Functional outcome of closed fractures of proximal humerus managed by Joshi’s external stabilizing system

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ABSTRACT

Background: Proximal humeral fractures account for 4–5% of all fractures; most of them involving elderly and osteoporotic people. 1 51% of such fractures are displaced. Two Fractures with minimal displacement, regardless of the number of fracture lines, can be treated with closed reduction and early mobilization, but anatomical reduction in displaced fractures is difficult to obtain and the incidence of pseudarthrosis is high 3-5. We evaluated the functional results of closed Neer’s 2- and 3-part proximal humerus fractures treated by Joshi’s external stabilizing system.

Materials and Methods: Sixteen patients with proximal humeral fractures were managed from 2008 to 2010 by Joshi’s stabilizing external fixation. They were 10 males and 6 females, with a mean age of 57.5 years. Based on Neer’s classification, there were eleven 3-part fractures and five 2-part fractures. The mechanism of injuries included seven road traffic accidents and nine fall. Shoulder mobilization exercises were started within 1 week after stabilization with JESS. External fixation was removed after the evidence of union (6–8 weeks). Pain was evaluated by visual analogue scale (VAS) and shoulder range of motion was evaluated by Constant Scoring System. Followup was done at 4 weeks, 8 weeks, 12 weeks, and then at every 4 weeks.

Results: Mean followup was of 20.5 months (range 9-30 months). Postoperative mean VAS score and Constant Score of patients was 2.1 (±0.73) and 78.1 (±9.61) at an average followup of 6 months. Mean duration for union was 6.5 (±1.18) weeks. One case of K-wire loosening and one case of pin tract infection were the complications noted.

Conclusion: External fixation by JESS is an alternative option to treat Neer’s 2 and 3 part proximal humerus fractures with good results.

Key words: External fixation, Joshi’s external stabilizing system, proximal humerus fractures

INTRODUCTION

Proximal humeral fractures account for 4–5% of all fractures; most of them involving elderly and osteoporotic people. 1 51% of such fractures are displaced. 2 Fractures with minimal displacement, regardless of the number of fracture lines, can be treated with closed reduction and early mobilization, but anatomical reduction in displaced fractures is difficult to obtain and the incidence of pseudarthrosis is high. 3-5 Open reduction and internal fixation entails an extensive surgical exposure and risks damage to the vascular supply of the fragments. Fixed angle locking plates enable fixation of many complex fractures 6 although their long term functional outcomes remain unknown. It provides early functional recovery, but we had to pay special attention to some of the surgical details to minimize complications. Locked intramedullary nails can be inserted using a minimally invasive technique 7 but for the risk of proximal impingement. Closed reduction and percutaneous pinning has a low risk of neurovascular complications or interference with glenohumeral joint motion. 8 Transcutaneous reuction and external fixation fixation achieves a satisfactory fracture stability once closed reduction is achieved, safer healing, superior functional result, low cost and less patient morbidity as compared to conservative treatment. 9 We assessed and compared the results of external fixation by JESS with those of the previous studies for displaced closed proximal humeral fractures.

MATERIALS AND METHODS

Sixteen patients with proximal humeral fractures were managed from 2008 to 2010 by fixation. They were 10 (62.5%) males and 6 (37.5%) females, with a mean...
age of 57.5 years. Road traffic accident (RTA) was the most common mode of injury in patients less than 60 years old (4 out of 6), while fall on the ground was the most common cause in fractures in elderly patients (age >60 years, i.e. 7 out of 10). Fractures of proximal humerus were classified by Neer’s classification system. Displaced (more than 45° of angulation or >1 cm of displacement) 2- and 3-part fractures and patients of age >20 years were included in the study [Figure 1a,b]. Neer’s 4-part fractures, open fractures, and those with other associated injuries were excluded from the study.

