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Original Article

Paratricepital Approach for Fixation of Distal Humerus Fractures in Adult – A Review of Thirty Cases

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Abstract

Background: Distal humerus fractures are most commonly managed by surgical approaches that disrupt the extensor mechanism of the elbow. Paratricepital approach for distal humerus fracture fixation has been done by orthogonal or parallel plate construct that allows excellent healing of fracture, motion arc of elbow more than 100°, and maintains of extensor mechanism strength.

Materials and Methods: A total of 30 cases of distal humerus fractures are fixed by paratricepital posterior approach. Bicolumner fixation done by elevating and retracting the triceps of the distal humerus keeping triceps insertion undisturbed by orthogonal or parallel plate construct. Early active-assisted range of motion initiated within limits of pain. The age group was 15–60 years. Among them 21% was Type A fracture, 17% Type B fracture, 33% Type C1 fracture, and 29% Type C2 fracture. More than 60% of cases have 1 year of follow-up. Radiograph and functional evaluation were done by mayo elbow performance score (MEPS), disability of arm, shoulder, and hand questionnaire.

Results: All 30 fractures healed primarily. The median arc of elbow motion was 105° (range 70°–140°). Average MEPS was 91 points (range 65–100) indicating excellent scores.

Conclusion: Treatment of distal humerus fracture in adults by paratricepital posterior approach results in excellent healing, a mean flexion extensor arc more than 100°, maintains of almost normal elbow extensor strength compared with the contralateral normal elbow.

Key words: Distal humerus, Elbow, Extensor mechanism, Para tricepetal

INTRODUCTION

Complex intra-articular distal humerus fractures are a considerable challenge to even the most experienced surgeon.[1] Distal articular humerus fractures are preferably treated by open reduction and internal fixation.[2] The surgery is technically demanding and an adequate exposure of the distal humerus articular surface is important for the surgery. The olecranon osteotomy approach has been the gold standard among surgical approaches for fracture fixation of the distal articular surface of humerus.[2-4] It is the most commonly used surgical approach and provides good visualization of the fracture.[4] Complications of this approach include hardware migration and prominence, delayed union, and non-union.[5,6]

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Surgical approaches to elbow joints that dissociate the triceps from olecranon have distinct disadvantages such as triceps avulsion, triceps weakness, and wound healing problem. Such complications necessitate more surgery and predispose to infection.[7] To avoid these complications an extensor mechanism sparing paratricipital posterior approach to distal humerus through midline posterior incision was suggested by Schildhauer *et al.*[8]

The bilaterotricipital approach (triceps sparing or triceps-on) was first reported by Alonso-Lames in 1972.

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This approach involves the creation of surgical windows along medial and lateral side of triceps muscle and tendon without disrupting its insertion on olecranon.[9]

The paratricipital approaches have several advantages: Complications of olecranon osteotomy can be avoided, triceps tendon insertion not disrupted, and allows early range of motion (ROM). This approach also preserves innervations and blood supply of anconeus muscle[9,10] which provides dynamic posterolateral stability of elbow. Finally, if further exposure required paratricipital approach can be converted to olecranon osteotomy and if further proximal exposure is required for associated fracture shaft humerus, lateral side paratricipital approach can be converted into the Gerwin *et al*.[11] approach. The disadvantage of paratricipital approach is the limited visualization of articular surface of distal humerus; therefore, this approach is usually inadequate for fixation of Type C3 fractures. The several advantages of this approach certainly indicate its use for AO/OTA Types A2, A3, B1, and B2 and possibly C1 and C2 fractures.[8,12]

The aim of our study is to prospectively evaluate the results of paratricipital approach in terms of adequacy of exposure of distal humerus for fixation of different types of distal humerus fractures, and ultimately the functional outcome of the elbow.

