

ORIGINAL RESEARCH

Retrospective And Prospective Study Of Functional Outcome Analysis Of Various Treatment Modalities For Intercondylar Humerus Fracture

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ABSTRACT

Aim: To assess functional outcome of various modalities of intercondylar humeral fractures management. **Material and methods:** This study was conducted on 30 patients admitted with inter-condylar fracture humerus in Chhatrapati Shivaji Subharti Hospital affiliated with N.S.C.B. Subharti Medical College of Swami Vivekanand University, Meerut, for over 2 years. **Results:** At 6 month follow up (final outcome), the range of motion was varying from 30 degree to 130 degree where in reconstruction plates it was 30 degree to 130 degree, in locking distal humerus plates it was 100 degree to 130 degree, in tension band wiring it was 70 to 106 degree and in cc screw it was 80 degree to 130 degree and the majority 23 (76.7%) of patients were belongs to >100 degrees, 4 (13.3%) and 3 (10.0%) of patients were belongs to 50-100 degrees and <50 degree. **Conclusion:** Finally, it can be said that reconstruction plates and locking distal humerus plates are an effective treatment for intercondylar humerus fractures, particularly when there are small comminuted distal fragments. However, larger control studies with long-term follow-up will be necessary before recommending it for wider use.

Key words: Intercondylar humerus, Reconstruction plates, locking distal humerus plates, elbow range of motion

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INTRODUCTION

Distal humerus intercondylar fractures are difficult injuries to manage for treating surgeons. These fractures are some of most challenging fractures of lower end of humerus and accounts for 2-6% of all fractures and 30% of elbow fractures. These fractures occur with direct impact with flexed elbow joint or indirect impact with extended elbow joint by impaction of proximal ulna over articular component (capitellum, trochlea) of the distal humerus². The paucity of these fractures and complex anatomy of elbow joint leads to difficult comprehensive management planning. Closed reduction with immobilization or limited fixation has left significant functional impairment and a loss of range of motion³. Good functional results can be attained by proper anatomical reduction, rigid fixation and early mobilization. Due to the intricate anatomy of the elbow joint, surrounding neuro-vascular architecture, and sparse soft tissue envelop, treating fractures is

difficult^{4,5}. The cornerstone of conservative therapy for these fractures prior to the 1970s was transolecranon traction or plaster application, which led to severe stiffness and poor functional results^{6,7}. Now Intercondylar humeral fracture has become more common due to increased incidence of motor vehicle accidents (MVA) in young population. A trivial trauma may cause these injuries in elderly individuals with osteoporotic bones¹. It is necessary to do proper preoperative clinical and radiological evaluation for good intraoperative surgical planning and to avoid postoperative complications like stiffness of joint, arthritis and heterotopic ossification. The joint should be mobilized as early as possible^{8,9}. Only undisplaced fractures are eligible for immobilisation^{2,9}. Joint may get stiff by capsule adhesion, ligament tightness or heterotopic ossifications. It is very challenging to regain normal range of motion (ROM) of joint. To regain pain-free, normal/ pre injury ROM of joint, anatomic restoration of the articular surface and stable

fixation of fracture fragments is necessary for early physiotherapy and rehabilitation¹⁰. For proper fragment reduction and fixation, the fracture needs good surgical exposure.

Open reduction internal fixation (ORIF) with different plates and screws is most frequently used method to manage these fractures¹¹. In cases of different untoward conditions like extensive bone loss at fracture site, advanced osteoporosis or severe comminution of intra-articular fragments (bag of bones), non-surgical approach of management can be adopted⁸, although functional outcome is not satisfactory^{8,11}. The main objective of a ORIF with plates and screws is to provide stable and rigid fixation of fracture for early mobilization of joint.

There are many approaches for elbow joint, but a posterior approach provides good visibility of the articular surface and access to both columns of distal humerus¹². Olecranon osteotomy gives good exposure to the joint but osteotomy site nonunion is a known complication.