The procedure was performed with the patient under general/local anesthesia in a supine position, using a sandbag to elevate the shoulder. The important structures at risk are the axillary nerve and the posterior humeral circumflex artery from the greater tuberosity pins, the anterior branch of the axillary nerve from the proximal lateral pins, and the cephalic vein, biceps tendon, and musculocutaneous nerve from the anterior pins. Three pins at humeral head were at 30° to each other in the same horizontal plane: The first one just lateral to bicipital groove, the other one in true lateral plane, and the third one posterior to the central one. The shoulder was externally rotated during placement of the greater tuberosity pins so as to move the axillary nerve and the posterior circumflex artery farther away from the humeral neck. Three pins were inserted in the shaft of humerus 2 cm distal to the fracture line in the same horizontal plane: Central one in true lateral plane, another one at 30° anteriorly, and the other one at 30° posteriorly. One pin was inserted just proximal to the lateral epicondyle in line with the central pins of head and proximal shaft. The fixator wires were then used as joysticks to obtain a reduction before attaching the frame. Aim of reduction was to bring the fragment in an acceptable position, i.e. less than 45° of angulation and less than 1 cm of displacement, and to hold these fragments in place. Once reduction was obtained, all the pins were connected to the external fixator bars using beta clamps to form a solid construct. Central pin of head, central pin of proximal shaft, and pin at lateral condyle were joined with knurled rod. Anterior and posterior pins of head were joined with anterior and posterior pins of proximal shaft, respectively, with knurled rod. Three pins of head were joined to each other using a curved knurled rod. Similarly three pins of proximal shaft were joined to each other by a curved knurled rod [Figure 1c]. A triangular sling was applied for comfort and patients were encouraged to begin active mobilization of the involved extremity from postoperative day 1. The pins were cleaned twice a day with hydrogen peroxide and Betadine solution. Wire and pin tract infections were classified according to the Dahl classification and were treated accordingly. Physical therapy was started immediately, beginning with pendulum exercises progressing to unrestricted range of motion by 6–7 weeks after fracture fixation. The decision of pin removal was made by radiological assessment of healing and functional activity.

Figure 1: Preoperative X-rays of right shoulder anteroposterior view (a) and axillary view (b) showing neer type 2 fracture of proximal humerus (c) immediate postoperative X-ray showing good alignment, final X-ray (d) anteroposterior view (e) Axillary view of the shoulder at 24 months followup showing sound fracture union
Patients were followed at 4 weeks, 6 six weeks, 8 weeks, and then 4 weekly interval for a minimum of 1 year, looking for clinical and radiological union, Constant Score, visual analogue scale (VAS), and for any complication. Constant Scoring System consists of four variables that are used to assess the function of the shoulder. The subjective variables are pain and activities of daily living (ADL) (sleep, work, recreation/sport), which give a total of 35 points (pain: 15, ADL: 20). The objective variables are range of motion and strength, which give a total of 65 points (range of motion: 40, strength: 25). Altogether there are 100 points. Constant Score divides the outcome of patients into four categories, i.e. excellent having a score >85, good having a score between 71 and 85, fair having a score between 61 and 70, and poor outcome with a score of 60 or less.

**RESULTS**

The results are summarized in Table 1. Maximum followup was 30 months and minimum followup 9 months, with a mean of 20.5 months [Figure 1d,e]. The fracture union time was ranging from 6.0 weeks to 8.0 weeks with mean of 6.5 weeks.

Mean Constant Score of patients (at mean followup of 6 months) was 78.1±9.61, with 18.75% (n=3) patients showing excellent results, 62.5% (n=10) having good results, and 18.75% (n=3) having fair results.

One patient had K-wire loosening and another a pin tract infection in second week which was managed according to Dahl classification by frequent pin care with half strength Hydrogen peroxide solution and oral antibiotic for two weeks.

ROM exercises were started from day one and full functional range was achieved with a mean of 16.5 weeks (range 8-32 weeks). Surgical time ranged from 30 minutes to 50 minutes. Five patients required reinsertion of anterior and posterior pins of head of humerus. Nine patients were operated in local anaesthesia and 7 in general anaesthesia depending on the the co-morbid conditions to undergo surgery in general anaesthesia. No nerve injury was reported.

