

PEDICAL APPROACH FOR INTRAARTICULAR LOWER END HUMERUS FRACTURES

Mantri D.*

Sonkar D.K.**

Jamra M.***

ABSTRACT

Background: Operative fixation of intra-articular fractures of the distal humerus requires adequate exposure. The transolecranon approach is a commonly used approach. The olecranon osteotomy has potential complications related to prominence/ migration of hardware, displacement/ nonunion of osteotomy and triceps weakness. Triceps reflecting anconeus pedicle (TRAP) avoids the olecranon osteotomy without compromising the operative exposure. We present outcome of fixation of displaced intra-articular distal humeral fractures with the use of TRAP approach.

Materials and Methods: We prospectively reviewed results of TRAP approach on cohort of 30 patients with intraarticular fracture lower end humerus over a duration of June 2012 to Aug. 2014. Results were evaluated on clinical grounds by Mayo Elbow Performance Index for functional recovery, stability, triceps strength and on radiological ground with mean follow-up of 12 month.

Results: In cohort of 30 patients (18 male, 12 female) more than 95 % showed good clinical or functional results on Mayo Elbow Performance Index. Patients were assessed for the functional status of the elbow joint and We found that 80% of them had a range of flexion as given by the Mayo classification of more than 100 degrees. The extension in 85% of the patients was more than 5 degrees in regard to range of motion and . Long term follow up of 6 months for triceps strength gave encouraging results as 96% had strengths in the range of 4-5 and none of them had triceps rupture. Radiological evaluation showed union in all . No patient needed a reoperation and none of them showed elbow instability or tricep weakness.

Conclusions: The TRAP approach provides good visualization for fixation of intercondylar fractures of the humerus, without any noticeable untoward effect on triceps strength and postoperative rehabilitation; and one can avoid iatrogenic fracture of the olecranon and its associated complications.

Key Word: Humerus, Intraarticular fracture, Triceps-reflecting anconeus pedicle approach

INTRODUCTION

Distal humerus fractures demand technically difficult operative treatment, often with relatively high morbidity. Adequate exposure of the articular surface of the distal humerus and elbow joint is required for operative stabilization of bicondylar intraarticular distal humerus fractures. The transolecranon approach, which provides complete posterior visualization and access to the distal

humerus, is the most commonly used surgical approach but have risks and possible complications such as prominence/migration of hardware, displacement/ nonunion of osteotomy and triceps weakness.

Need for better surgical visualization of fracture geometry has produced numerous new approaches and their modification. Surgical approaches to the elbow joint that dissociate the

* Assistant Professor
** Professor
*** Resident Surgical Officer

Address for correspondence:
Dr. Deepak Mantri
Asst Professor,
Dept of Orthopaedics, MGMMC,
Indore, MP 452001

triceps from the olecranon i.e. Triceps-reflecting Anconeus Pedicle (TRAP) have several advantages. This approach avoids an osteotomy and mobilizes the triceps and anconeus muscle off the posterior humerus and the intermuscular septae and provides adequate exposure for open reduction and internal fixation. Furthermore, this approach preserves neurovascular supply of anconeus, which is a dynamic stabilizer of the elbow. With all posterior approaches, the ulnar nerve must be carefully dissected without excessive stripping and usually is transposed anterior to the medial epicondyle at the end of the olecranon osteotomy which is not required with triceps-reflecting anconeus pedicle (TRAP) approach. Though this approach has disadvantages like more extensive dissection, triceps weakness and failures and delayed post op rehabilitation. The purpose of our study was to determine the functional outcome of fixation of displaced intra-articular distal humeral fractures with use of triceps-reflecting anconeus pedicle approach.

MATERIAL AND METHODS

This prospective study was carried out in Department of Orthopaedics and Traumatology, M.G.M. Medical College and M.Y. Hospital, Indore from June 2012 to August 14. After receiving approval from Institutional Scientific Review Board 30 cases with fracture distal end intraarticular humerus fractures in patients between age 18 to 60 years, treated by Triceps-reflecting Anconeus Pedicle (TRAP) were included in the study. Cases with Compound injury, associated trauma of upper limb same side, preexisting musculoskeletal disease, systemic disease, immune system disorders or other comorbid condition like diabetes mellitus, chronic liver and kidney diseases and thyroid disorders and patients on immunosuppressive drugs and those who gave refusal for study were excluded.

