Percutaneous fixation of unstable proximal humeral fractures augmented with external Ilizarov cubes: a new simple technique

Osam Metwally, Yehia Elbromboly

Orthopedic Surgery, Zagazig University Hospitals, Zagazig, Egypt

Correspondence to Osam Metwally, Orthopedic Department, Zagazig University Hospitals, Zagazig, Egypt
Tel: +201007686372;
Fax: +20552307830;
e-mail: osammetwally@yahoo.com

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Purpose
To present the management of unstable proximal humeral fractures with percutaneous pinning augmented by an external Ilizarov cubes in elderly patients with poor general condition.
Patients and methods
Between October 2021 and December 2021, 7 patients (mean age: 56.7, range 53–62) with three-part proximal humeral fracture with 2 or more co-morbidities were surgically managed by percutaneous pinning augmented by an external cube. Functional results were evaluated through measuring shoulder range of motion. Radiological evaluation was done by antero-posterior and lateral radiograms of the treated humerus.
Results
The patients were followed up for an average period of 6 months. The external cube and the pins were removed at about the 6 weeks mark. The average range of motion at the final follow up was Abduction 110°, forward flexion 140°, internal rotation 60°, external rotation 58°.
All patients achieved full radiological union.
Conclusion
Percutaneous fixation of unstable humeral fractures is an effective method of treatment especially in elderly patients with multiple co-morbidities. Adding external Ilizarov cubes to the construct is an easy, affordable, and quick method of improving results and minimizing complications of early pin loosening that give the ability of early range of motion and rapid bone union.

Keywords:
Ilizarov, percutaneous fixation, proximal humeral fractures

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Introduction

The management of the three- or four- part proximal humeral fractures in the elderly patients poses a continuous debatable problem. Some studies have demonstrated unsatisfactory results with non-operative managment [1]. On the other hand, there are different surgical solutions to the problem including closed reduction and percutaneous pinning [2], open reduction and internal fixation with a plate [3] and hemiarthroplasty [4]. Moreover, there are some factors of significant importance that affect the outcome including amount of displacement of the fragments, bone stock of the proximal humerus and the general condition of the patient [5].

The surgical management through a percutaneous technique has the potential benefits of the preservation of the critical blood supply to the humeral head, insignificant blood loss and the possibility of doing the surgery under regional anesthesia which is understandingly appealing specially in treating patients with poor general condition [6].

Patients and methods

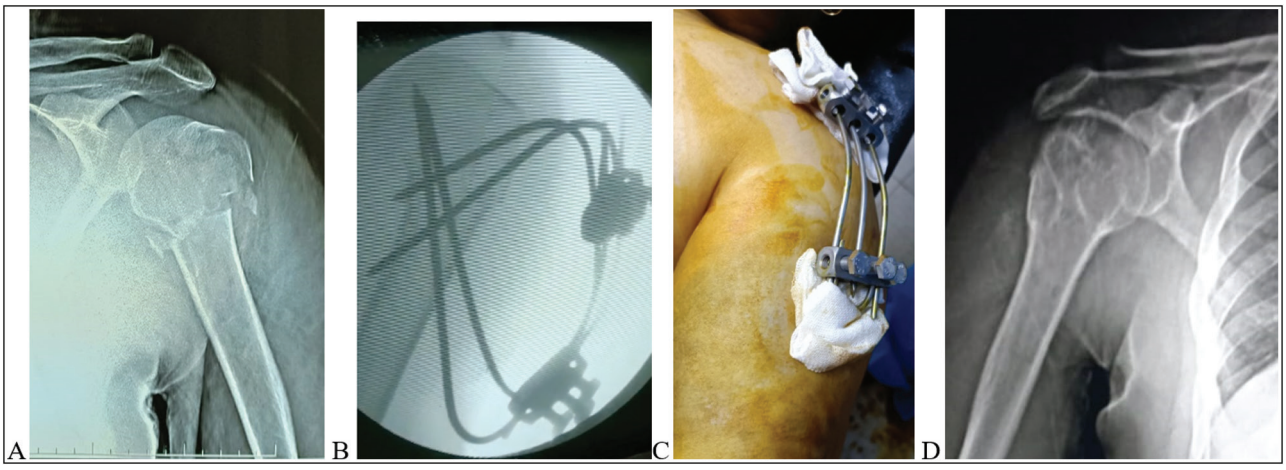
Between October 2021 and December 2021, all patients admitted to our university tertiary care hospital with diagnoses of three- or four-part proximal humeral fractures were screened. Once a patient aged 50 or older had 2 or more comorbidities, he/she was included in our study.

We had 7 patients (mean age: 56.7, range 53–62) with three-part proximal humeral fracture that fit our inclusion criteria. All patients had anteroposterior and lateral x-rays of the proximal humerus. CT scan of the proximal humerus was requested in case further details of the fracture pattern was needed. Only 2 patients had another Orthopedic injury, while the rest had only an isolated proximal humeral fracture Table 1.

