

## Research Article

# A clinical study of management of proximal humeral fractures in adults

Shakil Mohamad Khan<sup>1\*</sup>, Shifa Sheikh<sup>2</sup>, Shaik Hussain Saheb<sup>3</sup>

<sup>1</sup>Department of Orthopedics, JJM Medical College, Davangere, Karnataka - 577004, India

<sup>2</sup>Department of Dermatology, JJM Medical College, Davangere, Karnataka - 577004, India

<sup>3</sup>Department of Anatomy, JJM Medical College, Davangere, Karnataka - 577004, India

**Received:** 28 December 2013

**Accepted:** 07 January 2014

### \*Correspondence:

Dr. Shakil Mohamad Khan,

E-mail: orthosk@yahoo.com, drshakeelkhan123@gmail.com

© 2014 Khan SM et al. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

## ABSTRACT

**Background:** Fractures of the proximal humerus are one of the commonest fractures encountered by an orthopaedician. The incidence of this fracture has significantly increased perhaps due to the increased vehicular traffic and mechanized life. The approach towards the management of these fractures types of fractures has changed during the course of period. Since the appropriate treatment and results associated with each modality of treatment for these fractures is not defined this study was undertaken.

**Methods:** This longitudinal study was done on 150 cases of proximal humerus fractures which were managed by both conservative and surgically. Initial preoperative clinical and radiological assessment was done and appropriate mode of treatment of given depending upon type of fracture according Neer's classification. Follow up of patient was done both clinically and radiologically at 2<sup>nd</sup>, 6<sup>th</sup> and 8<sup>th</sup> weeks and assessed for any complications. Final assessment was done according to Neer's shoulder scoring criteria.

**Results:** The 90 cases were treated conservatively and 60 surgically. Maximum follow up was 9 months and minimum 4 month with an average follow-up of 6.67 months. Our series showed excellent result in 70 cases (46.6%), satisfactory in 65 cases (43.3%) and fair in 15 cases (10%).

**Conclusion:** Undisplaced fractures of the proximal humerus can be managed conservatively and non-displaced tuberosity fractures, if managed conservatively, give good results. Displaced two or three part fractures in young patients need anatomical reduction with internal fixation. Conservative treatment of four part fractures, four part fracture dislocation and anatomical neck fractures gives poor results and so primary hemiarthroplasty is indicated. There is direct relationship between displaced proximal humeral fractures between fracture severity i.e. greater displacement, comminution, and crushing and the eventual results that is more than the initial insult, worse the prognosis. Rehabilitation is the key to success.

**Keywords:** Surgical neck, U-slab, Percutaneous K-wire fixation

## INTRODUCTION

Fractures of the proximal humerus are one of the commonest fractures encountered by an orthopaedician. The incidence of this fracture has significantly increased perhaps due to the increased vehicular traffic and mechanized life. The injury is of great importance when it affects the young and middle age groups of the population. It leads to temporary disability and loss of

working hours. Restoration of the function of the limb is of paramount importance. These fractures usually do not constitute a major therapeutic problem. For most undisplaced and minimally displaced fractures of the proximal humerus non-surgical management is preferred because non-union is rare, healing time is short and infection very uncommon. For more displaced fractures and osteopenic bone, techniques of internal fixation, which emphasize less disruptive soft tissue dissection,

and minimal fixation with wire and non-absorbable sutures have been successful with a low complication rate. Even AO type buttress plates are being used, but they require more soft tissue dissection and may lead to infection. Severely comminuted and displaced fractures have been treated with hemiarthroplasty. In fractures treated conservatively or surgically minimal amount of malunion is cosmetically and functionally acceptable. Most studies indicate that for the majority of good results of fractures of this region are obtained by conservative methods. Some studies state that operative treatment is better, depending on type of fracture and the quality of the bone. Management of these fractures is associated with some morbidity and undesirable sequelae. They include complications like avascular necrosis, malunion, nonunion, infection, neurovascular injury, loss of motion of shoulder from adhesive capsulitis, chronic edema, elbow stiffness and atrophy of the soft tissues of the immobilized limb causing significant disability during healing and afterwards.<sup>1</sup>

