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Dr. Chandra Sekhar Pradhan
Assistant Professor, SCB Medical College & Hospital, Cuttack, Odisha, India

Dr. TSK Gupta
Assistant Professor, SCB Medical College & Hospital, Cuttack, Odisha, India

Dr. NC. Mohapatra
Professor, SCB Medical College & Hospital, Cuttack, Odisha, India

Dr. NR Mishra
Junior Resident, SCB Medical College & Hospital, Cuttack, Odisha, India

Dr. BK Ojha
Junior Resident, SCB Medical College & Hospital, Cuttack, Odisha, India

Correspondence
Dr. TSK Gupta
Assistant Professor, SCB Medical College & Hospital, Cuttack, Odisha, India

Evaluation of surgical treatment of inter-condylar humerus fracture with olecranon osteotomy approach

Dr. Chandra Sekhar Pradhan, Dr. TSK Gupta, Dr. NC Mohapatra, Dr. NR Mishra and Dr. BK Ojha

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Abstract
Background: Inter-condylar fracture distal humerus in adults often pose a challenge to orthopaedic surgeons because of the complex anatomy, fracture pattern and limited bone stock of this region. Adequate exposure of the articular surface of the distal humerus and elbow joint is essential for operative stabilisation of complex distal humerus fracture. Various operative approaches have been recommended to access this difficult region which includes triceps splitting, triceps reflecting and trans-olecranon approaches though each approach has its own advantage & disadvantage. Olecranon osteotomy approach provides better visualization of complex intra-articular fractures, enabling accurate reduction and fixation.
Aim of this study: To assess the functional outcome of intercondylar humerus fracture with olecranon osteotomy approach. **Study design:** prospective study
Material and methods: Sixty patients of inter-condylar fracture humerus fulfilling the inclusion criteria were treated with internal fixation with various implants with olecranon osteotomy via posterior approach. Preoperative and postoperative radiograph measurements were taken and fractures were classified according to the AO system. All patients were operated through posterior trans-olecranon approach. Elbow exercises were started at third postoperative week. Patients were followed at three weeks and thereafter monthly, with clinical examination and x-rays.
Results: The average ROM on follow up after 6 weeks was flexion up to 140^{o} and extension upto 5^{o} of elbow flexion. No cases of olecranon or distal humerus non-union were reported.
Conclusions: Posterior surgical approach with olecranon osteotomy provides optimal exposure of the intra articular aspect of distal part of humerus and among them olecranon osteotomy gives the best exposure of the articular surface and there by better reduction and internal fixation which in turn gives better stability and good range of motion as compared to other approaches.

Keywords: Surgical treatment, humerus fracture, olecranon osteotomy

Introduction
Intra- articular distal humerus fractures in adults often pose a challenge to the orthopaedic surgeon due to unique anatomy of the region, complex fracture patterns& limited bone stock. Open reduction & internal fixation remains treatment of choice. Preoperative planning, minimal devitalisation of bone and soft tissue and adherence to the prerequisites of a biomechanically sound fixation are all important elements in effecting the desired end results. Adequate exposure of the articular surface of the distal humerus and elbow joint is essential for operative stabilisation of columnar & comminute distal humerus fracture. Various operative approaches have been recommended, including triceps splitting, triceps reflecting and trans-olecranon approaches. Olecranon osteotomy approach provides better visualization of complex intra-articular fractures, enabling accurate reduction and fixation. But significant complications like delayed union, non-union and secondary procedures for removal of hardware have been reported with the use of the trans-olecranon approach. Alternative approaches like triceps splitting and triceps reflecting are advocated to eliminate the complications inherent to olecranon osteotomy; however they do not offer same degree of visualisation of fracture for proper reduction &fixation. In the present study we used the trans olecranon approach to manage complex distal humeral fractures & evaluate the union rate, complication and restoration of function.

Study center: SCB medical college & hospital, Cuttack between December 2014-December 2017

Aim of Study

To evaluate the results of olecranon osteotomy approach in terms of union rates, complications& functional outcome in inter-condylar fracture of humerus. To study the principles and to achieve the technical objective at the time of surgery for inter-condylar fractures of humerus. to analyze the surgical techniques for adequate reconstruction of the articular surface and both medial and lateral pillars.

