with the latter procedure.[16,26] However, recent evidence emanating from published studies noted a lower prevalence of these complications, contrary to what was previously reported[29,30,36,38]; moreover, complications such as stem loosening, instability, and infection purportedly compromise functional results after arthroplasty, especially in younger patients.[22,37] Because most of these fracture-dislocations occur in the younger population, arthroplasty may not be the optimal choice of treatment in the long-term. Surgeons should, therefore, endeavor to salvage the humeral head and restore bony congruity in these fracture-dislocations.

Locking plates have shown promising outcome after fixation of complex proximal humeral fractures.[32] By virtue of the fixed-angle plate-screw construct, the locking plate confers superior anchorage and stability in the fracture fragments compared with conventional plates.[17] In addition, the lower pressure of the locked plate to the bone and the biologic fixation principle by indirect reduction techniques have a substantial effect in protection of the local vascular supply.[27] With the evident benefits of locked plates to repair proximal humeral fractures, these plates have been used as a primary modality of treatment in patients with proximal humeral fracture-dislocations. In this study, we retrospectively analyzed proximal humeral fracture-dislocations repaired with locked plates and evaluated clinical and radiologic outcome and complications, and we provide guidelines for treatment of these complex injuries. We hypothesized that good results could be obtained after ORIF of proximal humeral fracture-dislocations in selected patients.

Materials and methods

All patients with proximal humeral fracture-dislocations between the ages of 18 and 60 years, managed in our hospital between January 2009 and December 2013, were retrospectively reviewed. We identified 49 patients during the stipulated time frame. The study excluded patients with associated ipsilateral upper limb fractures, open injuries, age older than 60 years, or those with associated vascular injuries. After exclusion, 34 patients were included for evaluation, of which 5 patients were lost to follow-up.

The final evaluation was done on 33 proximal humeral fracture-dislocations in 29 patients. No patient younger than age of 60 received prosthetic replacement for this injury during the study period. Most of these injuries were the result of high-velocity trauma resulting in 3- or 4-part fracture-dislocations. Before surgery, routine radiographs and computed tomography scans with 3-dimensional reconstruction were obtained to determine the accurate fracture configuration. All shoulders were operated on by a single surgeon (V.T.) using a deltopectoral approach or deltoid-splitting approach.

Surgical technique

An anterior deltopectoral approach was used when the dislocation was anterior. The deltoid-splitting approach was used when the dislocation itself was in the posterior direction. Dissection to mobilize the head fragment was performed meticulously to preserve the soft tissue attachments to the fractured fragments. The head fragment was then reduced by gentle manipulations. In patients with good bone stock, a threaded Kirschner wire or a thin Schanz pin was used to pull the humeral head back into place. For surgical neck fractures, the medial calcar was followed to ascertain reduction, whereas for anatomic neck fractures, the biceps groove was evaluated for assessment of reduction. The fracture fragments were reduced and provisionally stabilized with Kirschner wires. The plate was positioned to avoid subacromial impingement. Care was also taken to ensure that the plate was placed lateral to the tendon of the long head of the biceps. Every effort was made to put the lower calcar screws to prevent varus collapse of the head fragment.

Bone substitute material was used in 11 cases where there was void caused by severe comminution. In 3 shoulders with a 4-part fracture-dislocation with absent medial cortical support, a tricortical graft from the iliac crest was also used. This helped to maintain medial continuity and provide biological support.

The surgery in a few patients was delayed for more than 7 days because of associated injuries, comorbidities, or referral from other hospitals. Relocating the head fragment in these neglected patients was difficult. In these cases, gentle mobilization of the head fragment was done to remove the adhesions, followed by identification of head fragment with the help of pointed retractors.

The average operative time was 2.5 hours (range, 2-3.5 hours), and the average blood loss was 300 mL (range, 250-450 mL).

Postoperative protocol

Postoperatively, patients were placed in a sling except for the period of exercises. An aggressive physiotherapy regimen was initiated without stressing the bony fixation or the soft tissue repair. The course of physiotherapy was based on the injury pattern, fixation strength, bone quality, and patient compliance. Early passive range of motion (ROM) exercises were started on postoperative day 1 with pendulum exercises. Passive or active, or both, assisted forward elevation and external rotation were commenced up to 90° and 30°, respectively; restrictions were placed on passive adduction and internal rotation. Patients were discharged with a home-based physiotherapy regimen along with intermittent follow-up because most of the patients had limited access to regular formal physiotherapy. After 3 to 4 weeks, submaximal isometric internal rotation, external rotation, flexion, extension, and abduction were initiated as tolerated with the aim of achieving full passive ROM by 4 to 6 weeks; at that time active ROM was gradually initiated. As early as 8 weeks postoperatively, resisted ROM was commenced, which generally progressed to an aggressive stretching and strengthening phase after 10 to 12 weeks.