In study of Tytherleigh 249 fractures of humerus were analyzed, between 1989-1992. Here fractures were classified as AO type A in 63.3%, type B in 26.2%, type C in 10.4%. Most (60%) occurred in middle 1/3 of diaphysis, 30% in the proximal humerus and 10% in distal humerus. There was a bimodal age distribution with a peak in the third decade as a result of moderate to severe injury in men and a larger peak in seventh decade after a simple fall in osteoporotic women.<sup>2</sup>

In study of Kenneth J 140 cases, one-part fractures of the proximal humerus were treated with cuff and collar sling. They showed clinical and radiological union by 8-10 weeks, with 46% of cases having complete functional recovery.<sup>3</sup>

Richard F. Kyle study showed that, 80% of proximal humerus fractures can be treated conservatively. They also reported that, displaced three part and four part fractures in young adults require internal fixation. But rehabilitation is the key to success after stabilization of proximal humerus fractures.<sup>4</sup>

In study of M Pritsch 73 patients with humeral head fractures who were treated by closed pinning. There were 48-two part fractures, 18-three part fractures, 7-fracture dislocations. All fractures united between four to eight weeks. There were no cases of infection, axillary nerve damage and no avascular necrosis. In one patient reduction was lost. They concluded that closed pinning of humeral head fractures is a safe and reliable procedure and can be used alone or in combination with other procedures. The low morbidity of this method makes it superior to other methods.<sup>5</sup>

In study of Herbert Resch reported that untreated three and four part fractures of the proximal humerus have a poor functional outcome. Open reduction increases the risk of avascular necrosis, so percutaneous reduction and

fixation may be preferable. They studied 27 patients, 9 were three part and 18 with four part fractures which were treated with percutaneous reduction and screw fixation. Instruments were introduced into fractures through small incisions so that the fragments could be reduced under C arm. All three part fractures showed good to very good results, with no avascular necrosis till 24 months. Avascular necrosis was seen in 11% of 4 part fractures.<sup>6</sup>

In a study of Darder 35 patients with 4 parts displaced fracture which were treated with atraumatic method using two modified 'K' wires. They reported 41% fracture healing and 36% satisfactory to excellent functional outcome at the end of 4-6 weeks. They concluded that percutaneous 'K' wire fixation is of importance in older patients with osteoporotic bones who require less soft tissue disruption.<sup>7</sup>

In a study of Krishtiansen B reported a new technique for the treatment of displaced fractures of proximal humerus. All 11 patients were managed by transcutaneous reduction using a steinmann pin and external fixation with a Hoffman type neutralizing bar connected to two half-pins in the humeral head and three half pins in the shaft. The pins were removed after four weeks. Two cases of pin tract infection resolved with antibiotics. They concluded that there were no neurovascular injuries and refractures. They showed excellent results in 9 of 11 cases.<sup>8</sup>

Lill H study of 21 patients, displaced fractures of proximal humerus were treated with crossed screw synthesis. The screws were placed anteriorly and posteriorly in a crossed manner from the distal fragment into the humeral head. Fractures were classified as two parts in 10 patients and three parts in 11 patients. In their study excellent results were achieved in 15 patients, moderate in 3 patients and poor in 3 patients. The complication rate was 29%. They concluded that crossed screws osteosynthesis represents an alternative mode in surgical treatment of displaced proximal humerus fractures.<sup>9</sup>

In study of Takeuchi R, 41 unstable two-part proximal humeral fractures were treated by closed reduction and internal fixation with J-nails. Forty of two part fractures were at surgical neck and one at anatomical neck. All patients were treated by closed reduction and intramedullary fixation using three J-nails. The outcome was excellent in 25 patients, satisfactory in 12, unsatisfactory in 3 and failure in one. They concluded that J-nail fixation has the advantage of being an almost closed method without disadvantage of muscle transfixation associated with other methods and is one of the more reliable and effective treatments for proximal humerus fractures.<sup>10</sup>

