e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2023; 15 (12); 186-190

Original Research Article

TRAP vs. Olecranon Osteotomy in Intra-Articular Distal Humerus Fractures: A Comparative Study

Jyotirmaya Nayak[1], Sridhar Panda[2], Nagendra Kumar Rajsamant[3], Gopabandhu Patra[4]

[1]Associate Professor, Department of General Surgery, SCB Medical College, Cuttack
[2]Assistant Professor, Department of General Medicine, SCB Medical College, Cuttack
[3]Assistant Professor, Department of General Surgery, SCB Medical College, Cuttack
[4]Assistant Professor, Department of Orthopaedics, Bhima Bhoi Medical College, Balangir

Received: 25-09-2023 / Revised: 28-10-2023 / Accepted: 30-11-2023
Corresponding author: Dr. Gopabandhu Patra
Conflict of interest: Nil

Abstract:

Background and objectives: There are many techniques to managing intra-articular distal humeral fractures. The purpose of this research is to evaluate and compare the functional results associated with two separate techniques for treating intra-articular distal humeral fractures: one requiring olecranon osteotomy and the other utilizing the triceps-lifting approach (TRAP).

Materials and Procedures: In Group A, 17 patients were paired with an equal number in Group B. Age, gender distribution, length of injury, and amount of fracture comminution were all comparable in both groups. Surgical length, hospital stay, union rates, range of motion, and complications were all compared. The Mayos' elbow performance score (MEPS) was used to evaluate functional results.

Results: Patient follow-up was prolonged for a minimum of 12 months as a result of the findings. All patients in both groups had fracture union at or before 4 months, with the exception of one instance in Group A, when union was noted at 8 months. The average time to union was comparable in the two groups. In both groups, the total range of motion was comparable. There were no statistically significant variations in mean MEPS between the two groups. The cumulative complication rate in the TRAP group was 38%, whereas it was 28% in the olecranon osteotomy group.

Conclusion: In intra-articular distal humerus fractures, surgical intervention is required for good functional results. Despite its technical complexity, TRAP exposure appears as a feasible option to olecranon osteotomy. In the treatment of intra-articular distal humerus fractures, both approaches provide equivalent clinical and functional results.

Keywords: Distal Humeral Fracture, Olecranon Process, Osteotomy, Elbow.

Introduction

Intra-articular distal humerus fractures are uncommon in adults, with incidence rates varied according to age and gender. 30% of distal humerus fractures are intra-articular, accounting for roughly 0.5%-2% of total fractures. Given the complicated elbow anatomy, multiple fracture pieces, and minimal subchondral bone, these fractures provide a tremendous task even to the most experienced surgeons. Distal humerus fracture outcomes are determined by characteristics such as fracture type, age, gender, implant selection, and surgical method [1-6].

To achieve favourable functional results, anatomical reconstruction, rigorous fixation, and early mobilization are required for effective care of intra-articular distal humerus fractures. The best treatment strategy is open reduction and internal fixation (ORIF). The literature, however, continues to argue the best surgical strategy, implant type, and implant site for these fractures [7,8]. Our research used bicolumnar fixation, which uses two plates in a 90-90 arrangement and is a well-known successful approach for treating these fractures. This method, which involves placing two plates orthogonally, was selected above others such as triceps lifting (Campbell's technique), triceps splitting, triceps sparing, and olecranon osteotomy. Each of these techniques has intrinsic benefits and drawbacks [9].

Among the numerous techniques, olecranon osteotomy is largely considered to be the most regularly utilized and best, allowing maximal exposure and permitting efficient articular reduction with demonstrated excellent functional

effects. However, this method is not without drawbacks, such as visible hardware, delayed union, and non-union at the osteotomy site [10-14].

The major goal of our research was to compare the Triceps Reflecting Anconeus Pedicle (TRAP) technique to repairing these fractures with the routinely used olecranon osteotomy. Our hypothesis proposed that the surgical method influences functional results in comminuted intra-articular distal humerus fractures, with olecranon osteotomy predicted to give higher functional outcomes compared to TRAP.

