

Original Research Article

Functional outcome evaluation of Neer's two part and three part proximal humeral fractures treated by percutaneous K-wire fixation in a tertiary care hospital in North India: a prospective study of 21 patients

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ABSTRACT

Background: The treatment of proximal humeral fractures is controversial. The advantages of percutaneous Kirschner's wire (K-wire) fixation include preservation of periosteal blood supply, minimal blood loss, less soft tissue damage and shorter hospital stay. The aim of this study was to evaluate the 2 part and 3 part proximal humeral fractures in terms of functional outcome at final follow up.

Methods: This was a prospective study of 21 patients aged 20 to 60 years with mean age of 44.2 years including two part and three part proximal humeral fractures based on Neer's classification, treated by percutaneous K-wire fixation. Functional outcome was assessed by Constant-Murley score at 1 year follow up.

Results: On the basis of Neer's classification, 13 patients had 2 part fracture, 8 patients had 3 part fracture. Radiological union was achieved within 7 to 15.2 weeks, with an average of 11.6 weeks. The mean constant score at 1 year follow up was 78.2, range (42 to 96). In the present study, complications were seen in 8 (38.1%) patients. The results were in proximity with the existing literature.

Conclusions: Percutaneous fixation is minimally invasive technique with preservation of periosteal blood supply, minimal blood loss, less soft tissue damage, surgery can be done under brachial plexus block, less chances of avascular necrosis, shorter hospital stay, no hardware in situ, thus no hardware symptoms, leaves no surgical scar and lowers the rate of complications.

Keywords: Proximal humeral fracture, K-wire, Constant score, Visual analogue scale

INTRODUCTION

Proximal humeral fractures constitute for 5% to 6% of all the adult fractures.¹ It is the third most common fracture in people above 65 years of age, after fractures of hip and distal radius.² About 85% of these fractures are minimally displaced and are treated conservatively. The remaining 15% are displaced and unstable, and are treated operatively.³ The fractures were classified in accordance with Neer's classification.⁴ According to this

classification, in non-displaced fractures, conservative treatment is done, and in fractures where displaced fragment had an angulation of more than 45 degree and displacement of more than 1 cm, surgical intervention was needed. At present, various surgical techniques used are percutaneous Kirschner's wire (K-wire) fixation, intramedullary humeral nails, compression plates and screws, PHILOS plate and hemi-arthroplasty.^{5,6} The advantages of percutaneous pinning include preservation of periosteal blood supply, minimal blood loss, multi-directional fracture fixation, surgery can be done under

brachial plexus block, less avascular necrosis less soft tissue damage and shorter hospital stay.^{7,8} With advancing age and osteoporosis, irrespective of modality of treatment, the risk of poor results increase.^{9,10} A major disadvantage of non-operative treatment is failure to obtain early mobilization, thus result in high rate of shoulder stiffness and pain.¹¹ The complications of percutaneous pinning reported are pin migration, pin tract infection and loss of reduction.^{7,12} The use of plate for internal fixation prolongs the operative time and increases intraoperative bleeding, also it increases the risk of avascular necrosis of humeral head because of the disruption of the remaining vascularity.^{13,14} To obtain good results, we need appropriate patient selection and experienced surgeon.¹⁵

Objectives

The objective of this study is to evaluate the radiological and functional outcome of Neer's two part and three part proximal humeral fractures treated by percutaneous K-wire fixation clinically and in terms of constant score.

METHODS

This was a non-randomised observational prospective study of 21 patients (n=21) satisfying the inclusion criteria; Neer's type 2 and type 3 fractures, presented to the Government Medical College (GMC) hospital, treated by percutaneous K-wire fixation in the post graduate department of orthopaedics, GMC, Jammu from January 2019 to May 2021. Patients satisfying the selection criteria were included in the study after proper history, clinical examination, written informed consent for the surgery and anaesthesia, and explaining their possible complications prior to the surgery. The indication of surgery was based on Neer's classification.^{4,16} The data was analysed by appropriate statistical methods. Functional outcome was evaluated by constant score at 1 year follow up and was compared with the existing literature.¹⁷ Pain was evaluated by visual analogue scale.¹⁸

Inclusion criteria

Patients with closed proximal humeral fracture including two part and three part fractures within 2 weeks, with age 20 to 60 years, were included in the study.