SURGICAL TECHNIQUE

All operations were done under general anesthesia or regional blocks depending upon the patient

profile. The patients were placed in lateral position and tourniquet applied. A straight posterior incision was made just lateral to the olecranon tip, approximately 10 cm proximal and 8 cm distal.

Medial and lateral skin flaps were raised to expose the supracondylar ridge so neither side of the distal humerus. The ulnar nerve was first localized proximally where it emerged beneath the triceps end on. The distal aspect of the intermuscular septum was released to increase the mobility of the ulnar nerve. The nerve was followed and preserved and secured in a feeding tube loop. Its branches to the flexor carpi ulnaris were carefully preserved.

Laterally, the flap was elevated to expose the interval between the anconeus and the extensor carpi ulnaris. The anconeus-triceps flap was detached from its distal attachment (5-7 cm from the tip of olecranon) and dissected off the lateral side of the elbow and proximal ulna, preserving the integrity of the lateral collateral ligament complex, including annular ligament. This was accomplished easily by commencing the dissection distally and working proximally. The posterior capsule was incised and the dissection was carried out proximally between the triceps and posterior humerus. The fibers of the deep head of the triceps were dissected off the posterior humerus by sharp and blunt dissection.

The intra-articular component was reduced first, after which the reconstituted condylar block was reduced and fixed provisionally to the medial and lateral columns with 1.6 or 2.0-mm Kirschner wires. 3.5-mm reconstruction plates were contoured to it along the involved columns. As per fracture pattern one or both columns were fixed.

Long screws aiming from the medial or lateral epicondyles through the medial and lateral columns provided additional fixation in appropriate cases.

Intraoperative radiographic assessment under IITV control were made to confirm adequate placement of the hardware and reconstitution of the osseous anatomy, the elbow was moved

through range of motion to test the stability of the repair and also to guide the goals of post operative rehabilitation. The triceps was reattached within interrupted number-2 braided polyester sutures, with use of drill-holes through bone in the region of the olecranon. A hemovac drain was placed on the triceps fascia and the subcutaneous tissue and skin closed in layers. Above elbow slab was applied in 60° flexion for two weeks.

POST-OPERATIVE SPLINTAGE

Done with above elbow slab in 60° flexion. Suture removal done at 2 weeks. Gentle active and active-assisted range-of-motion exercises were started under the supervision of a physiotherapist after two weeks. Active extension was prohibited until six weeks postoperatively to avoid undue stress on the extensor mechanism repair.

FOLLOW-UP

Done at 2 weeks, 4 weeks, 6 weeks, 3 months, 6 months. On each follow up patient was assessed on following parameters.

1. Radiographic Analysis: Union
2. Clinical Assessment
3. Triceps Strength
4. Range of motion

5. Stability: by manual elbow examination.
6. Neurological : for ulnar nerve
7. Elbow functional assessment (Mayo elbow performance index)

Table 1
Mayo elbow performance index

Variable	Definition	No. of points
Pain (max., 45 points)	None	45
	Mild	30
	Moderate	15
	Severe	0
Range of motion (max., 100 points)	Arc > 100 degree	20
	Arc 50 to 100 degrees	15
	Arc < 50 degrees	5
Stability (max., 10 points)	Stable	10
	Moderately unstable	5
	Grossly unstable	0
Function (max., 25 points)	Able to comb hair	5
	Able to feed oneself	5
	Able to perform personal hygiene tasks	5
	Able to put on shirt	5
	Able to put shoes	5

75-100: Good (satisfactory) (n = 10),
50-74: Fair (n = 5), < 50: Poor (n = 0).



