Original Article

Functional Outcomes of Open Reduction and Internal Fixation of T- Y Condylar Fractures of Distal Humerus by Reconstruction Plate in Lateral Column and Tension Band Wiring in Medial Column Through Extrarticular Olecranon Osteotomy

DOI: dx.doi.org

Md Shahinul Islam[1*], Kazi Mizanur Rahman[2], Md Iqbal Qavi[3]

Received: 03 July 2024
Accepted: 15 August 2024
Published: 25 August 2024

Published by:
Sheikh Sayera Khatun Medical College (SSKMC), Gopalganj, Bangladesh

*Corresponding Author

ABSTRACT

Introduction: *Fractures of the distal humerus in adults are intricate and challenging to manage. Surgical intervention is typically necessary and often complicated by difficult access. This study sought to evaluate the functional results of open reduction and internal fixation for T-Y condylar fractures of the distal humerus in adults.* ***Methods & Materials:*** *This observational study was carried out at the National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Sher-e-Bangla Nagar, Dhaka, from January 2011 to December 2012. Patients suffering from recent T-Y condylar fracture of the distal humerus were selected for the study with definite inclusion and exclusion criteria. Purposive sampling was adopted to select a total of 18 patients. Collected data were analyzed using the software SPSS (Statistical Package for Social Sciences) version 16.0 for Windows. Descriptive statistics were used to analyze the data.* ***Results:*** *The study included 18 patients with a mean age of 34 years. Most injuries were due to motor vehicle accidents, with more cases on the left side. Post-surgery, 78% of patients could comb hair, 62% could feed themselves, and 89% could wear a lungi/sharee. According to the Mayo Elbow Performance Scores, 44% had excellent*

(The Insight 2023; 6(2): 141-147)

1. *Junior Consultant, Department of Orthopaedic Surgery, Shaheed Syed Nazrul Islam Medical College Hospital, Kishoregonj, Bangladesh*
2. *Assistant Professor, Department of Orthopaedic Surgery, Shaheed Syed Nazrul Islam Medical College Hospital, Kishoregonj, Bangladesh*
3. *Professor & Director, National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Dhaka, Bangladesh*

results, 33% good, 17% fair, and 6% poor. Overall, 78% had satisfactory outcomes at final follow-up. ***Conclusion:*** *This study concludes that the treatment of T-Y condylar fracture of the distal end of the humerus in adults with open reduction and rigid internal fixation by reconstruction plate in lateral column and tension band wiring in medial column provide adequate stability to allow for the early start of postoperative functional rehabilitation therefor better functional outcome.*

Keywords: *T-Y condylar fractures, Distal humerus, Open reduction, Internal fixation, Functional outcome*

INTRODUCTION

Fractures of the distal humerus in adults are intricate and technically challenging to treat. Surgical intervention is typically required and is frequently complicated by challenging exposure[1]. Fractures of the distal humerus represent 0.5% to 7% of all fractures and 30% of elbow fractures. These injuries are challenging to manage due to factors like osteoporotic bone, anatomical complexity, and comminution of both the articular and metaphyseal regions. The fundamental treatment approach for distal humerus fractures aligns with that for other intraarticular fractures: achieving stable anatomical reconstruction of the joint to facilitate early mobilization[2]. Distal humeral fractures commonly occur in younger individuals due to high-energy trauma and in elderly women due to relatively low-energy trauma[3]. Fracture of the adult distal humerus is challenging to treat and carries a relatively high complication rate. The elbow is an unforgiving joint and successful treatment requires stable internal fixation to allow early mobilization[4]. Open reduction and internal fixation (ORIF) continue to be the preferred method for managing intraarticular distal humerus fractures in physiologically active patients[5]. Conventional surgical methods are employed for the fixation of both columns, utilizing a combination of reconstruction plates, locking compression plates, screws, and K-wires. In rare situations, total elbow arthroplasty (TEA) may be considered. Controversy continues to surround the management of intraarticular distal humerus fractures in adults, particularly regarding the surgical approach, the type of olecranon osteotomy, the method of stabilizing the osteotomy, the fracture stabilization technique, the choice between orthogonal or parallel plate fixation, the necessity for ulnar nerve transposition, the role of primary total elbow arthroplasty (TEA), and the optimal rehabilitation protocol post-surgery[6]. Olecranon osteotomy for the exposure and fixation of distal humeral fractures was first popularized by Cassebaum Henley. They reported a 57% complication rate with transverse osteotomy, including issues such as symptomatic prominence of the K-wire, broken tension band wire, delayed union, and non-union. In 1982, Heim introduced the chevron osteotomy, with the apex of the "V" oriented distally. Extrarticular olecranon osteotomy is regularly recommended, as endorsed by Muller[7]. Wilkinson and Stanley demonstrated in a cadaver model that the median exposed articular surface for the triceps splitting, triceps reflecting, and olecranon osteotomy approaches was 35%, 46%, and 57%, respectively[5]. The reconstruction plate possesses several distinctive features that make it ideal for addressing the complex anatomy of the distal humerus. One key characteristic is the presence of notches along its sides, which allow for three-

