OPEN ACCESS

ORIGINAL ARTICLE

Evaluation of Distal Humerus Intercondylar Fractures Using Mayo Elbow Performance Score Following Elbow Reconstruction with Two Plates in Inverted Y Configuration

Muhammad Inam[1], Ubaidullah Khan[2]

[1]Department of Orthopaedics Surgery, Medical Teaching Institute, Lady Reading Hospital Peshawar; [2]Department of Orthopaedics Surgery, Maqsood Medical Center Ring Road Peshawar

ABSTRACT

Objective: Distal humerus fractures are common in elbow injuries. The objective of this study was to evaluate the clinical result following elbow reconstruction for distal humeral intercondylar fractures utilizing two plates applied in an inverted Y configuration using the Mayo Elbow Performance Score (MEPS)

Methodology: This descriptive case series was conducted from June 2019 to July 2023 in the department of Orthopedics at Akbar Medical Center, Peshawar and Maqsood Medical Center Peshawar. Patients were chosen using a non-probability, sequential sampling procedure. The study included all patients between the age of 20 and 50 years with distal humeral intercondylar fractures, regardless of gender, and whose fractures lasted less than a week. Data was analyzed using SPSS version 20.

Results: Out of 88 patients 53 (60.23%) were males and 35 (39.22%) females. The mean fracture duration was 4.19 ± 1.44 days. The clinical prognosis was excellent in 27 cases (30.68%), good in 37 cases (42.05%), fair in 16 cases (18.18%), and bad in 8 cases (9.09%) following elbow reconstruction utilizing two plates in an inverted Y configuration for distal humeral intercondylar fracture based on the MEPS.

Conclusion: A considerable percentage of patients had a satisfactory clinical outcome following elbow reconstruction with two plates arranged in an inverted Y configuration for distal humeral intercondylar fractures

Keywords: Elbow, Fracture, Humerus, Performance Score, Supracondylar

Authors' Contribution:
[1]Conception; Literature research; manuscript design and drafting; [1]Critical analysis and manuscript review; [1,2]Data analysis; Manuscript Editing.

Correspondence:
Muhammad Inam
Email: dr_mohammadinam@yahoo.co.uk

Article info:
Received: September 23, 2023
Accepted: January 20, 2025

Cite this article. Inam M, Khan U. Clinical Results for the Evaluation of Distal Humerus Intercondylar Fractures Using Mayo Elbow Performance Score Following Elbow Reconstruction with Two Plates in Inverted Y Configuration. J Islamabad Med Dental Coll. 2025; 14(1). 3-9.
DOI: https://10.35787/jimdc.v14i1.1041

Funding Source: Nil
Conflict of interest: Nil

Introduction

Distal humerus fractures are more prevalent in elbow injuries, making up to 30% of all elbow fractures, yet they are still quite uncommon, making up just 0.5 to 2% of all fractures. Both the inner and outer columns of the humerus bone are affected by these fractures, which usually happen within the joint in adults. Distal humerus fractures frequently follow a pattern with two distinct peaks in terms of age distribution.[1] Elderly patients are more likely to sustain low-energy injuries, whereas younger patients are more likely to sustain high-energy injuries.[2] Treating fractures in the distal humerus requires a thorough understanding of its anatomy. The distal humerus' articular surface is upheld by two separate bone pillars, one situated on the inner and second on the outer side, forming a configuration reminiscent of an inverted -Y shape.[3]

There are several categorization systems for distal humerus fractures, and they are mostly based on elements such as the involvement of the lateral and medial humeral columns and the existence of certain fracture patterns in the coronal or sagittal planes. Riseborough and Radin's categorization, for instance, aims to group these fractures based on the state of the condylar pieces.[4.] A categorization system was developed which divides distal humeral fractures into four categories: comminuted fractures, supracondylar fractures, extra-articular condylar fractures, and articular intercondylar fractures.[5] After examining fractures during surgery, Jupiter created his own categorization system, which included high T, low T, Y, H, medial, and lateral lambda fractures.