Exclusion criteria

Fractures presenting after 2 weeks, minimally displaced fractures, isolated greater tuberosity fractures, paediatric fractures, open fractures, pathological fractures.

Investigations

Appropriate radiological investigations were done in the form of antero-posterior and axillary views, and fractures were classified according to Neer's classification. In doubtful and complex fractures, computed tomographic

(CT) scan was also done. All baseline blood investigations, Chest X-rays and electrocardiography (ECG) was done. Informed written consent was taken and antibiotic prophylaxis was given.

Operative technique

The patient was kept in supine position with 40-45 degree elevation of shoulder, with a side table placed on the affected side. Fracture reduction was achieved under the C-arm fluoroscopy by closed manipulation and percutaneous introduction of pin to act as a joystick that manipulates the fragments. Once the reduction was achieved, definitive fixation was done using threaded K-wires inserted across fracture fragments. Depending upon the stability, 4 to 6 K-wires were used under image intensifier, placed in the proximal shaft and head fragments to the desired position avoiding injury to the radial nerve and axillary nerve. The K-wires were cut and bent near the skin to avoid migration. Post-operative check X-rays were taken and sterile dressing was done.

Post-operative treatment

Postoperatively, the arm was immobilized in an arm pouch. Adequate analgesia was given in the postoperative period. Intravenous antibiotic (cefuroxime) was given. Passive range of motion (ROM) exercises (pendulum exercises, passive forward flexion and external rotation) were started in immediate post-operative period. Active ROM of elbow wrist and hand were started immediately after surgery. Depending upon the stability on fixation, active shoulder isometric exercises were started at 3 weeks, followed by isotonic strengthening and stretching exercises at 8 to 12 weeks only after bony consolidation was confirmed on plain radiographs.

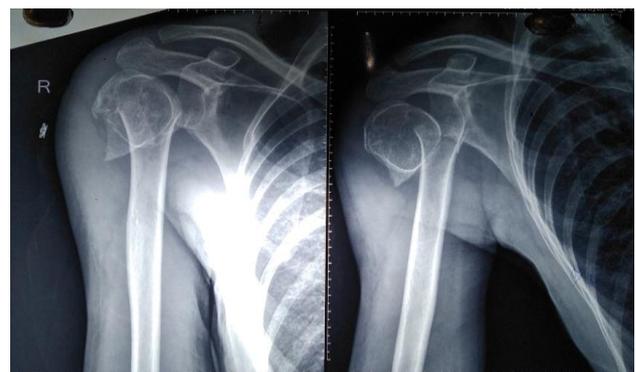


Figure 1: Proximal humerus fracture.

Follow up

Patients were assessed clinically and radiologically at 2 weeks, 6 weeks, 3 months, 6 months, and 12 months. Fracture healing was judged by both clinical and radiological methods. At each follow up, functional evaluation of the patient was done to note the range of movements at the shoulder and elbow, any pain,

deformities, and any residual complaint. The complications in the treatment were observed and were dealt appropriately. After two weeks, X-rays were taken again to check for position of the fracture, head, neck and shaft, and evidence of radiological union. After 3 months, patients were assessed by constant score which include severity of pain, activities of daily living, range of motion in terms of forward elevation, lateral elevation, internal rotation and strength. Subsequently, the patients were followed up at regular intervals till one year.

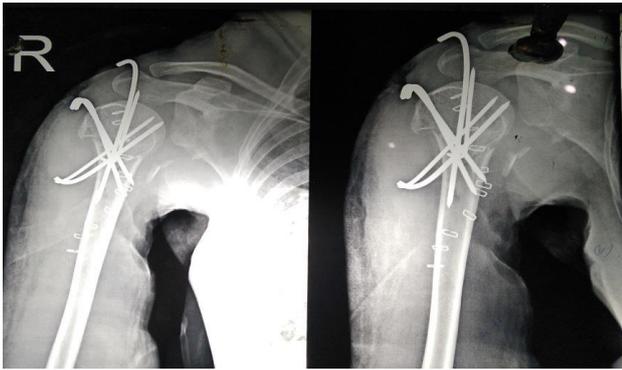


Figure 2: Post-operative X-ray showing fixation with K-wire.