Study Design: Prospective study

Materials and Methods

The present study includes 60 cases of intercondylar fracture of distal humerus admitted to SCBMCH Cuttack between December 2014-December 2017. The patients were evaluated in detail at the time of admission at casualty or OPD. Careful history was taken to reveal the mechanism of injury and patient were assessed clinically to evaluate their general condition (vitals and other systemics examination) and local examination (nature of wound, swelling, deformity, distal neurovascular status). AP and Lateral x-ray of the involved elbow were taken and the limb was then immobilised in above elbow POP slab with sling. In comminute fractures CT scan was also done to delineate the fracture patterns. All patients were treated with open reduction and rigid columnar internal fixation by olecranon osteotomy method through posterior approach. Most patients were operated within 7 days of admission. Post op physiotherapy were started after 10days.

Inclusion criteria: all patients with closed intercondylar humerus fracture (AO type B and C) i.e partial articular and complete articular fracture are chosen for this study.

Exclusion criteria

1. Open fractures (any grade)
2. Severe Co-morbid condition
3. Children less than 16 years of age
4. proximal olecranon comminute fracture

All patients were followed up at 3weeks, 6 weeks, 12 weeks, 6 months, 1year and 2 year. They were evaluated as per the Mayo clinic Functional elbow scoring system.

Results

Table 1: Showing the time interval between admission and time of surgery

Duration	Number of cases	Percentage
<24hrs	0	0
2-4 days	40	66.66
5-7 days	12	20
>7 days	8	13.33

No case was operated as surgical emergency. All cases were operated on regular OT days at the earliest. 40 patients were operated between 2-4 days, 12 patients were operated between 5-7 days, 8 patients were operated between more than 7 days.

Associated injuries: 6 patient had concomitant distal radius fracture of ipsilateral limb and 2 patient had multiple metacarpal fracture of contralateral hand

Table 2: type of fixation

Type of fixation	Number of cases	Percentage
Distal humerus LCP	7	12
Reconstruction Plate	24	40
Small DCP	16	26
Combined	13	22

In this series 24 patient were fixed with double recon plate of which supplementary k-wire were used in two cases and 7 patients were fixed with distal humerus anatomical locking compression plate.16 patients were fixed with bilateral small dynamic compression plate.13 patients were fixed with combined small dynamic compression plate and recon plate.
All cases were immobilised with above elbow posterior POP slab for 10 days and were encouraged active elbow motion thereafter.

Table 3: Complications

	Number of cases	Percentage
Superficial infection	10	16.66
Ulnar neuropathy	2	3.33
Non-union	0	00
Implant failure	2	3.33
Heterotrophic ossification	2	3.33

there were no cases of intraoperative complications. Post operatively 10 patient developed superficial infection which were controlled with appropriate antibiotics after culture sensitivity report. 2patient developed ulnar neuropraxia which recovered spontaneously after 3 weeks. No cases of olecranon or distal humerus non-union were reported. One case with comminuted fracture developed implant loosening due to early movement.

Table 4: Range of motion (6weeks postop)

Movements	Average
Flexion	140º
Extension	-5º

The average ROM on follow up after 6 weeks was flexion up to 140º and extension

Table 5: Individualised result of B & C typefractures based on mayo elbow scoring system

Results	Fracture type	No of Patients	Percentage
Excellent	B and C1	14	28.33
	C2	3	
Good	C1-	15	51.66
	C2	16	
Fair	C3	9	15.0
Poor	C3	3	5.0

The mean duration of follow-up was 6 months (Range: 3 to 18). At the final follow-up, according to the Mayo Clinic Elbow Score, 17 (28.33%) patients achieved an excellent result, 31 (51.66%) patients had a good result, 6 (15.0%) patients a fair and 3 (5.0 %) had a poor result. The average score was 80 points (Range: 48 to 98).Thirty-four (81%) patients had normal muscle strength in comparison to the contralateral side while eight (19%) had good muscle strength. There were no unsatisfactory results as regard muscle strength. Instability was not documented, either under valgus/varus stress or under pivot-shifting. Subcutaneous prominence of the hardware was observed in one case and needed removal of the implant.

Case 1

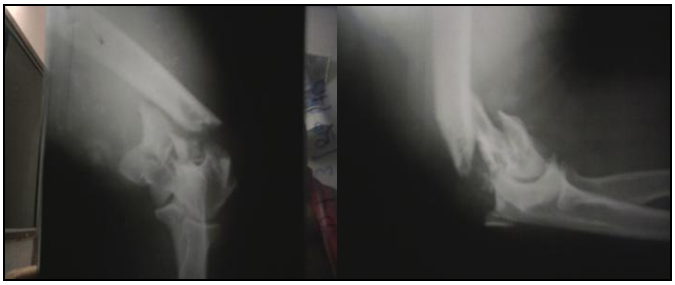

Fig 1-2: Showing Preoperative X-rays of case 1(AP& Lateral)

Fig 3: Showing Intra op fixation of Case 1

Fig 4: Showing postoperative xray of case 1

Fig 5-6: Showing Post op range of movement at 6weeks of case 1.

