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Functional outcome following external fixator (JESS) application for proximal humeral fractures

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ABSTRACT

Background: Proximal humeral fractures account for 5% of all fractures. Observed frequently in older osteoporotic patients but found in young patients with high-energy trauma. About 80% of these fractures are undisplaced or minimally displaced. Non-operative method requiring immobilization of shoulder often leads to a stiff shoulder, whereas surgical procedures such as plating need excessive soft tissue dissection. It was overcome in this study by less soft tissue dissection by use of external fixator application and early mobilization.
Methods: Total of 18 patients mean age 40.5 years, predominantly male (16/18) treated with external fixator - JESS (Joshi's external immobilization system) for Neer's two, three and four part proximal humeral fractures. Vehicular accidents were the most common mode of injury followed by fall. There were 8 cases each of Neer's two and three part fractures. Shoulder mobilization started within a week as postoperativelyas pain allowed. Patients followed up at 3, 6, 12 and 18 weeks for pain, function, range of motion and anatomy with check X-ray. After radiological union at 8-10 weeks JESS was removed. Cases were evaluated for functional result by constant scoring system.
Results: Average score on constant scoring system was 72 after a mean follow-up of 6 months. All fractures united in mean duration of 9.33 weeks. The complications included shoulder stiffness in one case and pin tract infection in two cases.
Conclusions: Early shoulder mobilization a prerequisite for good results can be achieved without compromising fracture union. Less soft tissue dissection required and significant cost effective.

Keywords: Proximal humeral fracture, External fixator, JESS

INTRODUCTION

Proximal humeral fractures account for nearly 5% of all fractures and are the third most common fracture after hip and distal radial fractures.[1]They occur more frequently in older patients which are usually due to low energy osteoporotic injuries but they are also seen in young patients due to high-energy injuries mainly from road traffic accidents.[2] 80% of the proximal humeral fractures are undisplaced or minimally displaced and usually treated non-operatively but remaining 20% of fractures are significantly displaced and more difficult to manage.[3-8] In the rest twenty percent of the proximal humeral fractures which include three and four part fractures, severe complications are the result of associated vascular compromise, which occurs because of interruption of the

ascending branch of the anterior humeral circumflex artery.[9] Avascular necrosis of the head of humerus is found in 12-34% cases of three part and 41-59% case of four part proximal humeral fractures.[10,11] Conservative method has a disadvantage of shoulder immobilization for at least three weeks and thus producing stiffness to a varying extent from person to person that is quite disabling especially in young active individualswhereas surgical procedures such as plating needs excessive soft tissue dissection which in turn increases the risk of avascular necrosis of humerus head. These problems were overcome by early mobilization and less soft tissue dissection by way of JESS application.

METHODS

We reviewed total 18 patients from June 2010 to June 2011 Era's Lucknow Medical College, Lucknow with a mean age of 40.5 years ranging from 21 to 60 years and male predominating with 16 in number, all treated surgically with external fixator (JESS) for Neer's 2, 3 & 4 part proximal humeral fractures. RTA (road traffic accident) was the most common mode of injury followed by fall. There were 8 cases each of Neer's two and three part fractures. All the patients included were above 16 years of age with duration of injury less than two weeks and included Neer's two, three, four part fractures and fracture dislocation. Any patient with other associated injuries was excluded. Each case included was evaluated clinically and radiologically and to study the type of injury the Neer's trauma series X-rays were done which include antero-posterior and axillary view as shown in Figure 1 and Figure 2.

The procedure was performed with the patient under general/local anaesthesia in a supine position, using a sandbag to elevate the shoulder. Reduction of proximal segment done under image intensifier. 2 mm K-wires/schanz pins are inserted through the safe area of deltoid region taking care of axillary nerve and circumflex vessels, at least three in number or more in to the proximal fragment. Proximal fragment K-wires/schanz pins are connected to each other with the help of 4 mm blocks and semi-circular ring of 3 mm rod. In cases of gross comminution another parallel supporting semi-circular ring of 3 mm connecting rod is fixed to the same schanz pins/ K-wires in the proximal fragment. Two (preferably three) 2 mm K-wires/ Schanz pins are passed in the shaft of humerus below the deltoid tuberosity from lateral to medial at different angles (to provide 3D fixation) taking care of radial nerve. These wires/pins in the distal fragment are connected to each other and to the proximal semi-circular ring by mean of 4 mm blocks and 3 mm bent rods as given in Figure 3. Assembly is tested for stability per-operatively and additions are made as per requirement. Movement of shoulder joint assessed per-operatively under image intensifier for stability of fixation.

Figure 1: AP view of Neer's two part fracture in 42 year male.

Figure 2: Axillary view of Neer's two part fracture in 42 year male.

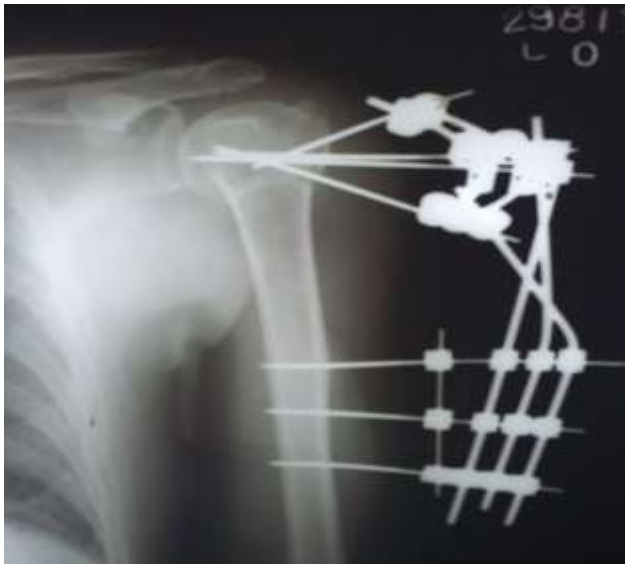

Figure 3: Postoperative AP view of Neer's two part fracture in same patient.