Lill H study of 35 patients, all the patients were managed using Locking-proximal humerus plate. There results

showed constant score of 77.6 points in two-part fractures, 75% points in three-parts and 64.8 points in 4-part fractures. They encountered complications like screw loosening in 2 and plate breakage in 3 cases. As demonstrated by these good results, they conclude that this plate is suitable for displaced humeral head fracture.<sup>11</sup>

A retrospective study conducted by Joseph P, where 60 patients with three part and four part fractures of proximal humerus were treated with open reduction and internal fixation with cerclage wires or a plate. After an average follow-up of 10 years, 87% had excellent to good results, and 13% had poor results based on constant score. Out of these 37% had development of avascular necrosis of humeral head and among them 77% had excellent to good constant score. They concluded that ORIF with cerclage wire or T-plate have given good results in most patients though some patients had developed avascular necrosis of humeral head.<sup>12</sup>

The aim of the study outcome of different modalities of treatment with respect to pain, function and range of movements in each type of fracture of proximal humerus according to Neer's classification. Neer's hemiarthroplasty prosthesis was introduced in 1972.

## **METHODS**

Our study was conducted at JJM Medical College, Davangere between 2009-2012. We studied 150 patients with proximal humerus fractures, regarding the cause of the fracture, modality of treatment, recovery, the complications and the eventual outcome in terms of shoulder mobility, pain, strength, and activity as compared with other side.

All patients above 18 years of age having closed undisplaced or displaced fractures of proximal humerus were included in the study. Patients with compound fracture of proximal humerus were excluded from the study.

The assessment of the patient's general condition and other associated injuries, whether the fracture was simple or compound and depending upon the nature of the patient's profession and age, and the radiological classification of the fracture it was decided whether to treat the patient conservatively or surgically. In most cases a conservative line of treatment was adopted.

### **Clinical diagnosis**

The most common symptoms were pain, swelling and tenderness about the shoulders especially in the area about the greater tuberosity, crepitus was usually present. Ecchymosis became visible 24-48 hours after injury and in some cases it spread to the chest wall and flank.

A detailed neuro-vascular examination was conducted as the brachial plexuses and axillary arteries are just medial to coracoids process and might have been injured, even in undisplaced fractures, so we always examined the peripheral pulses and loss of sensation in distal extremity. The axillary nerve was tested by sensations over the deltoid region. Examination of chest, abdomen and pelvis was done. There were occasionally associated fractures of the rib, and other fractures in addition to the humeral fractures.

### **Radiographic findings**

The "Trauma series" was used in diagnosing proximal humerus fractures. This consisted of,

1. Anteroposterior view in scapular plane.
2. Lateral view in scapular plane
3. Axillary view - Allowed evaluation in the axillary plane and was essential for evaluating the degree of tuberosity displacement, the glenoid articular surface, and relation of humeral head to the glenoid.
4. Occasionally, the velpeau view was taken. In this, patient was seated and tilted obliquely backwards 45<sup>0</sup>, with the plate below and X ray tube above the shoulder.

### **Treatment**

Most proximal humeral fractures that were undisplaced or minimally displaced were treated with a cuff and collar sling, then range of motion exercises were started after 6 weeks. Displaced fractures, however, needed intervention.

### **Conservative treatments**

Most of the cases were managed conservatively.

### **Operative treatments**

The technique employed depends on the type of fracture, quality of bone and soft tissue, and the age and reliability of the patient. The goal of internal fixation was stable reduction allowing early motion. Limited dissection of soft tissues about the fracture fragments was done and minimal implants were used. The approaches are Superior lateral approach to the shoulder, deltopectoral approach, open reduction and internal fixation.

### **Post-operative care**

The operated extremity was placed in a sling and swathe bandage for the first ten days. Sutures were then removed and if secure fixation was achieved, gentle pendulum exercises were started. If the bone was severely osteoporotic and fixation was less than rigid, motion was

delayed; otherwise redisplacement of the fracture fragments could have occurred. Pendulum exercises were permitted by the second or third week and gentle passive forward flexion and internal and external rotation exercises by the third or fourth week. By the fourth to sixth week, active exercises were started.