Material and Methods

A total of 38 consecutive patients presenting with intraarticular humeral fractures between the ages of 18 and 70 years were recruited in our study. The patients were divided into two groups at random: Group A (TRAP Group) and Group B (Olecranon Osteotomy Group). Following routine Anteroposterior (AP) and Lateral radiographs, fractures were identified in the Emergency Department using the AO classification of humerus fractures. Patients between the ages of 18 and 70 with closed and Grade 1 open fractures, fresh fractures within three weeks, no neurovascular involvement, no concomitant fractures in the same limb, and Type C (AO/ASIF classification) were included. Exclusion criteria included being medically unfit for surgery, having Grade 2 or 3 open fractures, having concomitant neurovascular impairments, having a fracture older than three weeks, and having concurrent ipsilateral upper limb fractures. Four patients were lost to follow-up, leaving 34 patients for the research, divided into Group A (17 patients) and Group B (17 patients), as shown in Table 1. A preanesthetic check-up was performed after standard preoperative examinations and assuring patient fitness and patients then underwent surgery. The operations were carried out under general anesthesia or regional block, with patients in the lateral decubitus posture, with the arm supported on an armrest or bolster and the forearm hanging by the side. A proximal digital pneumatic tourniquet was placed to the arm. Preoperative antibiotics were given, and all aseptic procedures, such as painting and draping, were followed.

A 14-16 cm midline skin incision was made, curling across the tip of the olecranon. Full-thickness medial and lateral flaps were created, with the ulnar nerve first identified and tagged using an infant feeding tube or surgical gloves. The ulnar nerve was dissected from proximal to distal, beginning at the medial border of the triceps tendon and ending at its first motor branch to the flexor carpi ulnaris muscle.

The technique employed for further dissection differed. The TRAP technique, as described by O'Driscoll et al. [15], was used in Group A. The triceps was raised from the medial and lateral intermuscular septae in Group B, preserving its insertion above the olecranon. The first articular reduction in both groups was accomplished using a pointed clamp and temporarily fastened with a K-wire, which was subsequently replaced with a 4mm cannulated cancellous screw. Intraoperative imaging validated the reduction and appropriate positioning of the plate. Elbow stability was evaluated using flexion, extension for motion arc checks, and varus and valgus stability tests.

A posterior slab was put at 90 degrees of flexion after surgery, and the limb was elevated for 2 days to avoid edema. Patients were released around the fifth surgical day, returning in two weeks for stitch removal and splint removal. A physiotherapy program was started, beginning with passive moderate range of motion exercises and progressively increasing in intensity. In the TRAP group, active elbow extension was limited for 6-8 weeks, while it began after two weeks in the osteotomy group.

Follow-up evaluations were performed at 2 weeks, 6 weeks, 12 weeks, and 18 weeks after surgery, and then every two months until the final follow-up. During each follow-up, patients were examined for symptoms such as pain, edema, evidence of infection, and range of motion (ROM) at the elbow. At each visit, anteroposterior and lateral images of the afflicted elbow were acquired. Elbow range of motion, triceps strength, and Mayo's elbow performance score (MEPS) were all measured during the 12-month follow-up.

For statistical analysis, the Statistical Package for Social Sciences 19.0 (SPSS Inc., Chicago, IL, USA) software was used. To compare the means of the two groups, the Student t-test, chi-square, and Fischer's exact test were used. Statistical significance was defined as a p-value of 0.05.

Results

There were no significant variations in age, gender, side, or duration of injury between the two groups. The AO classification was used to classify fractures, which revealed a greater occurrence in females and a right-sided predominance. The most prevalent cause of injury was found as falls, with associated connections of head damage and vertebral fractures (Table 1).

The operating time and hospital stay in Group A were much longer than in Group B. Both groups had fracture union at equal postoperative times. Range of Motion parameters such as flexion, extension loss, pronation, and supination were equivalent across the two groups. At the final follow-up, function assessment utilizing the average Mayo's Elbow Performance Score (MEPS)

computation revealed no significant alterations (Table 2). Table 3 lists the postoperative complications. Overall, there was no statistically significant difference in complication rates between the two groups. The MEPS scores in both groups are shown in Table 4.