There is another categorization system, on the other hand, which distinguishes between fractures that impact the trochlea or the capitellum and offers distinct therapeutic approaches for each kind.[6] Extra-articular, partially articular, and articular fractures are the three main types into which fractures are usually divided. The most widely used categorization scheme for fractures globally is the AO classification.[7]

When it comes to treating distal humerus fractures, surgery is thought to be the best course of action, with conservative measures playing a minor part.[8] Only when treating fractures that haven't moved from their original position, for patients who aren't considered surgical candidates, or as a stopgap for elderly patients prior to arthroplasty in order to avoid joint stiffness and abnormal bone growth, non-surgical treatment seem like a feasible option. [9]

A tried-and-true method of therapy with positive clinical outcomes is the use of two plates for open reduction with internal fixation to accomplish bi-columnar stability.[10] In practice, there are several methods for placing plates. Y-shaped, parallel, and perpendicular plating are all included in the widely used dual plating technique. In Y plating, two plates are positioned below the medial and lateral supracondylar ridges in the coronal plane.[11–13]

The MEPS was used in a study to evaluate the clinical results after elbow reconstruction for distal humeral intercondylar fractures utilizing two plates positioned in an inverted Y configuration. According to the findings, 10% of patients had bad outcomes, 25% had fair outcomes, 50% had good outcomes, and 20% had great outcomes.[14]

Perpendicular and parallel plating procedures have been investigated and compared in a number of studies; however, nothing is known about the results of Y-shaped plating using two plates, and no local data was found on the topic. The clinical outcome after elbow reconstruction for distal humeral intercondylar fractures with two plates put in an inverted Y configuration was assessed in this research using the Mayo Elbow Performance Score.

Methodology

This descriptive case series study was carried out by the orthopedic department of Akbar Medical Center and Maqsood Medical Center Peshawar between June 2019 and July 2023. The patients were selected using a non-probability, sequential sampling procedure. The study included all patients with distal humeral intercondylar fractures lasting less than a week, regardless of gender, who were between the ages of 20 and 50. The study excluded patients with congenital joint abnormalities, open fractures, head trauma polytrauma, prior elbow surgery, and any chronic illness, such as chronic liver disease (s/bilirubin >2.0 mg/dl) or chronic renal failure (s/creatinine >1.5 mg/dl). The patients were included to the study after receiving written informed consent.

The trans-olecranon method, which uses two plates inverted Y form, was used to rebuild the elbows of all patients. Age, gender, fracture type, duration, side effects, BMI, diabetes mellitus (DM), and clinical outcome were all recorded using a specially designed Performa. SPSS version 20.0 was used to analyze the data. For age, fracture duration, BMI, and Mayo elbow performance score, the mean and standard deviation were computed. Percentage and Frequency were computed for qualitative variables,

including diabetes mellitus (yes/no), gender, side affected (left/right), fracture type (I/II/III/IV), and clinical outcome (excellent/good/fair/poor).

The **institutional review board** of Akbar Medical Center, Peshawar gave its ethical approval (78-19/MI/IRB/ORTHO dated 15-04-2019) and **institutional ethical review committee (IERC)** of Maqsood Medical Center Peshawar gave its permission (IRB No 1623 dated 1st June, 2023).

Results

The study's participants (n=88) ranged in age from 20 to 50, with a mean age of 37.41 ± 7.19 years with majority between 35-50 (59.09%) years.

Of the 88 Cases, 35 (39.22%) were women and 53 (60.23%) were males, resulting in a male to female ratio of 1.5:1. The mean BMI was 29.03 ± 3.12 kg/m2 with majority having BMI more than 27(65.91%). The mean fracture duration was 4.19 ± 1.44 days (Table I). The majority of the patients (n=46) had their left side affected (52.27%). The distribution of patients by kind of fracture is shown (Table 2). The clinical outcome according to MEPS after elbow reconstruction using inverted two plates Y configuration for a distal humeral intercondylar fracture was excellent in 27 cases (30.68%), good in 37 cases (42.05%), fair in 16 cases (18.18%), and poor in 8 Cases (9.09%) (Figure 1).