### Rehabilitation

Rehabilitation was the key to functional outcome. Provided the fracture or fracture repair was stable, therapy was started early.

Hughes & Neer<sup>13</sup> three phase exercise system was followed. These exercises were performed four times per day for 20-30 minutes. A hot pack was applied 20 minutes before exercises were begun and analgesics given in the early phase.

### RESULTS

The study was conducted in JJM Medical College, Davangere. The cases with proximal humerus fracture were initially examined in out-patient department or casualty.

In this study among 150 patients, the mechanism of injury was road traffic accident in 95 patients; seven were due to domestic falls, three due to assault and one because of electric burns.

All 150 cases were treated and followed up for an average period of 20 weeks. Among these 150 cases, 40 cases were of undisplaced proximal humerus fracture.

In these 40 cases, 30 cases were surgical neck fractures and 10 were greater tuberosity. All the cases were treated conservatively and immobilization was done for 4-8 weeks. Clinical and radiological union was seen by end of 8-10 weeks.

Out of these 40 cases, 35 patients had excellent outcome and 5 satisfactory. This one patient with surgical neck humerus had associated ipsilateral undisplaced olecranon fracture, for which immobilization was done for 8 weeks.

Fractures were seen in all age groups, but were common in age group of 40-60 yrs (40%), the incidence of fractures of proximal was more common in males (66.66%).

Involvement of right side was more common left and ratio was 2:1.

In our study road traffic accident was the most common injury (63.33%). Other mechanism like fall (23.33%), assault (10%) and electric burns (3.33%) were encounter in our study.

Almost every type of fracture was seen in our study. Fractures at surgical neck only were present in 56.6% of cases and 3.3% of case had surgical neck fracture with anterior dislocation. Isolated greater tuberosity fracture was present in 20.33% of cases.

60% of cases were of proximal humerus fractures were treated conservatively and remaining 40% surgically.

The most common complication we encountered in our study was frozen shoulder which was present in 30% of patients. Malunion and delayed union were seen in 10.3% and 3.33% of cases respectively (Table 1).

**Table 1: Complications.**

Complications	No. of cases
Frozen shoulder	09
Malunion	04
Delayed union	01
Non-union	00
Superficial infection	01
Pin tract infection	01

110 cases of displaced fractures were classified according to Neer's classification.

Out of these 110 cases, 55 cases were of two part surgical neck fractures. In which 20 patients were treated conservatively and remaining 35 surgically in which 15 with plate and screws, 10 with interlocking nail and 10 with percutaneous K wire. In conservatively treated patients 15 had excellent results, 5 satisfactory and patients treated surgically 5 had excellent, 25 satisfactory and 5 poor. This one patient with surgical neck humerus was treated by open reduction and internal fixation with T- plate. Superficial infection subsided after antibiotics. The patient was not co-operative for rehabilitation program.

Two part Surgical neck Humerus were 55 cases out of these 25 cases were two-part greater tuberosity fracture, in which 10 were treated conservatively and 15 surgically, 5 with open reduction internal fixation with K wire and 10 with cancellous screws. In conservatively treated patient 5 had excellent result and 5 satisfactory, and in patients treated surgically one had excellent result and 10 cases satisfactory.

Three part fracture were 20 cases of three part fractures (surgical neck and greater tuberosity) 15 cases were treated conservatively and 5 surgically. Surgically treated patient had excellent result. In conservatively treated patients, 5 had satisfactory result and 10 had poor. In patients with poor results, one patient was case of hypertension, with diabetes mellitus and had osteoporosis with cardiomegaly and congestive cardiac failure. As patient was unfit for surgery, surgical management was

not undertaken. Another patient was not ready to get treated surgically.

The Final results of treatment were as follows excellent were 70 (46.66%), satisfactory were 65 (43.33%) and unsatisfactory were 15 (10%) (Table 2).