Case 2

Fig 7: Showing preoperative x-ray (Lateral of case 2)

Fig 8: Showing postoperative Xray of case 2 (AP and Lateral)

Fig 9-10: Showing range of movement of elbow of case 2

Discussion

Intra-articular fractures of the elbow joint usually present serious problems in the management, although they account for only 6% all fractures (Conn, J.Jr. and Wade, P.D. and Cochrane, W.A.). There have been many methods of treatment, suggested right from its early description by Desault in 1811. Till the 1970s most of the authors favoured for the conservative approach. But with the revolution in the field of metal engineering, implant biomechanics and early physiotherapy, the consensus has now gone in favour of operative mode of treatment whenever indicated. To help resolves these differences of opinion, the results of operative treatment in a series of communitted fractures of the distal humerus in the adults are reviewed.

This study "Evaluation of Surgical Treatment of Intercondylar Humerus Fracture with Olecranon Osteotomy Approach" was

carried out in the Department of Orthopaedics, SCB Medical College & Hospital, Cuttack. A total of 60 patients of intercondylar fractures of humerus were taken up for this study. among the various implants recommended, we have chosen K wires, cancellous screws, recon plate, small DCP, Locking compression plates for the fracture fragment fixation. As far as age incidence is concerned, out of 60 cases, majority of 28 (46.66%) patients were in the age group of 41-50 years and the minimum of 6 (10%) cases were in the age group of 51-60 years. amongst the rest, 8 (13.33%) patients were in the age group of 31-40 years. In this study, majority of patients i.e. 40 (66.66%) were male. Male predominance in this series might be due to fact that males are more exposed to various outdoor activities. in this study there were 36(60%) cases with fractures of the left humerus, the others 24(40%) cases had fractures of right humerus. none of the patients encountered bilateral affection. most common mode of injury in our series was RTA(63.33%), which is comparable with the study of Bradford Henley [4] (1987). Fall from height contributed to rest of the cases (36.33%).Fall on outstretched hand directly transfers the force to the lower end of the humerus thereby causing these injuries, mostly in the elderly persons. All the fractures in this series were classified according to AO classification system depending upon the displacement, rotation and comminution of the fracture fragments. Out of the 60 cases selected in our series, 14 (24%) were type B, rest Type C. In our series the average time elapsed between the times of injury to the time of surgery was 3.7 days. Maximum numbers of patients 40 (66.66%) were operated in the period of 2-4 days. Asper the observation of salter (1982) on the rabbit models, the earlier the intraarticular fracture is operated the better is the joint rehabilitation. For this reason, fracture of the distal end being intraarticular should be treated as early as possible. An appreciable of > 7days in 8 patients were due to various reasons including delayed presentation by the patients, fitness of the patients, etc. after the operation, physiotherapy was stared from the 10th post-operative day onwards according to patients tolerance after the removal of stitches. The slab was removed 2-3 times a day for gentle active assisted motion under the supervision of the physical therapist. All patients were followed up at 3weeks, 6 weeks, 12 weeks, 6 months, 1year and 2 year. They were evaluated as per the Mayo clinic Functional elbow scoring system and radiological status of the fracture. All the patients had to demonstrate greater than 40% range of motion prior to leaving the hospital. There were no cases of intraoperative complications. Post operatively 2 patient developed superficial infection which were controlled with appropriate antibiotics after culture sensitivity report. 1 patient developed ulnar neuropraxia which recovered spontaneously after 3 weeks. No cases of olecranon or distal humerus non-union, AVN, myositis ossificans were reported. One case with comminuted fracture developed implant loosening due to early movement. Out of the 60 Cases, 58 cases found to be clinically united by the end of 12 weeks. The mean duration of follow-up was 6 months (Range: 3 to 18). At the final follow-up, according to the Mayo Clinic Elbow Score, 17 (28.33%) patients achieved an excellent result, 31 (51.66%) patients had a good result, 6 (15.0%) patients a fair and 3 (5.0 %) had a poor result. The average score was 80 points (Range: 48 to 98).