Table 1: Clinico-demographic profile of study patients

Parameters	Group A	Group B
Mean Age (years)	42.5	38.2
Gender		
Males	7	10
Females	10	7
Side affected		
Left	8	14
Right	9	3
Time Interval Between Trauma andSurgery (Average Days)	5.8	4.9
Type of Fracture (AO)		
C1	5	2
C2	9	12
C3	3	3

Table 2: Comparison of operative and outcome parameters in both groups

Parameter	Group A	Group B	P Value
Duration of Surgery	120.2 minutes	110.75 minutes	<0.05
Blood Loss	228 milliliters	198 milliliters	0.54
Length of Hospital Stay	10.2 days	5.9 days	<0.05
Fracture Union Time	12.8 weeks	13.1 weeks	0.68
Functional Outcome	85.1	85.8	0.57
ROM			
Joint Flexion	117.5 degrees	118.5 degrees	0.91
Extension Limitation	11.8 degrees	12.3 degrees	0.46
Supination Angle	71.8 degrees	73.5 degrees	0.70
Pronation Angle	80.1 degrees	78.5 degrees	0.25

Table 3: Incidence of complications in both groups

Complications	Group A	Group B
Protrusion of hardware	0	2
Superficial infection	3	2
Deep infection	1	1
Ulnar nerve dysfunction	2	0
Lack of bone union	0	0
Weakness in extensor function	2	0
Delayed healing at Osteotomy Site	-	2

Table 4: MEPS scores in both groups

MES Scores	TRAP	Osteotomy	Total
Excellent	7	8	15
Good	7	7	14
Fair	2	2	4
Poor	1	0	1

Discussion

As with other joint fractures, the main goal of treating a patient with an intraarticular distal humerus fracture is to achieve anatomical restoration, stable stabilization, and early rehabilitation. Optimizing exposure is critical for visualizing articular fragments and ensuring appropriate reduction. For this goal, many techniques have been identified, including olecranon osteotomy, triceps reflecting, triceps splitting, and TRAP procedures.

However, owing to a lack of set norms, the choice of method often depends on the surgeon's expertise and comfort. Olecranon osteotomy, a typical treatment for similar fractures, is popular because to its familiarity and success. However, it is linked with problems such as delayed or non-union at the osteotomy site and hardware prominence. These difficulties, especially those associated with transverse osteotomy, have been alleviated by the use of chevron osteotomy—a V-shaped procedure that increases healing surface area, assists in

reduction, and provides improved stability owing to its intrinsic translational and rotatory stability. An apex distal chevron osteotomy was done in our research, which resulted in one instance of delayed union that resolved without intervention. The elimination of hardware prominence in one patient, attributable to tension band wire during osteotomy, was addressed post-union [16-19].

Comparative investigations, such as those conducted by Wilkinson et al. [20] and Jain R et al. [21], have evaluated joint surface exposure in triceps split, TRAP, and olecranon osteotomy procedures. The most exposure was documented with olecranon osteotomy (56%), followed by TRAP (46%). Although TRAP requires more operational time and has a steep learning curve, increasing elbow flexion may improve exposure and perhaps overcome this disadvantage. While triceps-elevating exposures are usually linked with triceps weakening or rupture [22], no triceps rupture was seen in our investigation. Weakness, which has been seen in a few instances, might be linked to trauma, as indicated by a patient who has weakness in both the triceps and the flexor muscles. Despite its time constraints and learning curve, the TRAP technique did not result in any subsequent procedures in our research, and no significant differences in clinical and functional results were detected between TRAP and olecranon osteotomy.

Despite this, our research has limitations, such as a small patient cohort, a retrospective design, and the exclusion of patients over the age of 70, delayed procedures, locally produced implants owing to budgetary restrictions, and the lack of preoperative CT scans in all instances. Future research incorporating particular age groups and homogenous sub-group types with comparable degrees of osteoporosis may give more accurate insights into the indications and efficacy of TRAP and olecranon osteotomy methods. Long-term studies are also needed to determine the effect of olecranon osteotomy on the development of osteoarthritis.

Conclusion

Both the trans olecranon and TRAP methods provide excellent imaging of the articular surface. Nonetheless, the TRAP technique requires a longer exposure period, but it avoids osteotomy and its related difficulties. Both techniques provide essentially comparable functional and clinical results in this investigation. This study emphasizes the importance of early precision surgical fixation in conjunction with a well-designed postoperative physiotherapy routine in returning patients to their pre-injury position.