**Table 2: Final results of treatment.**

Result	No of patients	%
Excellent	14	46.66%
Satisfactory	13	43.33%
Unsatisfactory	3	10%
<b>Total</b>	<b>30</b>	<b>100%</b>

## DISCUSSION

Fractures of the proximal humerus are one of the most common injuries encountered by orthopaedic surgeons. These fractures being described about two centuries back, even before the invention of radiography, have shown various trends in their management. Due to awareness of its complexity and complications, these fractures have stimulated a growing interest in finding the optimal treatment. An anatomical reduction and good rehabilitation is a strong predictor for good functional outcome.<sup>1</sup>

Earlier these fractures were considered simple and were managed by plaster cast technique, slings and slabs,<sup>2</sup> but recent advances in understanding of anatomy, good surgical skills and better instrumentation has lead to various modalities for the treatment of these fractures like percutaneous pinning,<sup>5,6</sup> external fixation,<sup>8</sup> bone grafting or bone cement supplements, plate fixation<sup>11</sup> or Prosthetic replacement.

We have treated 30 cases of fractures of proximal humerus either conservatively or surgically and assessed the outcome using Neer's shoulder scoring system.<sup>13</sup> Age of the patients was ranging from 20 years of minimum to 83 years of maximum with an average age of 51.4 years. In our study there were 20 males (66.6%) and 10 females (33.3%) and male to female ratio of the patients was 2:1. Our study showed the involvement of left side in 10 cases (33.33%) and 20 cases (66.67%) on right side and ratio was 1:2. In studies done by various authors there were similar findings.<sup>2</sup> In our study the main mechanism of injury is road traffic accident in 19 cases (66.67%). Fall includes 7 cases (20%) and 3 cases (13.33%) had history of assault and 1 case with electric burns. Thus showing high velocity injury as the main mechanism. Comparing our study with the published series, we find that the emergence of high velocity injury due to road traffic accidents has changed the complete outlook towards these fractures.<sup>2</sup>

Out of these 30 patients, two had head injury, one had facial injury, and one had superficial electric burns. One

each had clavicle and glenoid neck fracture, one had both bones fracture forearm, three had fracture shaft femur, two had rib fractures, one olecranon fracture, one fracture tibia, and a fracture phalanx and pelvis. Nine patients i.e. 30% out of 30 patients had evidence of osteoporosis, 3 had diabetes mellitus, 3 had hypertension and one had Hemi paresis. In earlier studies mentioned that osteoporosis was significant factor in management of these fractures.<sup>4,5</sup>

In our study, the majority 18 i.e. 60% patients were treated conservatively and rest 12 i.e. 40% were treated surgically. In earlier studies showed 70-80% of fractures of proximal humerus could be treated conservatively with satisfactory to excellent results. In our study we had similar findings i.e. 60% of the cases were treated conservatively.<sup>1,3,4,14</sup>

In our study, among patients treated conservatively, the majority were given 'U' slab after closed reduction if there was displacement of fracture fragments. A few patients with undisplaced fractures and displaced fractures after closed reduction were given an arm to chest strapping with combined cuff and collar sling for three weeks. These gave good results, which were comparable to published articles.<sup>3,4</sup> In majority of cases treated conservatively, closed reduction under general anesthesia with adequate muscle relaxation was needed when the fragment were displaced. The stability of fracture was checked in different positions. If a fracture after reduction was unstable further operative stabilization was necessary.<sup>4,11,12</sup>

In two part surgical neck fractures, the head was in the neutral position as both the tuberosities were attached to it, and the shaft was pulled medially due to the pull of the pectoralis major. Traction, with flexion and some adduction was required to reduce the fracture. In the case where reduction was not possible, there was found to be soft tissue interposition which was blocking reduction, on open reduction.<sup>5,6,9,10,11,15</sup>

Displaced two part greater tuberosity fractures were usually found retracted posteriorly and superiorly and closed reduction was difficult. If they were reduced anatomically however, a malunion could have occurred that would have later blocked gleno-humeral motion. Hence open reduction and cancellous screw transfixation was carried out with good results.<sup>1,6,7,9</sup>