Table I: Time Lapsed after fracture (n=88)

Duration (days)	No. of Patients	Percentage
0-3	29	32.95
4-6	59	67.05
Total	88	100.0
Mean ± SD = 4.19 ± 1.44 days		

Table II: Fracture Type (n=88)

Fracture type	No. of Patients	Percentage
I	16	18.18
II	35	39.77
III	30	34.09
IV	07	7.95

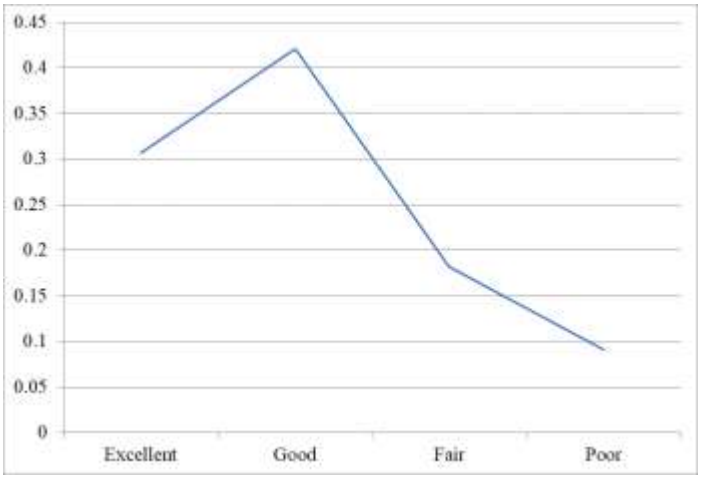

Figure 1: Clinical outcome after elbow reconstruction using two plates in inverted Y configuration for distal humeral intercondylar fracture using mayo elbow performance score (n=88).

Discussion

The distal humerus accounts for 2% of all fractures and around 30% of all adult humeral fractures.[15] These fractures typically have a bimodal distribution, with distinct patterns observed in elderly ladies with osteoporotic fractures and young men with high-energy trauma. They occur at a rate of 5.7 cases per 100,000 persons annually.[16] Because of the aging population and the ongoing trend of increased motorization in emerging nations, it is anticipated that the incidence of distal humerus fractures will increase at a rate similar to that of distal radius, hip, and spine fractures.[17] The triangle-shaped distal humerus is made up of two columns and a "tie arch."[18]

In connection with the previously mentioned bimodal distribution of age 16, two fracture mechanisms can be distinguished: low-energy trauma, which is more common in older patients and can be brought on by direct elbow impact or indirect impact from a fall onto an outstretched hand; and high-energy trauma, which is more common in younger patients and is often triggered by incidents such as traffic accidents or sports-related injuries.[17] Surgery is seen to be the best and most effective

treatment for distal humerus fractures; conservative therapy has a limited role in this regard.[19]

In order to prevent stiffness in the joint and abnormal growth of bone, non-surgical treatment seems to be a good option only for fractures that have not moved from their original position, for patients who are not considered good candidates for surgery, or as a stopgap measure for elderly patients prior to arthroplasty.[20] To facilitate early range-of-motion exercises, encourage appropriate bone healing, and avert future cartilage deterioration, it is imperative to achieve a secure internal fixation and precisely restore the architecture. [21, 22] Using two plates instead of one obviously increases stability and stiffness, according to biomechanical research, particularly in proximal and intra-articular fractures of the distal humerus.[23] Two plates oriented at right angles to one another are used in the traditional fixing technique used by most surgeons.[22]

But according to research done on cadavers, plates oriented perpendicularly or parallel to one another provide comparable degrees of stiffness.[24] In artificial bone models, Zhao et al compared the 90° offset approach with plates positioned dorsally and discovered that the group with plates positioned perpendicularly produced better results.[21] The 180° plate arrangement shows the maximum amount of stiffness when there is a gap between the pieces, followed by the perpendicular configuration and a dorsal arrangement, according to additional biomechanical experiments that differentiated between fracture patterns with or without bone loss. There were no appreciable variations in stiffness across the three fixation arrangements when there was no space between the bone pieces.[25] According to clinical research by Zdero and associates, the perpendicular plating group saw a greater rate of non-union. Comparing the clinical results to the parallel plating group, however, revealed no appreciable variations.[26] In contrast, Li G et al. found no statistically significant differences between the two groups' union time and clinical result.[22]

The extent to which distinct distal humeral fracture patterns can be linked to a particular plating method is yet unknown. For coronal shear fractures, perpendicular plating may be advantageous because it provides more stability in the coronal plane. However, because it enables the possibility of further screw fixation in that area, parallel plating may be the better option for fractures in the extremely distal portion of the humerus.[22] Similar to the current study, a study that used two plates in an inverted Y configuration for elbow reconstruction for distal humeral intercondylar fractures found that the clinical result was outstanding in 20% of patients, good in 50%, fair in 25%, and bad in 10%.[14] According to the MEPS at 6-month follow-up, about 80% of patients showed positive outcomes. The average Quick-DASH score for the group during the 6-month follow-up was about 15.96, with a variation of around ± 9.92. [27] The Mayo Clinic introduced a parallel-plate method based on same principles. This technique involves placing one plate on the lateral supracondylar ridges and another along the medial epicondyle. These sturdy plates on the inner and outer pillars are joined by an arch-like mechanism, and interlocking screws essential to the arch's structural integrity.