Table 1 Patients details

Patient number	Sex	Age	Other injuries	Side Rt/ Lt?	Type of fracture 3 or 4 parts?	Subluxation Yes/No?	Co-morbidities
1	F	57	N	R	3	N	Diabetic Hypertensive
2	F	62	Calcaneus tuberosity fracture	L	3	N	Diabetic Hypertensive Cardiac Asthmatic
3	F	53	Contralateral distal radius fracture	L	3	Y	Diabetic Hypertensive
4	F	55	N	R	3	Y	Diabetic with morbid obesity
5	M	56	N	L	3	N	Hypertensive Cardiac
6	F	60	N	R	3	Y	Cardiac Morbid obesity
7	F	59	N	R	3	N	Diabetic Hypertensive

Figure 1



A: pre-operative x-ray showing the fracture. B: Intra-operative image intensifier photo showing the assembly of the device. C: Intra-operative clinical photo showing the device. D: post-operative x-ray after removal of the device showing union.

The patients underwent clinical evaluation and shoulder radiographs at 2, 6 & 12 weeks. Range of motion was measured with a goniometer with the patients in the standing position.

Surgical technique

All patients had regional anesthesia in the form of brachial plexus block. The patient was placed supine with head of table elevation to about 30°. An attempt of closed reduction is undertaken by arm manipulation aided by traction and counter-traction. Afterwards, K-wires are introduced to secure the fracture fragments, 2 or 3 K-wires from distal to proximal and 2 or 3 k-wires from proximal to distal then we move the shoulder under live fluoroscopy to evaluate the stability and accuracy of the fracture reduction. Eventually, the protruding part of the k-wires were bent, and all of them are secured to the cubes.

Post-operative protocol

All Patients had an arm sling for comfort. Pendulum exercises were started 1 week post-operative, which was followed by passive assisted exercises at the 2 weeks mark as the motion was advanced according to the patient tolerance. Eventually, active motion was started at around 5 to 6 weeks post-operatively.

Results

The mean operative time was 40 min (20–60 min), the mean fluoroscopy time was about 80 s (59–105 s). The patients were followed up for an average period of 6 months. The external cube and the pins were removed at the 6-8 weeks postoperative guided by the union of the fracture. The average range of motion at the final follow up was Abduction 110°, forward flexion 140°, internal rotation 60°, external rotation 58°.All patients achieved full radiological union as shown in the Fig. 1d

We had one case of superficial pin tract infection that responded to oral antibiotics and local care with no need to change the wires.

Discussion

The importance of percutaneous techniques in the management of proximal humeral fractures cannot be overstated especially when treating elderly patients with multiple comorbidities as general anesthesia would be risky or even contraindicated. Its main drawback, compared to open reduction and internal fixation is its inferiority regarding achieving anatomical reduction. However, several publications have stated that

satisfactory results can be properly achieved with less than ideal anatomical reduction in proximal humeral fracture [7,8].

Nevertheless, Percutaneous fixation of proximal humeral fractures has two main additional disadvantages, namely pin migration and loss of reduction [8]. As a result, innovations had been made to overcome those limitations. One method is called the 'Humerus block' where a locking device is placed in contact to the cortical bone of the proximal humeral diaphysis under the deltoid muscle through a 4 cm incision [2]. The purpose of this device was to lock the two pins to increase the construct stiffness and prevent pin migration or loss of reduction [2]. Other study described the ' hybrid technique' where they did open reduction of the fracture fragments with fixation with pins that are connected to an external fixator [9].

Consequently, The MIROS (Minimally Invasive Reduction and Osteo-Synthesis System) was introduced [5]. It is a device that allows the correction of angular displacement and fixation of the fracture fragments by K-wires locked onto a metallic clip placed externally over the skin. The authors have achieved better clinical results using the MIROS device compared to traditional percutaneous pinning [5].

Our idea was similar to the MIROS device as it is not available in our country, so we substituted it with an Ilizarov cubes that is typically used in Illizarov external fixators. The biomechanical advantage of both techniques is to increase the stability of the fracture by shifting the shear forces from the weak cancellous bone of the proximal humerus to the more rigid cortical bone of the humeral diaphysis [5]. Other strengths of this technique are that it is minimally invasive, can be done effectively under brachial plexus block and the instrumentation can be removed in an outpatient setting without the need for a second procedure.

One limitation of our study is the number of patients as we decided to study the results first on a small number of patients before implementing it widely in our institution. Other limitation was that all our patients were 3- part fracture, so our results could not be implied over 4-part proximal humeral fractures. However, we are planning to conduct further comparative studies including more patients and different types of fractures.

Conclusion

Percutaneous fixation of unstable humeral fractures is an effective method of treatment especially in elderly patients with multiple co-morbidities. Adding external Ilizarov cubes to the construct is an easy, affordable and quick method of improving results and minimizing complications of early pin loosening that give the ability of early range of motion and rapid bone union.

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Conflicts of interest

The authors have no conflict of interest regarding this manuscript.

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