dimensional bending. Secondly, its holes accommodate 4.0 mm cancellous bone screws when the plate is positioned over cancellous bone. Thirdly, screws can be inserted at an angle of about 25 degrees longitudinally and 7 degrees laterally to ensure optimal engagement with bony pillars, whether the plates are contoured or non-contoured[8]. This study aimed to evaluate the functional outcomes of open reduction and internal fixation in the treatment of T-Y condylar fractures of the distal humerus in adults.

METHODS & MATERIALS

This observational study was conducted at the National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Sher-e-Bangla Nagar, Dhaka, from January 2011 to December 2012. Patients suffering from recent T-Y condylar fracture of the distal humerus were selected for the study with definite inclusion and exclusion criteria. Purposive sampling was adopted to select a total of 18 patients. Inclusion criteria: fractures within 2 weeks of injury, Riseborough and Radin (1996) type II (separation of the capitulum and trochlea without appreciable rotation of the fragments in the frontal line) and type III (separation of the fragments with rotator deformity), adult patients between the age of 18-50 years with T-Y condylar fracture of the distal humerus and patients of both sexes. Exclusion criteria: fractures more than 2 weeks old, children's fracture (age less than 18 years), open fractures, fracture, (Riseborough and Radin (1996) type-I (undisplaced fracture) and type-IV (displacement, rotation, and comminution). A complete history of the selected case was taken with particular emphasis on the time and mechanism of injury, past treatment, and an assessment to rule out any co-existing disease. This was followed by a thorough general and physical examination to exclude any associated injuries. All patients underwent radiological and laboratory investigations preoperative preparations and postoperative. Collected data were analyzed using the software SPSS (Statistical Package for Social Sciences) version 16.0 for Windows. Descriptive statistics were used to analyze the data. Analyzed data were presented in the form of tables with appropriate interpretations. The outcome evaluation at the end of five to eight months was done following the Mayo Elbow Performance Score (MEPS). The first and second follow-ups are at 2 2-week intervals then at 4 weeks intervals till the fracture union was achieved. Ethical clearance was obtained from the authority before the commencement of the study.

RESULTS

Out of 18 patients 7 (38.89 %) were 18 to 30 years of age, 7 (38.89 %) were 31 to 40 years, and 4 (22.22%) were 41 to 50 years old. The Mean age of the patients was 34 years and the youngest and oldest patients were 18 years and 50 years respectively. The mean age was 34± SD. 8(44.44%) of the patients were male and 10(55.56%) were female. Maximum patients were housewife 7(38.89%), however a significant number of patients were business 6(33.33%), service holder 4(22.22%), student 1(5.56%). The majority 9(50.00%) of the injuries were caused by motor vehicle accidents, 7(38.89%) were due to falls, and the rest 2(11.11%) injuries were due to fall from height. Among the 18 patients 12(66.67%) presented with left sited fracture and 6(33.33%) were presented with right sited fracture. In this study, 11(61.11)

cases were operated on within 1 week of occurrence of fracture while the rest 7(38.89%) of cases were operated on after 1 week. The mean interval between injury and operation was 8 days, where minimum and maximum intervals were 4 days and 14 days respectively. The mean time interval was 7.83 and SD was ± 3.46 **[Table I].**

Table I: Basic characteristics of the patients (*n*=18)