Post-operative assessment

Post-operative patients were assessed by Constant-Murley score. The test is divided into four subscales: pain (15 points), activities of daily living (20 points), strength (25 points), and range of motion: forward elevation, external rotation, abduction and internal rotation of the shoulder (40 points). The higher score has the higher quality of function. Constant score was categorized as: excellent (86 to 100), good (71 to 85), moderate (56 to 70), and poor (0 to 55).

Statistical tool

This study was not a comparative study, so simple statistical methods of mean and percentage were used.

RESULTS

The total number of cases in our study were 21, out of which, 13 were male and 8 were females, with mean age of 44.2 years ranging from 20 to 60 years.

In the present study, the majority of the mode of trauma was road traffic accidents in 61.9% of cases, followed by fall in 28.6% cases and assault in 9.5% of the cases. Out of 21 patients, 14 had trauma of the right side and 7 had trauma of the left side. On the basis of Neer’s classification, 13 patients had 2 part fracture, 8 patients had 3 part fracture. In the present study, 13 patients reported on the same day of injury, 4 patients reported after one day, 2 patients after 2 days, 2 patients reported after 1 week. Mean delay in reporting was 2.5 days. 15% of the patients

were found to be associated with other injuries (head 4%, chest 5%, fracture intertrochanteric 2%, fracture lateral malleolus 1%, blunt trauma abdomen 2%, and fracture radius 1%). In the present study, 16 patients were operated within first week, 5 patients were operated after first week.

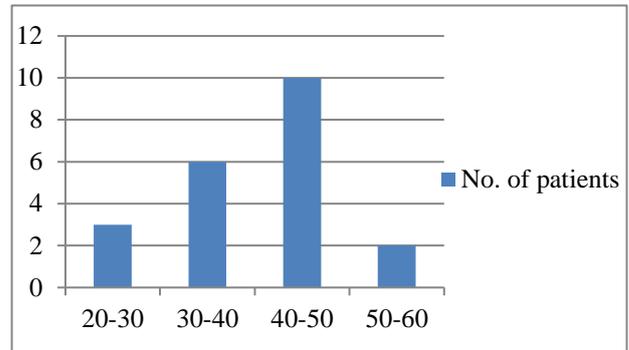


Figure 3: Age distribution of proximal humerus fracture.

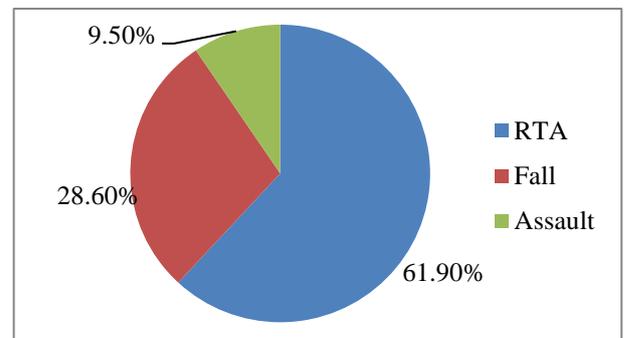


Figure 4: Mode of trauma.

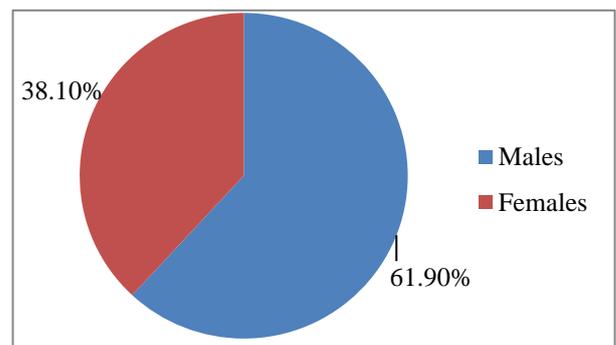


Figure 5: Sex distribution.