Two parallel plates were used as part of a therapeutic strategy for 34 consecutive instances of complicated distal humeral fractures.[28] Twenty-six of these fractures were classified as AO Type C3. According to the study, the average MEPS was 85 points, and the average range of motion in flexion and extension was 99°. In 79.4% of the cases, the findings were deemed satisfactory or exceptional. 16% of patients needed reoperation to treat the presence of heterotopic ossification, and there was one documented case of a deep infection that went away when the hardware was removed.

The above study included several implant types, such as the Mayo Clinic Congruent Elbow Plate, Howmedica's Dupont plate, as well as Synthes' pelvic reconstruction plates and dynamic compression plates (DCP), along with the

participation of various surgeons. Chitnavis S et al [29] found that 37 patients with Type C distal humeral fractures treated with the bicolumnar parallel plating approach had an average elbow flexion-extension range of motion of 97° and an average MEPS of 82 points. Bashir A et al [30] conducted a retrospective analysis of 16 patients who had distal humeral fractures repaired with the parallel plating technique. The mean flexion was 132° and the mean extension was 29°. The grip strength was 56% of the undamaged side, and the mean MEPS score was 72.3.

The strengths of the study were using the MEPS (Mayo Elbow Performance Score) which offers a standardized and validated method to evaluate clinical outcomes, making the results comparable to similar studies. By classifying outcomes as excellent, good, fair, and poor, the study provides a nuanced understanding of the success rate of the surgical method. The investigation into the inverted two-plate Y configuration for a specific type of fracture (distal humeral intercondylar) contributes valuable insights into orthopedic reconstruction techniques.

The weakness of the study was to focus on a specific age range (20–50) and fracture type, so the findings may not be applicable to other age groups or fracture patterns. The male-to-female ratio (1.5:1) could lead to skewed results, as gender-based physiological differences might affect outcomes. A majority of participants have a BMI above 27, which might influence recovery and outcomes, limiting applicability to individuals with lower BMIs. The average fracture duration is narrow (4.19 ± 1.44 days), meaning it doesn't represent cases with longer delays before treatment. While outcomes are categorized, the study doesn't provide deeper insights into why some patients had poor or fair results, limiting its value for improving surgical techniques. Data like the kind of fracture (Table II) and corresponding outcomes are not discussed in detail, leaving gaps in understanding how fracture type influences recovery.

Conclusion

There was a high frequency of favorable clinical results as determined by the MEPS after elbow reconstruction for distal humeral intercondylar fractures using two plates in an inverted Y configuration.

Recommendation: Elbow reconstruction for distal humeral intercondylar fractures be carried out on a regular basis in our general practice using two plates in an inverted Y configuration in order to reduce the morbidity of our population.

References

1. Medvedev G, Wang C, Amdur R, Neviaser R, Neviaser A. Operative distal humerus fractures in older patients: predictors for early complications based on a national database. Hosp Sp Surg J. 2017;13(3):212-6. https://doi.org/10.1007/s11420-017-9547-7
2. Sehrawat S, Bansal H, Sharma V, Farooque K. Sequence of Fixing Fractures Involving all the Three Major Joints of the Upper Limb: A Case Report. Indian J Orthop. 2021 Aug 29;56(3):495-500. https://doi.org/10.1007/s43465-021-00496-1
3. Shu W, Zhao R, Yang Z, Li X, Jiang G, Rai S, et al. Treatment of Pediatric Intercondylar Humerus Fracture with External Fixation and Percutaneous Pinning After Closed Reduction. Front Pediatr. 2022 Jul 11; 10:916604. https://doi.org/10.3389/fped.2022.916604.
4. Fan J, Ji JQ, Zhang X, Guo XW, Yao Y, Zhou JQ, et al. Operative effect and treatment strategies for the low distal humerus fracture. Zhonghua Wai Ke Za Zhi. Chinese. 2020 Mar 1;58(3):213-219. https://doi.org/10.3760/cma.j.issn.0529-5815.2020.03.009.
5. Saini R, Sharma A, Rathore KS, Sidhu SS. Clinical and Functional Outcomes of Anatomical Plating in Distal Humerus Fractures in Adults. Cureus. 2023 Feb 28;15(2):e35581. https://doi.org/10.7759/cureus.35581.
6. Mahapatra S, Abraham VT. Functional Results of Intercondylar Fractures of the Humerus Fixed with Dual Y-Plate; A Technical Note. Bull Emerg Trauma. 2017 Jan;5(1):36-41. PMID: 28246622; PMCID: PMC5316135.
7. 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 Mar;8(1):9-18.

