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Dr. Devendra Nayak
Associate Professor, Department of Orthopaedics, Government Medical College, Ratlam, Madhya Pradesh, India

Dr. Pradeep Dubey
Assistant Professor, Department of Orthopaedics, Government Medical College, Ratlam, Madhya Pradesh, India

Dr. Harshwardhan Dawar
Senior Resident, Department of Orthopaedics, Government Medical College, Ratlam, Madhya Pradesh, India

A Study comparing Olecranon osteotomy with Triceps reflecting anconeus pedicle approach (TRAP) for internal fixation of supracondylar and intercondylar fractures of the humerus

Dr. Devendra Nayak, Dr. Pradeep Dubey and Dr. Harshwardhan Dawar

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Abstract

Objective: To evaluate the outcome of the Olecranon osteotomy approach and TRAP (triceps reflecting anconeus pedicle) approach and comparing them, attributable to Mayo Elbow Performance Score, range of motion, duration of fracture union and duration of surgery.

Study done at: Government Medical College, Ratlam, MP, India

Method and Material: The study is a retrospective randomized control trial on patients with intercondylar and supracondylar fractures of humerus admitted and operated in Department of Orthopaedics, Government medical college and District Hospital, Ratlam from July 2019 to September 2020. Total of 30 patients was included in the study, 15 in each group viz. Group-A operated by TRAP approach and Group-B operated by olecranon osteotomy approach.

Results: The difference in Mean duration for fracture union was not statistically significant, in group-A was 12.21 ± 1.621 weeks, while it was 13.46 ± 2.307 weeks in group-B. Duration of surgery was statistically significantly different, more in group B (1.42 ± 0.14 hours) compare to group-A (1.21 ± 0.21 hours). Comparison between ranges of motion of both groups was assessed by Average of extension lag, the mean elbow arc of motion and average of flexion. No significant difference was found between the parameters. The average of extension lag was 11.96 ± 9.26 degree in group-A and it was 16.77 ± 10.31 degree in group-B. The mean elbow arc of motion in group A was 98.34 ± 24.17 degrees and in group B was 91.25 ± 21.84 degrees. Average flexion was 109.71 ± 16.65 degrees and 111.47 ± 20.37 degrees in group-A and group-B respectively. The average Mayo Elbow Performance Score in group-A was 86.93 ± 12.42 and in group-B was 83.48 ± 15.93 . P-value was $>.05$ show that there was no statistically significant difference between two groups Mayo elbow score. Finally, 25 patients (83.33%) out of 30 showed good and excellent results and hence concluding that there is no statistically significant difference between these two modalities when it comes to outcome.

Conclusion: TRAP approach is comparatively better than osteotomy approach in terms of stable fracture fixation and better outcome, with the advantage of intact olecranon. However the approach demands fast rehabilitation.

Design: Prospective randomized control trial

Keywords: Olecranon, osteotomy, anconeus, fractures & humerus

Introduction

The fracture pattern to be followed in the study are supracondylar fractures, single column (condyle) fractures, bicondylar fractures and coronal shear fractures of the distal humerus. These fractures accounts for 0.5-7% of all fractures and 30% of fractures around elbow joint^[1]. Articular fractures of elbow are quite difficult ones to treat given their proximity to vital structures, complex anatomy and fracture pattern. These injuries occur in a bimodal spread of incidence, low energy falls in elderly and high energy impact in younger population^[2].

Treatment options in such injuries are many but the protocol is nebulous. Double tension banding technique, Closed/open reduction and crossed screws or K-wire pinning, single-sided plating techniques, Orthogonal and parallel plating, minimal osteosynthesis with hinged external fixators, hemiarthroplasty, and total elbow replacement are the options. Multiple approaches to the distal elbow are described, posterior approach being one of them. Multiple

Corresponding Author:

Dr. Harshwardhan Dawar
Senior Resident, Department of Orthopaedics, Government Medical College, Ratlam, Madhya Pradesh, India

posterior approaches have been defined and they are ones used most commonly as they allow a more adequate exposure, complaisance in the use of implants, encountering less major neurovascular structures, when compared to medial and lateral approaches. The olecranon osteotomy approach is perhaps the most frequently used method. Prominence and migration of hardware, nonunion, displacement of osteotomy, need for secondary procedures are some of the complications of olecranon osteotomy [3, 4].