Figure 1 : Skin incision for Triceps-reflecting Anconeus Pedicle approach

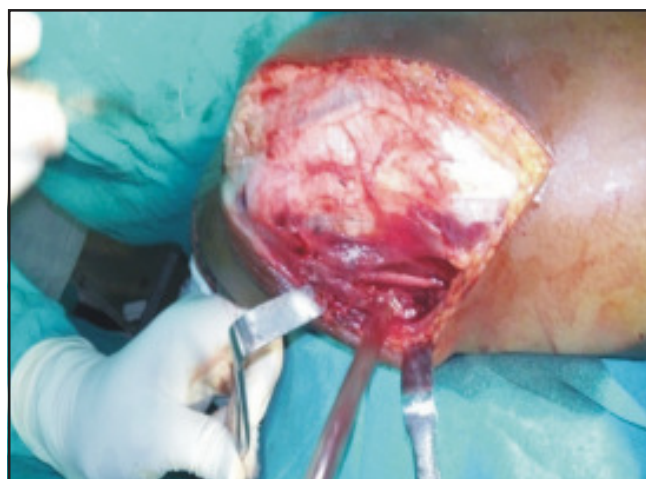


Figure 2 : Ulnar nerve Isolated

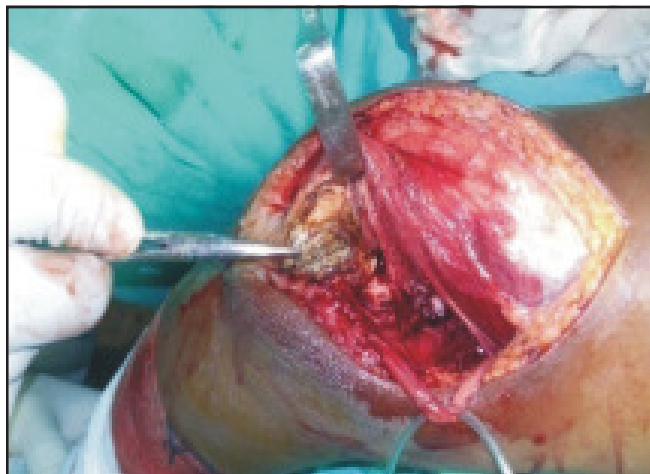


Figure 3 : The anconeus-triceps flap is detached from its distal attachment and the flap is reflected to expose the lower end of the humerus

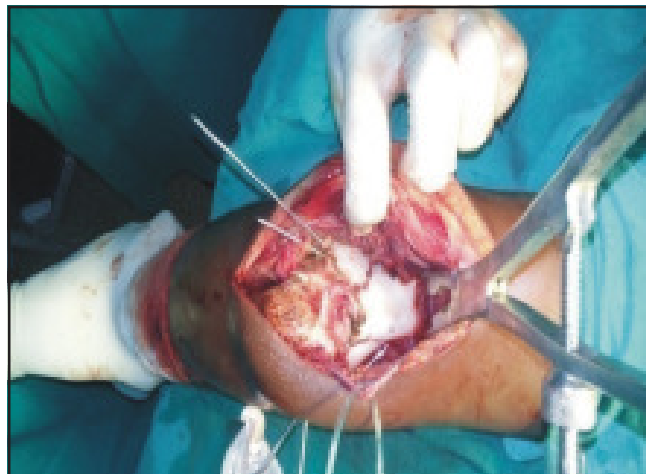


Figure 4 : Good visualization of the fracture and an intact olecranon helps in reconstituting the distal humerus



Figure 5 : Plate fixation
Final reduction and anatomical fixation of distal humerus with plate and screws

RESULTS

Our study included total 30 cases 18 were Males and 12 were females with age range of 21-60 years with a mean age of 34.4 years. Right sided injuries were more common (67%) with fall on outstretched hand (67%) being the commonest mode of injury. More than (70%) cases were having AO type C fractures. Out of 30 patients more than 95 % showed good clinical or functional results on Mayo Elbow Performance Index. Patients were assessed for the functional status of the elbow joint and we found

that 80% of them had a range of flexion of more than 100 degrees. The extension in 85% of the patients was more than 5 degrees in regard to range of motion and long term follow up of 6 months for triceps strength gave encouraging results as 96% had strengths in the range of 4-5 and none of them had triceps rupture only one patient had weakness grade III due to poor compliance to physiotherapy. Radiological evaluation showed union in all. No patient needed a reoperation and none of them showed elbow instability or triceps weakness.