Depending on the frequency of comminution and displacement, various surgical implants are used which are Kirschner wires, 1/3rd tubular plates, Reconstruction plates, Dynamic Compression Plates, Locking Compression Plates or Double Tension Band Wiring. Different post-operative complications as Implant failure, non-union, loss of reduction, malunion, elbow stiffness, ulnar nerve neuropathy, and heterotopic ossification are more or less occurs with all approaches and implants.¹⁴

Even after improved treatment guidelines for fixing intercondylar humerus fractures have established the outcome of surgically managing intercondylar fractures with different implants is somehow unclear. According to the outcomes of the more recent series, fixation with two plates at a 90-degree angle to one another or a parallel plate arrangement has emerged as the gold standard against all other methods of fixation are evaluated. The ORIF technique for fractures management enables the surgeon to realign the fracture fragments anatomically and to perform early range-of-motion exercises that may help to regain better elbow functional range of motion after surgery. Recently, the site and position of locking plate to fix at and around fracture site has been discussed, with the majority of authors are in favour of using at least two plates to offer appropriate stability and enable adequate restoration of anatomy^{15,16,17,18}.

After intercondylar fractures management, the elbows function depends on a large extent on its extent of normal anatomical reconstruction. The one of worst post operative consequence/complication is arthritis of elbow joint, which is poorly tolerated because of lack of compensatory movements in the nearby joints. Uncertain factors, including fracture complexity and patient characteristics, may determine the most effective course of treatment for these fractures. In this study, we assessed how well various surgical or non-surgical methods for treating intercondylar

humeral fractures affected the elbow's functional outcomes.

MATERIAL AND METHODS

This study was conducted on 30 patients admitted with fracture inter-condylar humerus in Chhatrapati Shivaji Subharti Hospital affiliated with N.S.C.B. Subharti Medical College of Swami Vivekanand University, Meerut.

PREOPERATIVE EVALUATION

All Patients were evaluated with preoperative history, clinical examination and plain radiographs. Patients were classified according to The Riseborough and Radin classification. Comprehensive laboratory examinations was done before surgery. Proper verbal and written consent of patient or family members was acquired prior to the procedure. Antibiotics and tetanus toxoid was given before surgery, Part preparation was done a day before the surgery. All of the implants and instruments planned to be used in surgery were verified and sterilised in advance. The choice of implant was influenced by the type of fracture, compounding, degree of comminution, patient affordability, and the time interval between the injury and surgery.

OPERATIVE TECHNIQUE

All Patients were operated under regional anaesthesia with sedation and under prophylactic antibiotics cover. Patient position was lateral with operating limb above and arm supported on post with elbow flexed and forearm hanging.

The distal humeral epiphysis is only partially exposed when the medial technique is used¹⁹⁻²¹. It necessitates ulnar nerve neurolysis and exposes the anterior portion of the distal quarter of the humerus. The medial epicondyle was able to approach and plateshaped to match the outlines of the distal humerus by dividing the longitudinal fibres coming from it. The term "technique" refers to the vascular surgical method²¹. With an elbow epiphysis fracture, the lateral approach was employed the most^{19,20}. It expands longitudinally after beginning centrally over the lateral epicondyle's tip, exposing the lateral epicondyle, the front and back of the distal humerus, and the muscles on the lateral epicondyle. The proximal attachment of the muscles coming from the lateral epicondyle must not be damaged while treating a distal humerus fracture, and the joint incision is made on either side of these structures. The only method that enables simultaneous visualisation of both columns of the distal humerus with a single incision is the posterior approach. With the olecranon bulge in the middle and the posterior crest of the ulna below, a vertical skin incision is made over the superior midline of the triceps shape. To find and release the ulnar nerve (neurolysis). The triceps muscle can be moved medially or laterally to view either column. Various methods could be utilised at

this point of exposure to enhance your ability to see the epiphysis. The extensor mechanism must be sliced and mirrored to provide the 18 clearest image of the joint . Then the posterior approach is paired with an olecranon osteotomy that is transarticular or extra-articular, the terminal tendon being severed, or the triceps being cut at the muscle-tendon joint (TRAP technique).



Figure 1: Type 4 intercondylar fracture humerus right side, pre op, post op xrays and clinical photos showing range motion at 12 weeks follow up

FOLLOW UP PROTOCOL

All patients were regularly followed up in 6weeks, 12 weeks and 6 month(s) and then annually after the operation thereafter.

RESULTS

At every follow up, clinico-radiological assessment with functional outcomes were evaluated. Clinically, range of motion and myo elbow performance score was calculated .The follow up ranged from 3weeks -6 months.