Shoulder mobilization exercises started within one week as soon as post-operative pain and swelling subsided. All patients were followed up at 3, 6, 12 & 18 weeks for pain, function, range of motion and anatomy with check X-ray as shown in Figure 4 and Figure 5. After union radiologically and clinically at 8-10 weeks, JESS was removed and cases were evaluated for functional result by using constant scoring system. Constant scoring system consists of four variables that are used to assess the function of the shoulder i.e. pain, activities of daily living, range of motion and strength. 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.

Figure 4: AP view of Neer's two part fracture in same patient after union (10 weeks).

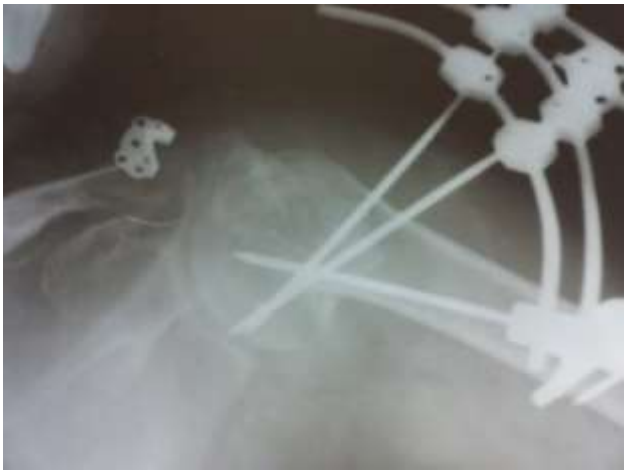

Figure 5: Axillary view of Neer's two part fracture in same patient after union (10 weeks).

RESULTS

The shoulder mobilization exercises started within one week and in most of the cases immediately after 1-2 days. The mean constant score came out to be 72 at a mean follow up of 6 months at regular interval. There was 100% union with mean duration of 9.33 weeks followed by removal of JESS. There were four cases (22.22%) which showed excellent results, eight cases (44.44%) showed good results, four cases (22.22%) showed fair results and two cases (11.11%) showed poor results one of which was due to non-compliance in physiotherapy as advised. The complications included shoulder stiffness in one case and pin tract infection in two cases which responded well to dressing and oral antibiotics.

DISCUSSION

The proximal humeral fractures are still a debatable and controversial subject in orthopaedics. Based on our experience and results we conclude that proximal humeral fractures were quite disabling despite surgeon's best efforts. Full range of movement in severely comminuted fractures was an unlikely outcome. The different modes of management of proximal humeral fractures include conservative, open reduction and internal fixation, closed reduction and internal fixation and closed reduction and external fixation. Each procedure has some limitations and complications. In conservative treatment, the problem of shoulder stiffness is common to varying extent from person to person that is quite disabling especially in young active individuals. To overcome this problem, early mobilization is mandatory and that is not possible in conservative treatment before three weeks.[12-14] Restriction in range of movements in conservative group is due to increased bursal and capsular adhesions.[15] The early mobilization could be achieved by the use of external fixator (JESS) which allows shoulder mobilization within one week. In cases of open reduction and internal fixation, due to excessive soft tissue dissection there is increased risk of avascular necrosis of humeral head because of the disruption of the residual vascularity.[16,17] Also in cases of osteoporotic bone, there is difficulty in achieving rigid fixation and results in implant failure. Postoperative adhesions further limit the range of motion as a result of extensive dissection needed in cases of open reduction and internal fixation.[18] These problems were overcome by the use of JESS which requires less soft tissue dissection and provides stable fixation even in osteoporotic bones. In addition, presence of comminution offers difficulty in internal fixation while external fixation provides good fixation as it works on the principal of ligamentotaxis. 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 use of partially threaded K-wire increases the pull-out strength. The successful results can be attributed to the following points i.e. early surgery, good preoperative planning, minimal soft tissue dissection, stable reduction, minimum

implants, supervised postoperative exercise and regular follow up. The use of external fixation was reported to have several advantages i.e. no exposure and soft tissue stripping preserves humeral head vascularity which in turn decreases the incidence of osteonecrosis of humeral head, this configuration of external fixation produces extremely solid fixation which allows early mobilizations and subacromial impingement was avoided by external fixator.

Complications encountered by the use of external fixator in fractures of proximal humerus are K-wire loosening, pin tract infection, malunion, and elbow stiffness.

Results obtained in our study by JESS was compared to study done by Altay et al and Anil et al on management of proximal humeral fractures by external fixator as given in Table 1.[19,20]

Table 1: Comparison of functional results of our study with other studies.

Constant score	Our Study (2012)		Altay et al. Study (2005)		Anil et al. Study (2010)	
	No. of patients	Percentage (%)	No. of patients	Percentage (%)	No. of patients	Percentage (%)
Excellent	04	22.22	–	–	03	18.75
Good	08	44.44	05	62.5	10	62.5
Fair	04	22.22	02	25.0	03	18.75
Poor	02	11.11	01	12.5	-	-
Total	18	100	08	100	16	100

JESS is a preferable alternative to treat proximal humeral fractures with the advantages of early shoulder mobilization a prerequisite for good results which can be achieved without compromising fracture union, less soft tissue dissection requirement and significant cost effective

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