**DISCUSSION**

The closed proximal humeral fractures have been treated with a wide range of options, namely non-operative, open reduction internal fixation, external fixation, closed K-wire fixation, percutaneous screw fixation, and tension band fixation. Each procedure is has some limitations and complications. A major disadvantage of non-operative treatment is failure to obtain early mobilization, which results in a high rate of shoulder stiffness and pain, and malunion or nonunion is likely with certain fracture types.\(^\text{10,12}\) JESS fixator application in our study allowed sound fracture union with functional mobility in our study. A disadvantage of open internal fixation is difficulty in achieving rigid fixation in the osteoporotic cancellous bone of proximal humerus. Cortical bone in osteoporosis constitutes only a thin shell of bone and provides weak purchase for the screws. Presence of comminution offers difficulty in internal fixation while external fixation works on principal of ligamentotaxis. Internal fixation has been reported to have increased complication rates in these patients due to hardware loosening and pullout of the screws.\(^\text{13-15}\) Additionally, the use of internal fixation device prolongs the operative time, increases intraoperative bleeding, and increases the risk of avascular necrosis of humeral head because of the disruption of the residual vascularity.\(^\text{14,15}\) Postoperative adhesions further limit the range of motion as a result of extensive dissection needed in cases of open reduction and internal fixation.\(^\text{16}\) However, recent studies have shown good long term results of proximal humerus fractures managed by PHILOS plate.\(^\text{17,18}\)

The use of external fixators in the management of proximal humeral fractures has begun to gain acceptance over the last 10 years. The idea of minimal fixation now lends to the fact that the blood supply to the head of the humerus is preserved. Hoffmann’s external fixators were used for this type of fracture by many authors, but their use was hindered by bulky Steinman pins, increasing the risk of injury to soft tissue and limiting the space for application of
multiple pins in different planes. The smaller K-wires used in JESS have lesser risk of soft tissue, neural, and vascular injury. Multiple K-wires used in different planes add to the rotational stability to a reduced fractures. The principles of management for complex proximal humeral fractures are minimal soft tissue dissection to avoid the occurrence of avascular necrosis of the humeral head, adequate fixation to provide good stability for early rehabilitation, and an intact rotator cuff for an optimal functional outcome. Closed reduction and the use of JESS achieve these principles adequately [Figures 2a,b].

Complications encountered by external fixation of fractures of proximal humerus are K-wire loosening, pin tract infection, malunion, and elbow stiffness. The use of partially threaded K-wire increases the pullout strength. The undue tension on skin should be avoided to avoid pressure necrosis.

Results obtained in our study by JESS were compared with those of studies [Table 2] done by Altay et al., 19 Monga et al., 20 and Kristianse et al., 21 on the management of proximal humerus fractures by external fixation. Limitation of our study is that we have included only 2- and 3-part fractures, while some studies like those of Kristianse et al. and Monga et al. have included 4-part fractures also.

JESS is an alternative option to treat Neer’s 2- and 3-part proximal humerus fractures, especially in elderly patients with osteoporotic bone, showing excellent to good results in almost 80% cases. However, more randomized studies are needed to validate the possible advantages associated with external fixation.

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Table 2: Comparison of functional results of our study with other studies

| Results | Our study (2010) | Altay et al. (2005) | Monga et al. (2009) | Kristianse et al. (1987) |
|---------|----------------|-------------------|-------------------|-------------------------|
| Number of cases | 16 | 14 | 19 | 23 |
| Excellent | 18.75% | - | 50% | 8.69% |
| Good | 62.5% | 62.5% | 30% | 43.48% |
| Fair | 18.75% | 25% | 10% | 43.48% |
| Poor | - | 12.5% | 10% | 4.35% |
| Duration of union (weeks) | 6.5 | 8.4 | 11 | 9.3 |

Figure 2: Clinical photograph showing extension and abduction at shoulder at 24 months follow-up.
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