Fig 2: Riseborough and Radin grading: type 3 intercondylar fracture humerus right side , pre op , post op xrays and clinical photos showing range motion at 12 weeks follow up.

DISCUSSION

In the present study we studied a total of 30 patients with mean age 34.6±11.2 years with majority of the cases in the age range less than equals to 30 years (50.0%) followed by 31-40 years (23.3%). The males were in predominance (76.7%) than females (23.3%). Right side was affected in majority of cases (70.0%). Our findings were in accordance with the findings of Reddy PVVSN and Kumar LP²²who reported that the orthopaedic department treated 20 cases of intercondylar humerus fractures throughout the course of the last two years, from July 2015 to September 2017 and males (75.0%) sustained more number of fractures than females, as general trauma is more common in males when compared to females and the male/female ratio 15:5 of the 20 cases taken in study and the age range from 18 to 30 years was the most prevalent (50.0%) with average age 33.6 years with least age of 21 years and highest age of 58 years. and 60.0% of the studied cases right side was affected. The study is comparable to the study by Henley MB¹⁵ and in Wang KC et al²³ which showed 60.0% males and 40.0% females. According to Sunil B et al²⁴average age of patients in our study was 37.5 years which was comparable with other studies 36 years by Mishra A et al²⁵, 37.5 years by Singh V et al²⁶, and 38.4 by Gupta RK²⁷ et al years. Sunil B et al²⁴ found male population affected more in their study, i.e., the active working population. Which was consistence with otherstudies like 66.7% by Atalar AC et al²⁸ and 60.0% by LakheyS et al¹⁴. Sata VR Agarwal A²⁹ has reported that the mean age of the patient was 35.0±2 years, 60.0% cases were males and 40.0% cases were females. Right sided involvement was more frequent in the present study 52.0% cases.

	Range of Motion	>100 degrees	50-100 degrees	<50 degrees
At 6 weeks	Reconstruction Plates	7	6	5
	Locking Distal Humerus Plates	5	2	0
	Tension band wiring	1	0	1
	Cc Screws	0	1	2
At 12 weeks	Reconstruction Plates	10	4	4
	Locking Distal Humerus Plates	6	1	0
	Tension band wiring	1	1	0

At 6 months	Cc Screws	0	1	2
	Reconstruction Plates	14	2	2
	Locking Distal Humerus Plates	7	0	0
	Tension band wiring	1	1	0
	Cc Screws	1	2	0

Table 1: Distribution of studied patients based on follow up and range of motion

In our study we observed the etiology of the admitted cases and it was observed that majority of the cases were due to road traffic accidents (83.3%) followed by fall from height (16.7%). Our findings were comparable to the findings of Reddy PVVSN and Kumar LP²² who stated that high velocity RTAs were the primary cause of the majority of fractures, accounting for roughly 80.0% of cases, while 20.0% of cases were caused by direct falls, which was equivalent to Henley MB¹⁵ study's finding that 61.0%

of cases were caused by RTA and 39.0% by direct falls. Road traffic accidents were the mode of injury in our investigation, according to Sunil B et al²⁴, in contrast to previous studies that involved falls, such as those by Li SH et al³⁰ and Muzaffar N et al³¹. The results of Sata VR Agarwal A²⁹ also differ from our study who reported that (24.0%) cases sustained fracture because of RTA, (76.0%) cases had domestic fall.

Implant Used	Excellent	Good	Fair	Poor
Reconstruction Plates	10	6	1	1
Locking Distal Humerus Plates	-	4	3	-
Tension band wiring	-	-	1	1
Cc Screws	1	2	-	-

Table 2: Distribution of studied patients based on association between implant used and NAYO elbow performance score