DISCUSSION

Adequate exposure of the articular surface of the distal humerus and elbow joint is required for operative stabilization of bicolunar distal humerus fractures. Need for better surgical visualization of fracture geometry has produced numerous new approaches and their modification. There are many studies on the various surgical approaches for treatment of distal intra-articular humeral fractures but literature on evaluation of patients only by Triceps-reflecting Anconeus Pedicle procedure is scanty.

Triceps-splitting, Triceps-reflecting and Olecranonosteotomy are the most common posterior surgical approaches to the adult elbow. Triceps-splitting or-peeling approaches have postulated an egative effect on muscle strength on the basis of the potential for weak enedre attachment, direct muscle injury with resultant fibrosis, elbow stiffness and injury to intramuscular nerve branches. In the TRAP approach the dissection is in the inter nervous planes and hence muscle injury with resultant fibrosis and injury to intramuscular nerve branches are avoided with this approach. The median exposed articular surface for triceps splitting, triceps reflecting and olecranon osteotomy approaches has shown to be 35%, 46% and 57% respectively in a cadaver study.

There is consensus that best approach and visualization in these challenging fractures is through the posterior approach. It is generally thought that a posterior surgical approach provides optimal exposure of the intra-articular aspect of the distal part of the humerus and the olecranonosteotomy is the gold standard against which ot her approaches are compared. However, its drawbacks (delayed union or nonunion, prominent hardware and soon) have led too the ravenues of dealing with the extens or mechanism. Several authors have reported various complications associated with tension band wiring of olecranon. Mackoetal reported elbow symptoms due to prominent K-wire 15 cases (75%) out of their 20 cases and skin break down in four (20%).⁹

In a study of 88 fractures of the olecranon, Horneetal reported that 66 (75%) patients required removal of the wire within one year because of pain and 7% patients had nonunion. Ringetal reported an on-union rate of 30% of transverse olecranonosteotomy insurgical fixation of fractures o f distal humerus. Gainor et al observed that 27% of their patients necessitated removal of hardware because of symptoms related to wires and septicolecranonbursitis.

Triceps-reflecting anconeuspedicle approachc an avoid such problems altogether. The median exposed articular surface for the triceps-splitting, triceps-reflecting and olecranonosteotomy approaches was 35%, 46% and 57%, respectively. Moreover, extensor mechanism repair following trap approach is easy and strong enough to allow early aggressive elbow rehabilitation. It preserves the nerve supply to anconeus which acts as an important lateral stabilizer of the elbow. Good to excellent intra-articular reduction is obtained. No fracture was fixed with > 2mm intra-articular step or gap. This approach affords excellent articular visualization.

Olecranonosteotomy exposed more articlarsur face than the triceps-splitting approach but was not significantly greater than the triceps-reflecting approach.

Extreme flexion of elbow allows visualization of most of the anterior articlarsur face of the humerus. We had no problem even in comminuted bicondylar fractures with triceps-reflecting anconeuspedicle approach.

In our study 87.5% of patients regained normal strength by 12 months while Askewetal reported loss of st rength of triceps in all patients with olecranonosteotomy or triceps-splitting approach.

The TRAP approach a llows extensive distal humerus exposure, including the supracondylar/intercondylar region. The TRAP approach is extensile enough in treating complex humeral fractures. Both articular reconstruction and fixation can be easily managed without creating an

olecranon fracture. The repair is easy and strong enough to allow a rapid rehabilitation. No significant triceps weakness and dysfunction was observed after the TRAP approach in the treatment of the intra-articular fractures of the humerus.

Our study has certain short comings. We measured muscle strength manually and that may insinuatethepotential of subjective bias; objective testing of the muscle strength would have avoided this bias. The rate of post traumaticde generative changes in the elbow may increase with time, negatively affecting function and hence along er follow-up is required.

SUMMARY AND CONCLUSION

Adequate exposure is a prerequisite for treatment of distal humeral fractures, as with most surgical procedures. Challenging as they may be to reduce and fix, these fractures can be made more or less difficult to treat based on exposure; complications of successful treatment may arise as a result of the exposure. In this article we describe the triceps-reflecting anconeus pedicle (TRAP) approach to the distal humerus, which provides an extensile and versatile approach for treatment of fractures and nonunions. The TRAP approach provides almost the same exposure as an olecranon osteotomy, without the complications of the osteotomy, and has the added advantage of retaining the whole olecranon to use as a template against which to assemble the articular fragments of the trochlea.