The specific objectives are as follows:

a. To determine the adequacy of exposure of distal humerus in respect to dissection of soft tissue and extensor mechanism of elbow, for fixation of different types of distal humerus fracture in AO/OTA classification
b. Time taken for surgery
c. Rate of complications
d. To evaluate post-operative ROM and functional outcome by visual analog score for pain and Mayo Elbow Performance Score (MEPS).[13]

MATERIALS AND METHODS

A study of 30 cases of supracondylar and intercondylar fracture of the humerus were conducted in the Department of Orthopaedics, Medical College, Kolkata between January 2011 and June 2012. There were 17 female patients and 13 were males. Left elbow was involved in 21 cases and right elbow was involved in 9 cases. The most common mode of injury was road traffic accident (66.67%), then fall from height (20%), and then simple fall (13.33%). Injury operation interval of <1 week was 56.67%. Among all patients 33% of fractures were Type C1, 29% of fractures were Type C2, and others are Type A and B fractures. About 63.33% of patients had >12 months of follow-up. About 29.17% of patients had ROM of >120, 54.17% of patients had ROM 90°–120°, and 16.66% of patients had ROM of <90°.

Inclusion Criteria

Displaced supracondylar and intercondylar fracture of the distal humerus in the age group of 15–80 years were included in the study.

Exclusion Criteria

The following criteria were excluded from the study:

a. Undisplaced distal humerus fracture which can be managed conservatively
b. Open fracture of distal humerus
c. Patients with medical comorbidities, not fit for anesthesia.

Surgical Technique

Anesthesia

Regional anesthesia.

Position of the patients

Patient was positioned in lateral decubitus with a bolster placed between arm and chest, and the entire upper extremity draped free.

All cases were operated with tourniquet applied over upper arm, if operative time exceeded more than 1 h 45 min tourniquet was deflated.

Surgical exposure

The posterior approach to distal humerus was followed.

Surgical steps

Bony landmarks are marked including olecranon process, subcutaneous border of ulna, medial, and lateral epicondyles.

Incision

A posterior midline longitudinal incision was made over the lower arm and extended distally beyond the elbow joint [Figure 1]. Just above the tip of olecranon, the incision was curved laterally. It was continued 5 cm distal to tip of olecranon.

Superficial surgical dissection

Deep fascia incised in the midline and full-thickness skin flaps is developed [Figure 2]. These are kept as thick as possible, with deep plane consisting of triceps fascia and epitendon proximally and forearm fascia and ulnar periosteum distally.

Figure 1: Posterior midline longitudinal skin incision

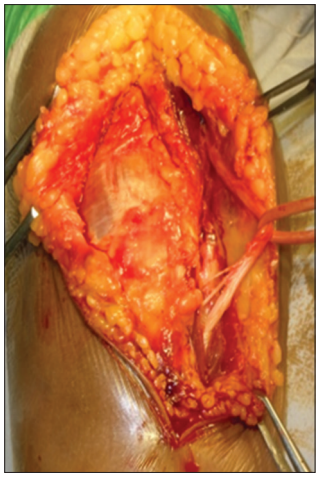

Figure 2: Full-thickness skin flap developed and ulnar nerve exposed

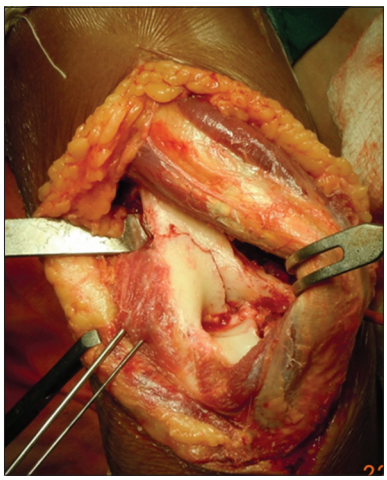

Figure 3: Retracting triceps medially and laterally to expose the intra-articular fracture site

Aponeurosis of the triceps exposed. Ulnar nerve palpated on the back of medial epicondyle. Fascia over the ulnar nerve incised to expose the ulnar nerve. When more proximal exposure of humerus was required, ulnar nerve was followed further until it pierces the intermuscular septum coming from the anterior compartment. Distally, it was released from cubital tunnel and dissected to its first branch. Articular branch of the ulnar nerve may be sacrificed.