In present study Riseborough&Radin classification was used to classify the fracture and we found that the majority of the fractures were of type III (50.0%) followed by type II (26.7%), type IV (13.3%) and type I (10.0%). A systemic review by Chen H et al³² has stated that out of 30 included studies, olecranon osteotomy was n=7 and triceps sparing was n=5 were the most frequently assessed treatment options for distal humerus intercondylar fracture. The Orthopedic Trauma Association (i.e., OTA) (n=1), AO (n=18), Muller (n=5), Riseborough and Radin (n=2), AO/ASIF (n=1), and Gustillo and Anderson (n=1) criteria were among the many that were used to analyse fractures Sata VR Agarwal A²⁹ in their study on functional outcome in Supracondylar Intercondylar Fracture of Humerus in Adults reported that of several classification systems for intra-articular both column fractures of distal humerus have been pro-posed. The Riseborough&Radin classification gives information about displacement & severity of the fracture. Singh V et al²⁶ similarly classified inter-condylar humerus fractures treated with locking compression plates in their study, noting that of a total of 27 instances, there were 2 cases of type I, 8 cases of type II, 14 cases of type III, and 3 cases of type IV fracture according to Riseborough&Radin classification.

In this study the mode of management of the fracture was reconstruction plates 18 (60.0%) in majority cases followed by Locking Distal Humerus Plates 7 (23.3%), Tension band wiring 2 (6.7%) and Cc screws in 3 (10.0%) patients. Our findings were consistent with the findings of Reddy PVVSN and Kumar LP²² who reported that internal fixation with recon plating or locking distal humerus plating (25.0%), cc screw fixation (5.0%), external fixation (5.0%), or K wires

(5.0%) was used to treat all patients. Sata VR Agarwal A²⁹ stated that 25 cases of supracondylar humerus fractures with intercondylar extension were treated by open reduction and internal fixation with dual plating (3.5 mm reconstruction plate and 1/3rd tubular plate) with k wires.

In our study the cases were classified on the basis of range of motion and it was observed that at 6 weeks, the range of motion was varying from 30 degree to 105 degree where in reconstruction plates it was 30 degree to 105 degree, in locking distal humerus plates it was 75 degree to 100 degree, in tension band wiring it was 45-102 degree and in cc screw it was 35 degree to 75 degree; the majority 13 (43.3%) of patients were belongs to >100 degree, 9 (30.0%) and 8 (26.7%) of patients were belongs to 50-100 degrees and <50 degrees respectively. At 12 weeks, the range of motion was varying from 30 degree to 110 degree where in reconstruction plates it was 30 degree to 110 degree, in locking distal humerus plates it was 98 degree to 105 degree, in tension band wiring it was 65 degree to 104 degree and in cc screw it was 45 degree to 98 degree; majority 17 (56.7%) of patients were belongs to >100 degree, 7 (23.7%) and 6 (20.0%) of patients were belongs to 50-100 degrees and <50 degrees respectively. At 6 month follow up (final outcome), the range of motion was varying from 30 degree to 130 degree where in reconstruction plates it was 30 degree to 130 degree, in locking distal humerus plates it was 100 degree to 130 degree, in tension band wiring it was 70 to 106 degree and in cc screw it was 80 degree to 130 degree and the majority 23 (76.7%) of patients were belongs to >100 degrees, 4 (13.3%) and 3 (10.0%) of patients were belongs to 50-

100degrees and <50 degrees respectively. Our findings were similar to the findings of Senthilnathan A et al³³ who reported that 85.0% cases were having more than 100 degrees motion followed by 50-100 degrees (10.0%) and 5.0% with less than 50 degrees of range of motion in their final outcome. The resultant mean ROM was 116 degrees at the final follow up, which nearly identical with the study by Mang I et al³⁴ in 2014 where they achieved mean elbow ROM of 110. Reddy PVVSN and Kumar LP²² reported that 93.3% have archived more than 90 degrees of range of motion.

In the present study there were no complications in 76.7% cases whereas 6.7% were having deep infection and 6.7% have joint stiffness, superficial infection, Secondary osteoarthritis and Neurovascular Complication was in one case each. SenthilnathanA et al³⁴ reported no complications in 75.0% cases and elbow stiffness in 15.0% whereas superficial infection, ulnar neuropraxia and metal prominence in 5.0% each. Mishra A et al²⁵ in their study complication rate was 15.0% with 10.0% cases of transient ulnar neuropraxia and 5.0% case of superficial infection. Muzaffar N et al³¹ in their study encountered 16.0% cases of superficial infection; 4.0% case of Ulnar neuropraxia 8.0% had metal prominence (olecranon K-wires). Mang I et al³⁴ in their study encountered 4.0% case of elbow stiffness, 4.0% case of Ulnar neuropraxia which recovered spontaneously. According to Singh V et al²⁶ Of the 27 patients, 21 experienced no problems. Three incidences of infection occurred, with two cases having superficial infection and one case having deep infection. One patient experienced malunion, one case of post-operative heterotopic ossification, and one case of ulnar neuropathy. Reddy PVVSN and Kumar LP²² also reported similar results.