Triceps reflecting anconeus pedicle approach

SW O' Driscoll has described the triceps reflecting anconeus pedicle approach (TRAP) [5], the patient is in a lateral decubitus position with the fractured arm brought across the chest, a linear incision beginning 8-9 cm above posterior aspect of the humerus is given, note on avoiding the olecranon tip by curving the incision slightly medially and then continuing over the border of the ulna. Further on exposing the triceps fascia and ulnar nerve as it runs into the cubital tunnel. On dissecting the ulnar nerve distally to its first motor branch, the intermuscular septum needs to be isolated proximally. Then it is translocated anteriorly into a subcutaneous pocket. In lieu of splitting the triceps, clear the medial aspect of the triceps reflecting it laterally up to the level of the joint capsule, distally incise the fascia along the medial aspect of the olecranon and proximal ulna. Raise a full-thickness sheet of periosteum, fascia, and triceps insertion in a medial to lateral fashion exposing the olecranon. Reflect the sheet laterally, attempting to include the posterior joint capsule. The anconeus can be elevated off the ulna distally. Subsequently, entire triceps is elevated off the posterior humerus. On closure, the proximal part of the triceps is inserted into crossing drill holes into the olecranon, and more distally attaching the periosteum to the superficial forearm fascia, to prevent ulnar subluxation deep forearm fascia is then securely closed. Figure 1 shows a postoperative x-ray in a case explored with the TRAP approach at 4 months.



Fig 1: Postoperative x-ray in a TRAP approach

Olecranon osteotomy approach

Midline incision over the palpable ulna, subcutaneous border of the proximal ulna is exposed. An apexdistal chevron osteotomy is made on the bare proximal posterior ulna, preferably by a 12 mm electric saw blade up to two-thirds of the thickness. It is advisable to insert multiple k-wire perforations before osteotomy to guide the fixation later on during repair. Apply controlled leverage on the olecranon fragment causing fracture of the remaining third. After the osteotomy, the olecranon fragment along with the triceps bulk including the tendon and

musculature; can be bluntly dissected off the posterior aspect of the distal humerus. Olecranon osteotomy can be later fixed with tension band wiring or screw tension band constructs. Tension band wiring was used in all the cases of group B. Figure 2 shows a postoperative x-ray in a case explored with the olecranon osteotomy approach at 4 months.



Fig 2: Postoperative x-ray in an olecranon osteotomy approach.

Methodology

The study is a prospective randomized control trial on patients with intercondylar and supracondylar fractures of humerus admitted and operated in the Department of Orthopaedics, Government medical college and District Hospital, Ratlam during July 2019 to August 2020. Total of 30 patients were included in the study, 15 in each group viz Group-A operated by TRAP approach and Group-B operated by olecranon osteotomy approach. Exclusion Criteria includes patients with vascular injuries, Open fractures, Old distal humeral fractures (more than 2 weeks), associated with ipsilateral, and comminuted olecranon fractures extending into elbow joint and skeletally immature patients.

After adequate pre-anesthetic checkup patients were induced for anesthesia with either upper limb nerve blocks or general anesthesia.

Reconstruction

All fractures were stabilized with the use of parallel plating or by orthogonal plating. Both the columns were fixed using 3.5mm pre-contoured distal humerus plates.

Post-operative care and follow UP:

Post-operative immobilization in an above elbow POP slab with supination was applied in 90° flexion for two weeks. Check x rays were taken postoperatively. Suture removal was done on the 14th post-operative day. All patients were examined each month for three months and then at 6 and 12 months post-operative for assessment of late complications. Active extension was prohibited until 7 weeks. Outcomes were measured at the end of 4 months postoperatively in terms of:

1. Mean duration for fracture union on X-ray.
2. Duration of surgery
3. Extension lag
4. The mean elbow arc of motion
5. Flexion range.
6. Mayo Elbow Performance Score: table 1

Table 1: Mayo elbow performance score [6]

Function	Definition	Points	Score classification
Pain	None	45	Excellent >90 Good 75-89 Fair 60-74 Poor <60
	Mild	30	
	Moderate	15	
	Severe	0	
Motion	Arc >100	20	Excellent >90 Good 75-89 Fair 60-74 Poor <60
	Arc 50-100	15	
	Arc <50	5	
Stability	Stable	10	Excellent >90 Good 75-89 Fair 60-74 Poor <60
	Mild Instability	5	
	Gross Instability	0	
Function	Comb Hair	5	Excellent >90 Good 75-89 Fair 60-74 Poor <60
	Feeding	5	
	Hygiene maintenance	5	
	Shirt buttoning	5	
	Shoe	5	
Total		100	

Results

Age: The mean age of group A was 39.32 ± 17.32 years (range- 19 to 79) and the mean age of group B was 38.75 ± 21.26 years (range- 21 to 81).