Age in years	***n***	**%**
18-30	07	38.89
31-40	07	38.89
41-50	07	22.22
Mean± SD	34±9.7	
Range	18 years to 50 years	
Sex		
Male	08	44.44
Female	10	55.56
Occupation		
Housewife	07	38.89
Businessman	06	33.33
Service holder	04	22.22
Student	01	5.56
Mechanism of injury		
Motor vehicle accident	09	50.00
Fall	07	38.89
Fall from height	02	11.11
Site of involvement		
Right	06	33.33
Left	12	66.67
The time interval between injury and operation		
<1 week	11	61.11
> 1 Week	07	38.89
Mean ± SD	7.83 ± 3.46	

On the final follow-up, 14(77.78%) patients had no limitation of performing comb hair the rest 4(22.22%) had difficulty in performing comb hair, 11(61.67%) of the patients had no limitation of feed himself or herself and the rest 7(38.89%) of the patients cannot feed himself or herself, 83.33% of the patients can maintain personal hygiene him or herself and 16.67% cannot maintain, 12(66.67%) of the patients had no limitation of wear Shirt Blouse and 6 (33.33%) of the patients had a limitation, 88.89% of the patients can wear Lungi/Sharee and 11.11% of the patients cannot **[Table II].**

Table II: Distribution of patients according to activities of daily living (*n*=18)

Performance status	***n***	**%**
Comb hair		
Can do	14	77.78
Cannot do	4	22.22
Feed		
Can do	11	61.67
Cannot do	07	38.89
Personal hygiene		
Can perform	5	83.33
Cannot perform	3	16.67
Wearing Shirt/Blouse		
Can do	12	66.67
Cannot do	06	33.33
Wearing Lungi/Sharee		
Can do	16	88.89
Cannot do	02	11.11

The outcome of the patient was graded according to the Mayo Elbow Performance Score; criteria as Excellent 8(44.44%) patients, good 6(33.33%), fair 3(16.67%), and Poor 1(5.56%) patients **[Table III]**.

Table III: Distribution of the patients according to the Mayo Elbow Performance Scores (*n*=18)

Grading	*n*	%
Excellent (>90)	8	44.44
Good (75 to 89)	6	33.33
Fair (60 to 74)	3	16.67
Poor (<60)	1	5.56
Total	18	100

Finally, satisfactory result was found 14 (77.78%) & unsatisfactory were 4 (22.22%) **[Table IV].**

Table IV: Evaluation of outcome at final follow-up (*n*=18)

Outcome	*n*	%
Satisfactory	14	77.78
Unsatisfactory	4	22.22
Total	18	100

DISCUSSION

The treatment of distal humerus fractures focuses on achieving a stable, painless elbow with satisfactory function. This necessitates the anatomical reconstruction of the articular surface, restoration of the distal humerus's overall geometry, and stable fixation of the fracture fragments to enable early and complete rehabilitation. While these objectives are widely endorsed by the orthopedic community, they can be technically challenging, particularly in cases with significant osteoporosis or comminution[9]. This prospective study was carried out to evaluate the functional outcome of open reduction and internal fixation of T-Y condylar fractures of distal humerus in adults by reconstruction plate in lateral column and tension band wiring in medial column through extrarticular transolecranon approach within 3 weeks of incidence were enrolled in this study, who were admitted in National Institute Of Traumatology And Orthopaedic Rehabilitation (NITOR) over 2 years from January 2011 to December 2012. In this study, patients are assessed according to the Mayo Elbow Performance score to evaluate the overall functional result, which is based on the belief that it is important for the specific functional index used in clinical practice that represents all functions of the elbow joint as accurately as possible[8]. The result of the current study demonstrates that the mean age of the patients included in the study was 34 years SD was ± 9.7 and the youngest and the oldest patients were 18 years and 50 years respectively. In this present series, it was observed that the majority 10(55.66%) of the patients were female whereas 8(44.44%) of the patients were male. In the current study, it was observed that 9(50.00%) of injuries were caused by MVA, 7(38.89%) due to fall, and 2(11.11%) due to fall from height. Vinit Gupta et al., reported that RTA was the commonest mode of injury 18(70%) and the next common mode was fall 8(30%)[10]. In this study, it was observed that 7(38.89%) of the patients were housewives, and 6(33.33%) were businessmen. In the present series, the left side was more 12(66.67%) affected than the right side 6(33.33%). Regarding the time interval between injury and operation, it was observed in this study most 11(61.11%) of the patients were operated on within 1 week of injury and the rest 7(38.89%) were operated on between 1 to 2 weeks and mean ± SD was 7.83 ± 3.46. In the current study, patients were assessed by using the joint-specific Mayo Elbow Performance Index (MEPI), which measures motion, pain, stability, and func-