We observed the performance score by using Mayo elbow score postoperatively and it was found that 36.7% cases have excellent score followed by good score (40.0%), fair (16.7%) and poor in 6.7% cases at end of the follow ups. Our findings were in accordance to the findings of Reddy PVVSN and Kumar LP²² who reported 50.0% excellent cases followed by good (25.0%), fair (15.0%) and 10.0% poor. Therefore, good and excellent outcomes were found in 75% of cases, which is comparable to other studies like Gupta R's³⁵ study of 20 cases of intercondylar fractures of the humerus treated with an open reduction, internal fixation, and early mobilisation, which had good and excellent outcomes in 75% of cases. Another study by Allende CA et al³⁶. with 40 surgically treated cases and similar inclusion criteria similarly produced equivalent findings, with satisfactory and outstanding outcomes in 85.0% of cases. One of the two patients in their study who performed poorly had an open fracture (grade II), and the repair was accomplished using external fixation. Sunil B²⁴ reported that 83.0% of patients had excellent and good scores in mayo elbow grading. We had 2 patients with poor score i.e.,

less has 59. Average mayo elbow grading score in their study was 83.83±13.98. These results were different when compared to Singh V et al²⁶ where excellent and good were 62.9%, fair (26.0%), and poor (11.1%). The results were same and consistent with Mishra A et al²⁵, Jung SW et al¹¹ with excellent and good 90.0% and 81.6%, fair (5.0%, 13.2%) and poor (5.0%, 5.3.0%) respectively.

A number of parameters, including intra-articular involvement, fracture type, bone quality, fragment displacement, soft-tissue quality, joint stability, and coverage, were taken into consideration while deciding whether to perform surgery for humerus fractures. Individual characteristics such as patient age, compliance, general health status, and functional extremity requirements were also taken into account. Prior to surgery, patients should be aware of expected results and the value of rehabilitation. The operative intervention's main objectives were to stabilise the elbow and re-establish articular congruity. The risk of post-traumatic arthritis and elbow stiffness was another objective. Studies confirmed the idea that open anatomic reduction, stable fixation to allow for early anatomic restoration, and upper-extremity range of motion were the bestways to treat humerus fractures in adults.. Despite the risks associated with surgical intervention, risk can be reduced by carefully managing the anatomic reduction, the soft tissue management and preservation, early mobilisation, and stable fixation. Operative treatment for articular fractures and unstable non-articular fractures that allows for direct imaging of the joint surface as well as anatomic reduction and stabilisation could stop the development of more severe arthritis caused by articular incongruity.

CONCLUSION

Anatomical reduction and rigid internal fixation are crucial in the surgical treatment of intercondylar fractures of the distal humerus, coupled with precisely recreating the articular surface. For a favourable functional outcome, early post-operative mobilisation through active aided exercises and physiotherapy is essential. Poor fixation necessitates lengthy post-operative immobilisation, which always results in subpar functional outcomes. Careful pre-operative evaluation and planning and early operative intervention with distal humerus plates for anatomical reduction and stable fixation, followed by early mobilization is must. Early mobilisation reduces elbow stiffness and yields positive functional results , The findings of the current study are comparable to those of other series, demonstrating that although the techniques of tension band wiring, ccs screw fixation, and external fixation are technically simpler, more practical, and economical to use, they also require fewer implants that are simple to place and reduce the amount of time under tourniquet but due to the need of application of slab post operatively early mobilization is not possible which leads to stiffness

and decrease in functional outcome so these are not as good as reconstruction plates and Locking Distal Humerus Plates which do not require application of slab post operatively and provides stable-enough fixation and helps in restoration of normal anatomy for good result and early rehabilitation. , Therefore, it can be said that reconstruction plates and locking distal humerus plates are an effective treatment for intercondylar humerus fractures, particularly when there are small comminuted distal fragments. However, larger control studies with long-term follow-up will be necessary before recommending it for wider use.

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