References

1. Rose SH, Melton LJ, Morrey BF, Ilstrup DM, Riggs BL. Epidemiologic features of humeral fractures. Clin Orthop Relat Res. 1982; (168):24–30.
2. Jupiter JB, Neff U, Holzach P, Allgöwer M. Intercondylar fractures of the humerus. An operative approach. J Bone Joint Surg Am. 1985; 67(2):226–39.
3. Ilyas A, Jupiter J. Treatment of distal humerus fractures. Acta Chir Orthop Traumatol Cech. 2008; 75(1):6.
4. Wagner M. General principles for the clinical use of the LCP. Injury. 2003; 34(Suppl 2):31–42.
5. Cannada L, Loeffler B, Zadnik MB, Eglseder AW. Treatment of high-energy supracondylar/intercondylar fractures of the distal humerus. J Surg Orthop Adv. 2011; 20(4):230–5.
6. Lawrence TM, Ahmadi S, Morrey BF, Sánchez-Sotelo J. Wound complications after distalhumerus fracture fixation: incidence, risk factors, and outcome. J Shoulder Elbow Surg. 2014; 23(2):258–6.
7. Eralp L, Kocaoglu M, Sar C, Atalar AC. Surgical treatment of distal intraarticular humeral fractures in adults. Int Orthop. 2001; 25:46–50.
8. Sanchez-Sotelo J, Torchia ME, O'Driscoll SW. Complex distal humeral fractures: internal fixation with a principle-based parallel-plate technique. J Bone Joint Surg Am. 2007; 89(5):961–9.
9. Jung SW, Kang SH, Jeong M, Lim HS. Triangular Fixation Technique for Bicolumn Restoration in Treatment of Distal Humerus Intercondylar Fracture. Clin Orthop Surg. 2016; 8(1):9–18.
10. Bryan SR, Morrey FB. Extensive Posterior approach to the elbow. Clin Orthop. 1982; 166:188–92.
11. Bass RL, Stern PJ. Elbow and forearm anatomy and surgical approaches. Hand Clin. 1994; 10(3):343–56.
12. Archdeacon MT. Combined olecranon osteotomy and posterior triceps splitting approach for complex fractures of the distal humerus. J Orthop Trauma. 2003; 17(5):368–73.
13. Ziran BH, Smith WR, Balk ML, Manning CM, Agudelo JF. A true triceps-splitting approach for treatment of distal humerus fractures: a preliminary report. J Trauma. 2005; 58(1):70–5.
14. Mühldorfer-Fodor M, Bekler H, Wolfe VM, Mckean J, Rosenwasser MP. Paratricipital-triceps splitting "two-window" approach for distal humerus fractures. Tech Hand Up Extrem Surg. 2011; 15(3):156–61.

15. O'Driscoll SW. The triceps-reflecting anconeus pedicle (TRAP) approach for distal humeral fractures and nonunions. Orthop Clin North Am. 2000; 31(1):91–101.
16. Mckee MD, Kim J, Kebaish K, Stephen DJ, Kreder HJ, Schemitsch EH, et al. Functional outcome after open supracondylar fractures of the humerus. The effect of the surgical approach. J Bone Joint Surg Br. 2000; 82(5):646–51.
17. O'driscoll SW, Sanchez-Sotelo J, Torchia ME. Management of the smashed distal humerus. Orthop Clin North Am. 2002; 33(1):19–33.
18. Ring D, Gulotta L, Chin K, Jupiter JB. Olecranon osteotomy for exposure of fractures andnon-unions of the distal humerus. J Orthop Trauma. 2004; 18(7):446–9.
19. Atalar AC, Demirhan M, Salduz A, Kiliçoglu O, Seyahi A. Functional results of the parallel-plate technique for complex distal humerus fractures. Acta Orthop Traumatol Turc. 2009; 43(1):21–7.
20. Wilkinson JM, Stanley D. Posterior surgical approaches to the elbow: A comparative anatomic study. J Shoulder Elbow Surg. 2001; 10(4):380–2.
21. Jain R, Frank HC, Dutta KK, Hazarika K. Intra-articular distal humerus fracture – TRAP or olecranon osteotomy. Indian J Orthop Surg. 2023; 9(2):53-60.
22. Pierce TD, Herndon JH. The triceps preserving approach to total elbow arthroplasty. Clin Orthop Relat Res. 1998; 354:144–52.