tion. In this study, 8(44.44%) were excellent, 6 (33.33%) were good, 3 (16.67%) were fair and 1(5.56%) was poor results. Vinit Gupta et al., reported that based on Jupiter et al system 20(77%) had excellent to good results and 6(23%) had fair to poor results[10]. At a mean follow-up of 6.78 months 14(77.78%) of patients were excellent to good and 4(22.22%) patients were fair according to MEPI which closely resembled the current study.

In the present study, it was observed that satisfactory result was found in 77.78% and unsatisfactory results were 22.22%. In a series of 26 patients Nadim Aslam & Willett Keith, reported that 70% had a satisfactory result and 33% had unsatisfactory results[7].

Limitations of the Study

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community.

Conclusion:

This study concludes that managing T-Y condylar fractures at the distal end of the humerus in adults with open reduction and rigid internal fixation—using a reconstruction plate for the lateral column and tension band wiring for the medial column—provides sufficient stability. This approach facilitates early postoperative functional rehabilitation, resulting in improved functional outcomes.

Recommendation:

The study recommends early surgical intervention for T-Y condylar fractures of the distal humerus in adults, ideally within the first two weeks post-injury, to achieve optimal outcomes. The preferred surgical technique involves using a reconstruction plate in the lateral column and tension band wiring in the medial column through an extra-articular trans olecranon approach, providing sufficient stability for early rehabilitation. Postoperative rehabilitation should begin early to enhance functional recovery. Functional outcomes should be evaluated using the Mayo Elbow Performance Index (MEPI), focusing on motion, pain, stability, and function.

Funding: No funding sources

Conflict of interest: None declared

REFERENCES

1. *Nauth A, McKee MD, Ristevski B, Hall J, Schemitsch EH. Distal humeral fractures in adults. JBJS. 2011 Apr 6;93(7):686-700.*
2. *Galano GJ, Ahmad CS, Levine WN. Current treatment strategies for bicolumnar distal humerus fractures. JAAOS-Journal of the American Academy of Orthopaedic Surgeons. 2010 Jan 1;18(1):20-30.*
3. *Babhulkar S, Babhulkar S. Controversies in the management of intra-articular fractures of distal humerus in adults. Indian journal of orthopaedics. 2011 Jun;45(3):216-25.*
4. *Arnander MW, Reeves A, MacLeod IA, Pinto TM, Khaleel A. A biomechanical comparison of plate configuration in distal humerus fractures. Journal of orthopaedic trauma. 2008 May 1;22(5):332-6.*
5. *Coles CP, Barei DP, Nork SE, Taitsman LA, Hanel DP, Henley MB. The olecranon osteotomy: a six-year experience in the treatment of intraarticular fractures of the distal humerus. Journal of orthopaedic trauma. 2006 Mar 1;20(3):163-70.*
6. *Gupta R. Intercondylar fractures of the distal humerus in adults. Injury. 1996 Oct 1;27(8):569-72.*
7. *Aslam N, Willett K. Functional outcome following internal fixation of intraarticular fractures of the distal humerus (AO type C). Acta orthopaedica belgica. 2004 Apr 1;70(2):118-22.*

8. *Huang TL, Chiu FY, Chuang TY, Chen TH. Surgical treatment of acute displaced fractures of adult distal humerus with reconstruction plate. Injury. 2004 Nov 1;35(11):1143-8.*
9. *Liu JJ, Ruan HJ, Wang JG, Fan CY, Zeng BF. Double-column fixation for type C fractures of the distal humerus in the elderly. Journal of shoulder and elbow surgery. 2009 Jul 1;18(4):646-51.*
10. *Gupta V, Kalsutra N, Gupta RK, Motten TS, Kamal Y. Operative management of intercondylar fracture of the distal end humerus in adults. J Bone Joint Surg Am. 2010;17:5580/4c6.*