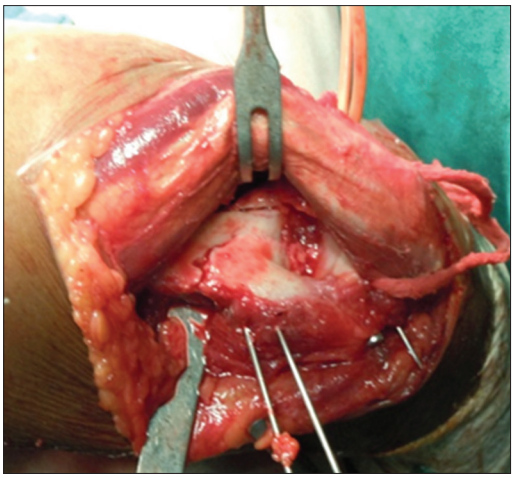

Figure 4: Fracture provisionally fixed with K wires

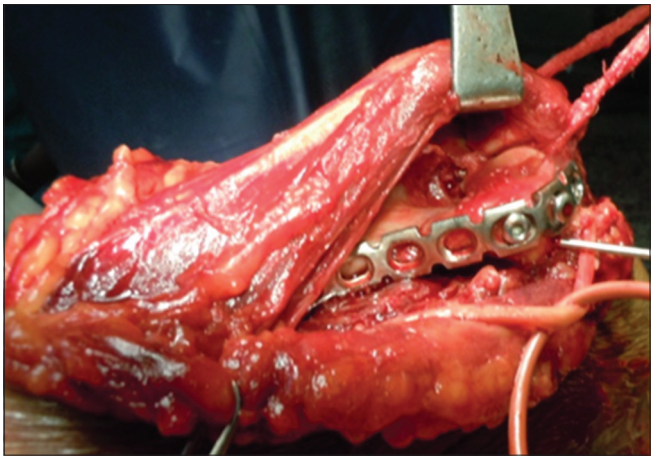

Figure 5: Fracture fixation done with plate and screws

Deep surgical dissection

Dissection was continued to lateral and medial triceps borders at their respective interfaces with the posterior aspect of intermuscular septum. The distal lateral dissection was continued anteriorly to the anconeus muscle, allowing the muscle to be elevated along with the triceps and preserving its neurovascular supply. The posterolateral humeral shaft approached by elevating the triceps and anconeus muscle from posterior periosteum and by retracting it medially. Medial paratricipital dissection along with the posterior border of intermuscular septum exposed the posteromedial aspect of the distal humerus. The intra-articular fat pad was excised [Figure 3]. This provided visualization of the entire posterior articular surface, comprising roughly 50% of the overall articular surface of the distal part of the humerus.

Retracting triceps muscle medially and laterally exposes both columns. Trochlea can be visualized by flexing elbow more than 90°. A sponge or 0.25 in 0.6 cm, Penrose drain was placed into the ulnohumeral joint to allow distraction of the joint by pulling distally on the olecranon through the sigmoid notch to aid in visualization and facilitate the reduction through ligament taxis.

The distal part of the humerus was anatomically reduced with direct visualization posteriorly and indirectly with fluoroscopy. The intact sigmoid notch was used as a template for reduction.

Techniques of Fracture Reduction

- Articular fragments are reduced and provisionally fixed with guide wire [Figure 4]
- Definitive fixation of intra-articular part is done by 4 mm cannulated cancellous screws
- Care must be taken not to narrow the trochlea with a lag screw when there is bone loss
- Once intra-articular part is fixed, intercondylar fracture is converted into supracondylar fracture
- This is provisionally fixed with Kirschner's wire and converted with definitive fixation with either parallel plate or orthogonal plate construct [Figure 5]
- Fixation stability and motion arcs were assessed before closure.

Technical Objective for Fixation of Fractures

- Every screw should pass through a plate
- Each screw should engage a fragment on the opposite sides that is also fixed to a plate
- As many screws as possible should be placed in distal fragments
- Each screw should be as long as possible
- Each screw should engage as many articular fragments as possible
- Plate should be applied such that compression is achieved at the supracondylar level for both columns
- Plates used must be strong and stiff enough to resist breaking or bending force before union occurs at the supracondylar level.[14]

Closure

- The ulnar nerve was not anteriorly transposed in any case
- Implants were covered with soft tissue to prevent ulnar neuritis
- Triceps attached with an intermuscular septum
- A negative suction drain was given
- Bulky dressing around elbow done.