Triceps-reflecting anconeuspedicle approach provides good visualization for fixation of intra-articular fractures of the humerus, without any untoward effetontriceps strength and post operative rehabilitation; and one can avoid iatrogenic fracture of the olecranonandits associated complications.

REFERENCES

- Gupta R, Khanchandani P. Intercondylar fractures of the distal humerus in adults: A critical analysis of 55 cases. *Injury* 2002; 33:511-5.
- K. Schmidt-Horlohé, S. Siebenlist, U. Stöckle, R. Hoffmann(. *OrthopClin North Am.* 2000 Jan;31(1):91-101.
- Sudhir Babhulkar and Sushrut Babhulkar; Controversies in the management of intra-articular fractures of distal humerus
- Scolaro JA, Hsu JE, Svach DJ, Mehta S. Plate selection for fixation of extra-articular distal humerus fractures: A biomechanical comparison of three different implant
- Gainor BJ, Moussa F, Schott T. Healing rate of transverse osteotomies of the olecranon used in reconstruction of distal humerus fractures. *J South Orthop Assoc* 1995;4:263-8
- Bashyal RK, Chu JY, Schoenecker PL, Dobbs MB, Luhmann SJ, Gordon JE. Complications after pinning of supracondylar distal humerus fractures
- Mighell M, Virani NA, Shannon R, Echols EL Jr, Badman BL, Keating CJ. Large coronal shear fractures of the capitellum and trochlea treated with headless compression screws. *J Shoulder Elbow Surg.* Jan-Feb 2010;19(1):38-45.
- Xie X, Qin H, Shen L, Zeng B, An Z. Open reduction and bi-columnar internal fixation of intra-articular distal humerus fractures through a combined medial and lateral approach. *Eur J Orthop Surg Traumatol.* Aug 28 2013
- O'Driscoll SW. The triceps-reflecting anconeus pedicle (TRAP) approach for distal humeral fractures and nonunions. *Orthop Clin North Am* 2000;31:91-101
- Ring D, Gulotta L, Chin K, Jupiter JB. Olecranon osteotomy for exposure of fractures and nonunions of the distal humerus. *J Orthop Trauma* 2004;18:446-9
- Ozer H, Solak S, Turanli S, Baltaci G, Colakoglu T, Bolukbasi S. Intercondylar fractures of the distal humerus treated with the triceps-reflecting anconeus pedicle approach. *Arch Orthop Trauma Surg* 2005;125:469-74.
- Amite Pankaj, G Mallinath, and Surya Bhan Surgical management of intercondylar fractures of the humerus using triceps reflecting anconeus pedicle (TRAP) approach *Indian J Orthop.* 2007 Jul-Sep; 41(3): 219-223.
- Puneet Mishra, Aditya Aggarwal, Mukunth Critical analysis of triceps-reflecting anconeus pedicle (TRAP) approach for operative management of intra-articular distal humerus fractures *Journal of Clinical Orthopaedics & Trauma* Volume 1, Issue 2, Pages 71-80, December 201
- Wilkinson JM, Stanley D. Posterior surgical

PEDICAL APPROACH FOR INTRAARTICULAR LOWER END HUMERUS FRACTURES

- approaches to the elbow: A comparative anatomic study. J Shoulder Elbow Surg 2001;10:380-2.
15. Journal of Clinical Orthopaedics & Trauma Volume 1, Issue 2 , Pages 71-80, December 2010
16. Bryan RS, Morrey BF. Extensive posterior exposure of the elbow. Clin Orthop Relat Res 1982;166:188-92
17. Brown RF, Morgan RG. Intercondylar T-shaped fractures of the humerus. Results in ten cases treated by early mobilization. J Bone Joint Surg Br 1971;53:425-8
18. Surgical Approaches to the ElbowEmilie V. Cheung andScott P. SteinmannJ Am Acad Orthop Surg May 2009 ;17:325-333
19. Jupiter JB, Goodman LJ. The management of complex distal humerus nonunion in the elderly by elbow capsulectomy, triple plating, and ulnar nerve neurolysis. J Shoulder Elbow Surg. 1992;1:37-42.