The aim of operative treatment of intra-articular distal humeral fractures is anatomic reduction and rigid fixation to allow early range of motion and finally to restore the pre-injury function. The inter-condylar position of the fracture has been usually secured with screws, appropriate to the size of the fragments and their alignment. Locking plates are preferred in case of osteoporotic bones. Dual plate has been used by several authors and seems to provide the most secure fixation. The recommendation of the AO group are for placement of semi-tubular plate medially and 3.5 mm reconstruction or DCP plate postero-laterally to achieve the technical objectives. Restoration of anatomy and early range of motion of elbow is the goal of operative treatment of fractures of distal humerus in adults.

Numerous operative approaches for the management of distal humeral fractures have been described. Irrespective of the approach used, the ulnar nerve mustal ways be isolated, mobilized, and protected throughout the procedure. While there is general agreement about isolation and mobilization of the ulnar nerve, whether to transpose the nerve anteriorly or not at the conclusion of the procedure is a subject of some debate. While there are many approaches for the posterior exposure of the distal humerus, each has its own advantages and disadvantages in terms of exposure, ease of fixation & complications. Posterior approach by osteotomy provides best exposure & fracture fixation though in some cases non-union of osteotomy & hardware prominence has been observed.

The purpose of this study was to evaluate the outcome of olecranon osteotomy in terms of union, complications, adequacy of surgical reduction of fracture and ultimate functional outcome.

Trans-olecranon approach has been traditionally considered as gold standard in treating intercondylar fractures.

Table 6: Comparison of distal humerus articular surface exposure in different approaches [9].

Table

Comparison of Distal Humerus Articular Surface Exposure

Study and Approach	Articular Surface Exposed[a]
Dakouré et al[7]	
Bilaterotricipital	26
Triceps splitting	37
Olecranon osteotomy	52
Wilkinson and Stanley[8]	
Triceps splitting	35
Triceps reflecting	46
Olecranon osteotomy	57

[a]*Percentage of entire articular surface.*

Olecranon osteotomy for exposure and fixation of the distal humeral fracture as initially popularised by Cassebaum [4]. Henley *et al.* reported a57% incidence of complications with the transverse osteotomy, including symptomatic prominence of the K-wire, broken tension band wire, delayed union and non-union [12]. We used the technique of chevron osteotomy in our study. Wang *et al.* recommend routine anterior subcutaneous transposition of the ulnar nerve using a posterior approach [12]. We have not found it necessary to perform a routine anterior transposition and have performed an adequate mobilisation as described by Jupiter *et al.* [10]. Sodergard *et al.* reported a12.5% neural complication following the surgical fixation, 3.1% of the patients had a permanent dysfunction of the ulnar nerve in a series of 96 adult patients at an average follow-up of 6 years [11]. There was two case of ulnar nerve palsy in our series, which recovered by 3weeks. Heterotopic ossification was seen in two cases although much higher rates have been reported in

similar series. We believe that the olecranon osteotomy minimises triceps muscle trauma and combined with early mobilisation reduces this complication.

Conclusion

The general Philosophy behind fracture treatment was well documented by J.N. Wilson in 1982 in his statement "We are here not to replace Natures methods of repair, but only to use intelligence given to us to assist that repair and prevent some of the disabilities which can be the result of nature, if left to its own resources.

elbow injuries leading to intercondylar fractures of the humerus can badly influence the normal functioning of the elbow joint which is indispensible for the activity of the upper limb. The prognosis of the lesions in the lower parts of humerus not only depends on the localization and complexity of the fractures, but also on the accuracy of the clinical and radiological evaluation, the condition of the patient and not least on the skill and ability of the surgeon.

basic tenets for such complex fractures have emerged for successful outcome which include atraumatic soft tissue surgery including meticulous aseptic measures, adequate extensile exposure through olecranon osteotomy approach, anatomical reduction of the fracture fragments including the articular surface, stable internal fixation with the metal implants, and early active mobilization of the joint and the patient. anatomic reconstruction and rigid internal fixation followed by early active mobilization is the key to a satisfactory end results.

It is generally accepted that a posterior surgical approach provides optimal exposure of the intra articular aspect of distal part of humerus and among them olecranon osteotomy gives the best exposure of the articular surface and there by better reduction and internal fixation which in turn gives better stability and good range of motion as compared to other approaches. So it can be considered as the gold standard in intercondylar fracture.

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