After treatment

- Plaster of Paris back slab applied
- Drain was removed at 48 h
- Out of 30 cases, 6 cases were operated under tourniquet control in rest tourniquet had to be released intraoperatively as operative time exceeded more than 1 h 45 min
- Blood loss in cases operated with tourniquet – measured by collected blood in the suction drain
- In 24 cases, tourniquet had to be removed intraoperatively
- Blood loss in such cases measured with numbers of mops required during surgery plus collection in drain - (one wet mop = 200 ml of blood approx)
- Wound inspection was routinely done on 5th post-operative day
- Suture removal was done on 14th post-operative day.

Post-operative Rehabilitation

The patients are put through active elbow motion of flexion and extension, pronation, and supination within limits of pain at 5th post-operative day.

Follow-up

Patients were reviewed every 2 weeks for the first 2 months, every month for next 6 months, and then every 3rd month and were assessed on:

- Time taken for functional recovery
- ROM
- Any specific complaints
- Time taken for fracture healing
- Functional outcome by MEPS.

Final follow-up was done 1 month before the conclusion of the study and various scoring systems and classification were used to analyze the results.

Results were analyzed statistically using the SPSS software system.

RESULTS

All 30 patients were reviewed clinically and radiographically. Follow-up ranged from 18 months to 6 months, with an average of 12.6 months. Nineteen patients had an excellent result, 10 had good, and one had poor.

Time Taken for Functional Recovery

Functional recovery is an interval between injury and time of return to normal daily activities. The average time is 101.8 days.

ROM

The median arc of elbow motion was 105° (range 70°–140°). Arc of motion >120° seen in 29.17% of patients, arc 90°–120° present in 54.17% of cases, and arc <90° seen in 16.66% of cases.

MEPS

Average score is 91, indicating the excellent results.

Disability of Arm, Shoulder and Hand Questionnaire

Mean score was 32.36.

Strength of Triceps

According to the Medical Research Council grading mean strength was 4.84 (maximum 5, and minimum 0).

Complications

- Symptomatic hardware (23.33%)
- Flap necrosis (6.66%)
- Superficial skin infection (13.33%)
- Tourniquet palsy (10%)
- Ulnar nerve neuropraxia (20%).

DISCUSSION

Thirty patients with distal humerus fractures treated with paratricepital posterior approach and fixation done with either orthogonal or parallel plate construct. In this study, fracture was most common in female patients (56.67%). Left elbow most commonly involved (70%), minimum age of the patient of this study was 15 years, and maximum was 85 years. The mean age of this fracture was 32.89 years. The most common mode of injury was road traffic accident (63.33%). Most of these patients were operated within 1 week of injury (56.67%). Delaying of intervention in others is due to treated elsewhere by quacks or due to time taken for the management of other more serious life-threatening injuries. Among all patients, 33% of fractures were Type C1, 29% of fractures were Type C2, and others are Type A and B fractures. About 63.33% of patients had >12 months of follow-up. About 29.17% of patients had ROM of >120, 54.17% of patients had ROM 90°–120°, and 16.66% of patients had ROM of <90°. Follow-up ranged from 18 months to 6 months, with an average of 12.6 months. Nineteen patients had an excellent result, 10 had good, and one had poor. Functional recovery is interval between injury and time of return to normal daily activities. Average time is 101.8 days. The average MEPS score is 91, indicating excellent results. The most common complication is symptomatic hardware (23.33%). Others are flap necrosis (6.66%), superficial skin infection (13.33%), tourniquet palsy (10%), and ulnar nerve neuropraxia (20%).

Associated injuries were # distal radius (10%), # acetabulum (3.33%), U/L # shaft ulna (3.33%), closed head injury (26.67%), and closed abdominal injury (6.67%).

CONCLUSION

Treatment of distal humerus fracture in adults by paratricepital posterior approach results in excellent healing, a mean flexion extensor arc more than 100°, maintains of almost normal elbow extensor strength compared with contralateral normal elbow. This approach can be an alternative to other triceps detaching approach, where the complications are more. Although this approach can be easily used for fixation of Type A, B, C1, and C2 fractures according to AO classification, fixation of Type C3 and multifragmentary fractures by this approach can be problematic where there needs a lot of research.

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