Gender: Group A, 9 Males and 6 females; Group B, 10 Males and 5 females.

Mode of injury: Group A, 9 (60%) patients were injured by a form of road traffic accident, 1 (6%) patient fell from a tree, 5 (33%) were injured by fall from a sedentary position. In group B out of 15 patients, 11 (74%) got injured in a Road Traffic accident and 4 patients experienced fall from sedentary positions.

Operating time (Duration of surgery): Duration of surgery was statistically significantly different, more in group B (1.42 ± 0.14

hours) compare to group-A (1.21 ± 0.21 hours). p value= 0.0032

Time for fracture union: The difference in Mean duration for fracture union was not statistically significant, in group-A was 12.21 ± 1.62 weeks, while it was 13.46 ± 2.30 weeks in group-B. P-value= 0.091

Extension lag: The average extension lag was 11.96 ± 9.26 degree in group-A and it was 16.77 ± 10.31 degree in group-B. P-value= 0.189

The mean elbow arc of motion: The mean elbow arc of motion in group A was 98.34 ± 24.17 degrees and in group B was 91.25 ± 21.84 degrees. There was no statistically significant difference. P-value= 0.4064

Flexion: Average flexion was 109.71 ± 16.65 degrees in group A and 111.47 ± 20.37 degrees in group B. P-value= 0.7975

Table 2: Results and statistics for MEPS

MEPS score	Group A		Group B		Difference	Standard error	Degree of freedom	95% CI	P-value
	No.	%	No.	%					
Excellent	8	54%	7	46%	-3.450	5.215	28	-14.133 to 7.723	0.5137
Good	4	26%	3	20%					
Fair	2	14%	3	20%					
Poor	1	6%	2	14%					
Total	15		15						

Mayo Elbow Performance: The average Mayo Elbow Performance Score in group-A was 86.93 ± 12.42 and in group-B was 83.48 ± 15.93 . P-value= 0.5137

Discussion

Adequate surgical exposure always possess a challenge for distal humerus fracture. Olecranon osteotomy was always considered the most easiest and convenient of them all for such surgical exposure [5]. Approaches include the triceps splitting approach, paratricipital approach and TRAP approach. However, the approaches may face the aftermath of complications including weakness in triceps, fibrosis, stiffness of elbow or some of them may provide inadequate exposure. Olecranon osteotomy and TRAP provides a similar level of exposure but when it comes to complications our study suggests that TRAP has less surgical time and the possibility of complication [6]. TRAP approach group has better outcomes in terms of Mayo elbow performance score, flexion, extension lag and range of motion however not statistically significant. All the motion parameters got better with physiotherapy in both the groups.

When it comes to exposure of fracture both the concerned approaches are indifferent but TRAP has the benefit of not making an iatrogenic fracture. Both the methods have less risk of injury to intramuscular nerve branches but TRAP approach

being in the inter nervous plane shows resultant fibrosis; also an intact olecranon in the method serves as an important piece of the puzzle for better understanding of the final reduction [7]. But when it comes to expertise, TRAP shows a much steeper learning curve with requisite for better equipment and better haemostatic field of surgery i.e. a need for a good tourniquet [8]. Complications of our study include skin bulge of the tension band wire for olecranon osteotomy in 2 patients of group B, Olecranon bursitis after 1 year of surgery in 6 patients; 4 in group B and 2 in group A. None of the cases had implant failure or implant protrusion. We had one case of superficial infection group A at 2nd week, which was treated with culture sensitivity and antibiotics.

Conclusion

TRAP approach comes out as the better modality in our study. The precondition of the approach being a good applied knowledge of anatomy and good closure of the dissected extensor and anconeus mechanism. It allowed the much-needed exposure as well as the convenience of an intact olecranon. That

acquiesce for much worthier physiotherapy.

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