Clinico-radiological consolidation

Fractures were assessed clinically when painless, unaided movements were possible and there was no tenderness. Out of 21 patients, in 6 patients the fracture was united within 8 weeks. In 12 patients, the fracture was united at 11.5 weeks, and in 3 patients, the fracture was united at 15.2 weeks in the present study. The average union time was 11.6 weeks. The union time was more in three part fractures.

Table 1: Following parameters were studied.

| Parameter | No. of patients | Percentage (%) |
|-------------------------|-----------------|----------------|
| Mode of injury | | |
| RTA | 13 | 61.9 |
| Fall | 6 | 28.6 |
| Assault | 2 | 9.5 |
| Neer's type | | |
| Two part | 13 | 61.9 |
| Three part | 8 | 38.1 |
| Sex | | |
| Males | 13 | 61.9 |
| Females | 8 | 38.1 |
| Delay in surgery | | |
| Less than 1 week | 16 | 76.2 |
| More than 1 week | 5 | 23.8 |

Functional evaluation

Patients were functionally evaluated based on subjective (35 points) and objective (65 points) parameters as per constant scoring system. In the present study, at 1 year follow up, 17 patients had no pain, 2 patients had pain at extreme of movements and 2 patients had significant pain evaluated by visual analogue scale. Pain severity was more with 3 part fractures. The mean constant score at 1 year follow up was 78.2, range (42 to 96). The constant score was higher in the younger patients and patients with two part fractures as compared to the three part fractures in the present study. Out of 21 patients, 1 patient with 3 part fracture had a lowest CS of 42. Out of 21, (n=8, 38.1%) had excellent outcome, (n=10, 47.6%) had good functional outcome, 1 (4.8%) had moderate outcome, 2 (9.5%) had poor outcome.

Complications

In the present study, complications were seen in 8 (38.1%) patients. Pin tract infection in 4 patients which was managed by wound wash, sterile dressings and antibiotics, pin tract loosening in 2 patients which was treated by repeating the procedure, varus malunion in 2 patients.

Table 2: Complications.

| Complication | No. of patients | Percentage (%) |
|----------------------------|-----------------|----------------|
| Pin tract infection | 4 | 19 |
| Pin tract loosening | 2 | 9.52 |
| Varus malunion | 2 | 9.52 |
| Total | 8 | 38.1 |

DISCUSSION

Most of the undisplaced proximal humeral fractures can be treated conservatively. However, displaced fractures require surgical treatment for better outcome. The goal of

the treatment was to achieve a painless mobile shoulder. The operative treatment for proximal humeral fractures is controversial and a challenge for the surgeon.

In our study, the maximum incidence of proximal humeral fracture was observed in 5th decade with mean age 44.2 years, which has similar results as compared to Gerber et al (44.9 years), Jagiasi et al (47.1 years), and Vijay et al (51.29).¹⁹⁻²¹ In comparison to incidence of PHF of our study to Vijay et al our study has lesser mean age.²¹ This is due to the younger group of patients selected in the present study.

In the present study, 13 (61.9%) were males and 8 (38.1%) were females, with male preponderance. Our study had results similar to study given by Jagiasi et al and Bansal et al.^{20,22} A study by Vijay et al had observed female predominance.²¹ This can be explained by the younger age group of patients in our study in which males are outdoors to earn livelihood, and elderly females with osteoporosis have higher risk of fracture with minor fall.