Displaced three part fractures were difficult to reduce and still more difficult to hold reduced, probably because if the greater tuberosity was attached to the head, it was pulled into external rotation with the humeral articular surface facing forward. If lesser tuberosity was attached to it, the articular surface was facing posteriorly. The shaft was pulled medially by the pectoralis major and probably the long head of biceps was caught between the fracture fragment and prevented reduction. Moreover, since the fracture usually occurred in osteoporotic bone,

vigorous manipulation and repeated attempts at reduction could cause further comminution at the fracture site. The similar finding has been found in literature published by various authors.<sup>4-7,11,12</sup>

In those treated surgically, three young patients had surgical neck humerus and closed reduction was unstable, so open reduction and internal fixation with plate was done.<sup>11,16</sup> In one case with surgical neck humerus, where age factor and quality of bone was considered and was treated with percutaneous 'K' wire fixation.<sup>5,6</sup> Two cases with surgical neck humerus were internal fixed with interlocking nail.<sup>17-19</sup> Two cases with displaced greater tuberosity fractures were reduced openly and stabilized with cancellous screws.<sup>9</sup> Another 2 cases with three-part fracture were treated with percutaneous wires.<sup>6</sup> One case with 3-part fracture dislocation was reduced and fixed with 'K' wires. Many authors in their published literature have mentioned that, in management of displaced proximal humerus, good reduction is mandatory and stable fixation gave good results. They also reported that open reduction and internal fixation in young adults gives better outcome. In older persons the quality of bone and soft tissue disruption should be given importance, and it is better to fix percutaneously.<sup>4-12</sup>

In our series the patients treated surgically had better outcome and number of complications were less compared to patients treated conservatively, as they required longer period of immobilization. One patient had superficial infection which settled with antibiotics. One patient had pin tract infection, which subsided after removal of 'K' wires. In patients complicated with frozen shoulder, phase wise physiotherapy was started after clinical union was confirmed. They ended up with satisfactory results.<sup>20</sup>

## CONCLUSION

All the patients were evaluated on the basis of Neer's scoring system and following conclusions were drawn.

Undisplaced fractures of the proximal humerus can be satisfactorily managed conservatively, that is with 'U' slab combined with cuff and collar sling.

Undisplaced tuberosity fractures, if managed conservatively, give good results.

Young adults with displaced surgical neck humerus fractures, if stable after closed reduction, can be treated conservatively. If unstable, it is ideal to do open reduction and internal fixation.

In older individuals with surgical neck humerus it is good to fix with percutaneous 'K' wires, keeping in mind about quality of bone (osteoporosis) and also to shorten the period of surgery.

Displaced greater tuberosity fractures should always be fixed internally with screws after open reduction.

Displaced three-part fractures in young patients need anatomical reduction and are fixed internally with percutaneous 'K' wires or plate.

Literature says anatomical neck fractures of proximal humerus account for only 0.54% of proximal humeral fractures. Displaced anatomical neck fractures cause complete disruption of blood supply to the articular segment. The success rate of closed pinning and headless screw fixation is very less. The chance of avascular necrosis of humeral head increases by 5 times in these types of fractures. The only preferred treatment for displaced anatomical neck fracture is primary hemiarthroplasty.

The Neer's four part fractures and 4-part fracture dislocation are rare compared to other fractures of proximal humerus. The chances of avascular necrosis are very high. The Neer's primary hemiarthroplasty is preferred treatment.

The goal of open reduction and internal fixation is to restore proximal humeral anatomy with enough stability so that fracture can heal and for early motion and to avoid stiffness.

Early open reduction and internal fixation prevents complications like Frozen shoulder, malunion and late osteoarthritis.

There is direct relationship between displaced proximal humeral fractures, between fractures severity (i.e. greater displacement, comminution) and eventual results. The more the initial insult, worse the prognosis.

Rehabilitation is the key to success. After the fracture is stabilized by whatever means, continuous active followed by passive motion should be started. On discharge, the patients must be instructed regarding physical therapy to be done several times a day.

Irrespective of whether the patient was managed conservatively or surgically, and whether he had two, three or four part fracture, improvement occurs rapidly during the first year and then tends to plateau off.

*Funding: No funding sources*

*Conflict of interest: None declared*

*Ethical approval: The study was approved by the Institutional Ethical Committee*

## REFERENCES

1. Jobe F. W., Tibone J. E., Pink, M., Jobe C. M., Kvitne R. S. The Shoulder in Sports. In: Rockwood and Matsen, eds. "The shoulder". 2nd ed.

- Philadelphia: W. B. Saunders Company; 1993: 337-379.
2. G. Tytherleigh Strong. "The Epidemiology of Humeral shaft fracture". *JBJS.* 1998; March;80B(2).
  3. Kenneth J. Koval, Maureen, "Functional outcome after minimal displaced fractures of proximal humerus". *JBJS.* 1997 Feb;79(2):203-7.
  4. Richard F. Kyle. "Current techniques in proximal fractures". *JBJS.* 1997;79B(Supp IV).
  5. M. Pritsch, A. Greental. "Closed pinning for humeral fractures". *JBJS.* 1997;79B(Supp III).
  6. Herbert Resch. "Percutaneous pinning of 3-4 part fractures of the proximal humerus". *JBJS.* 1997 March.
  7. Darder A. Darder AJ. "Four part displaced proximal humerus fractures; operative treatment using Kirschner wire and a tension band". *J Orthop Trauma.* 1993;7(6):497-505.
  8. Krishtiansen B, Kofoed H. "External fixation of displaced fractures of proximal humerus. Technique and preliminary results". *JBJS Br.* 1987 Aug;69(4):643-6.
  9. Lill H, Korner J, Glasmacher S, Hepp P. "Crossed screw osteosynthesis of proximal humerus fractures". *Unfallchirurg.* 2001 Sep;104(9):852-9.
  10. Takeuchi R, Koshino T. "Minimally invasive fixation for unstable two-part proximal humeral fractures: surgical techniques and clinical results using J-nails". *J Orthop Trauma.* 2002 Jul;16(6):403-8.
  11. Lill H, Heep P, Rose T. "The angle stable locking-proximal-humerus plate for proximal humeral fractures using a small anterior-lateral deltoid-splitting-approach". *Zentralbl Chir.* 2004 Jan;129(1):43-8.
  12. Joseph P. Iannotti, Mathew L. Ramsey. "Nonprosthetic management of proximal humerus fractures". *JBJS Am.* 2003;85:1578-93.
  13. Hughes M, Neer CS. Glenohumeral joint replacement and postoperative rehabilitation. *Phys ther.* 1975;55:850.
  14. Campbell's. "Operative Orthopaedics". In: Terry Canale, James Beaty, eds. *Operative Orthopaedics.* 10<sup>th</sup> ed. US: Elsevier; 2003: 2989-3002.
  15. Bellumore P., Determe P., Bonneville M. Preliminary results of internal fixation combined with distal-proximal Kapandji nailing in fractures of the head and tuberosities of the humerus. *JBJS (BR).* 1997;79B(Suppl).
  16. Rene D. Esser-Treatment of 3 and 4 parts fractures with a Modified Cloverleaf plate Device. *JBJS.* 1997;79B(Supp IV).
  17. J. W. Owen. New Cross Boltable Intra-Medullary Nail for humeral fractures. *JBJS (BR).* 1995;77 (Supp I).
  18. M. Hile et al. Huckstep humeral Nail. *JBJS (BR).* 1995.
  19. N. B. Johnson, M. P. Esser. Humeral shaft fractures treated with intramedullary nail fixation. *JBJS (BR).* 1997;79B(Supp).
  20. S. Stahl, G. Volpin. Frozen shoulder and Dupuytren's disease. *JBJS (BR).* 1997;79B(Supp II).

DOI: 10.5455/2320-6012.ijrms20140509

**Cite this article as:** Khan SM, Sheikh S, Shaik Saheb SH. A clinical study of management of proximal humeral fractures in adults. *Int J Res Med Sci* 2014;2:422-8.