In our study, the most common cause of proximal humeral fracture was road traffic accident (n=13, 61.9%) followed by fall from standing height (n= 6, 28.6%), and assault (n=2, 9.5%) which was similar to the previous studies Bansal et al.²² The study of Patel et al is contradictory.²³ This is explained by higher incidence of fracture in elderly females with osteoporosis, who can have fracture with minor fall. In the present study, most common fracture type was two part (n=13), followed by three part (n=8) on the basis of Neer's classification. Similar observations were reported by Jagiasi et al, Shiva et al and Rangan et al.²⁰⁻²³ The incidence of 3 part fractures was higher in a study of Muncibi et al.⁸ This can be explained by the higher age group which has osteoporotic bones that can lead to more severity of fracture type. Radiological union was achieved within 7 to 15.2 weeks, with an average of 11.6 weeks. Similar observations were made by Muncibi et al, Kelkar and Mundra, and Dolfi et al.^{8,26,27}

Table 3: Time of radiological union.

| Study | Average time of union (weeks) |
|---------------------------------------|-------------------------------|
| Dolfi et al²⁷ | 10.4 |
| Muncibi et al⁸ | 8.2 |
| Kelkar and Mundra²⁶ | 8 |
| Yadav et al²⁸ | 11.74 |
| Present study | 12.6 |

The functional outcome was assessed on the basis of constant score. Out of 21, (n=8, 38.1%) had excellent outcome, (n=10, 47.6%) had good functional outcome, 1 (4.8%) had moderate outcome, 2 (9.5%) had poor outcome. The mean constant score was 78.2. Our results were similar to previous studies Vijay et al, Muncibi et al, Daljit et al, Jaura et al, and Varaprasad and Kumar.^{8,21,30-32} Out of 21 patients, complications were seen in 8, (38.1%)

patients. Pin tract infection in 4 patients which was managed by wound wash, sterile dressings and antibiotics, pin tract loosening in 2 patients which was treated by repeating the procedure, varus malunion in 2 patients. Our

results were similar with the existing literature, Vijay et al, Varaprasad and Kumar, and Bozkurt et al.^{21,32,34} No neurovascular complications were observed in the present study.

Table 4: Comparison of results with previous studies.

| Study | No. of cases | Follow up (months) | Constant score | Complication (%) |
|---------------------------------|--------------|--------------------|----------------|------------------|
| Keenar et al ²⁹ 2007 | 62 | 35 | 73.9 | 46.7 |
| Daljit et al ³⁰ 2010 | 20 | - | 73.6 | 40 |
| Muncibi et al ⁸ 2012 | 35 | - | 87.6 | - |
| Jaura et al ³¹ 2014 | 30 | - | 76.4 | 40 |
| Present study | 21 | 12 | 78.2 | 38.1 |

Table 5: Comparison of functional outcome in terms of grading of constant score.

| Study | Score | No. of patients | Percentage (%) |
|---------------------------------|-----------|-----------------|----------------|
| Vijay et al ²¹ | Excellent | 05 | 20.1 |
| | Good | 07 | 29.2 |
| | Moderate | 06 | 25 |
| | Poor | 06 | 25 |
| Kelkar and Mundra ²⁶ | Excellent | 07 | 26 |
| | Good | 14 | 52 |
| | Moderate | 06 | 22 |
| | Poor | - | - |
| Soni et al ³³ | Excellent | 1 | 20 |
| | Good | 3 | 60 |
| | Moderate | - | - |
| | Poor | 1 | 20 |
| Present study | Excellent | 8 | 38.1 |
| | Good | 10 | 47.6 |
| | Moderate | 1 | 4.8 |
| | Poor | 2 | 9.5 |

Limitations

The present study was non-randomised, the sample size was small and the constant scoring system used is based on both subjective parameters as well. All these factors can lead to bias in the study.

CONCLUSION

The treatment of proximal humeral fractures remains controversial. Principle of fixation is anatomical reconstruction of the articular surface with minimal injury to soft tissues and preserving the vascular supply. Percutaneous fixation is minimally invasive technique with preservation of periosteal blood supply, minimal blood loss, less soft tissue damage, surgery can be done under brachial plexus block, less chances of avascular necrosis, shorter hospital stay, no hardware symptoms, leaves no surgical scar and lowers the rate of complications. Adequate surgical skills and experienced surgeon are needed to achieve good results.

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Conflict of interest: None declared

Ethical approval: The study was approved by the institutional ethics committee

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