https://doi.org/10.4055/cios.2016.8.1.9. Epub 2016 Feb 13.
8. Kiran GU, Shashidhara H, Manjunath J, Akshay M, Muralidhar A. A prospective study of functional outcome in intraraticular lower end of humerus fracture treated with dual plating. Int J Orthoped Surg. 2017;3(3):37-42. http://dx.doi.org/10.22271/ortho.2017.v3.i3a.09
9. Li BB, Lin F, Cai LH, Chen Y, Lin ZJ. Meta analysis of parallel versus perpendicular double plating for distal humerus fracture of type C in adults. Zhonghua Wai Ke Za Zhi. 2017;55(8):626-31. https://doi.org/10.3760/cma.j.issn.0529-5815.2017.08.014
10. Kumar S, Singh S, Kumar D, Kumar N, Verma R. Intercondylar humerus fracture- parallel plating and its results. J Clin Diagn Res. 2015;9(1):1–4. https://doi.org/10.7860/jcdr/2014/12137.5479
11. Mahapatra S, Abraham VT. Functional results of intercondylar fractures of the humerus fixed with dual Y-plate; a technical note. Bull Emerg Trauma. 2017;5(1):36–41.
12. Shaik RB, Reddy VP, Naidu AK. Study of clinical outcome in intra articular distal humerus fractures treated with dual plating. Int J Res Med Sci. 2017; 5:2438-41. https://doi.org/10.18203/2320-6012.ijrms20172425
13. Rahman MM, Islam NS, Kabir SJ, Islam MS, Rahman MM, Islam MA, et al. Outcome of Double Tension Band Wiring Method for the Treatment of Intercondylar Fractures of Humerus. Mymensingh Med J. 2020 Jan;29(1):78-85. PMID: 31915340.
14. Fan J, Ji JQ, Zhang X, Guo XW, Yao Y, Zhou JQ, et al. Operative effect and treatment strategies for the low distal humerus fracture. Zhonghua Wai Ke Za Zhi. Chinese.2020 Mar 1;58(3):213-219. https://doi.org/10.3760/cma.j.issn.0529-5815.2020.03.009.
15. Mahapatra1 S, Abraham VT. Functional Results of Intercondylar Fractures of the Humerus Fixed with Dual Y-Plate; A Technical Note. Bull Emerg Trauma. 2017 Jan; 5(1): 36–41.
16. Kong L, Wang Y, Lu Q, Han Y, Wang F. Biomechanical properties of a novel fixation system for intra-articular distal humerus fractures: a finite element analysis. J Orthop Surg Res. 2021 Dec; 16:1-4. https://doi.org/10.1186/s13018-021-02836-1
17. Kong L, Wang Y, Lu Q, Han Y, Wang F. Biomechanical properties of a novel fixation system for intra-articular distal humerus fractures: a finite element analysis. J Orthop Surge Res. 2021 Dec; 16:1-4. https://doi.org/10.1186/s13018-021-02836-1
18. Yetter TR, Weatherby PJ, Somerson JS. Complications of articular distal humeral fracture fixation: a systematic review and meta-analysis. J Shoulder Elbow Surg. 2021 Aug 1;30(8):1957-67. https://doi.org/10.1016/j.jse.2021.02.017
19. Haglin JM, Kugelman DN, Lott A, Belayneh R, Konda SR, et al. Intra-articular distal humerus fractures: parallel versus orthogonal plating. HSS Journal®. 2022 May;18(2):256-63. https://doi.org/10.1177/15563316211009810
20. Wang C, Zhu Y, Long H, Lin Z, Zhao R, Sun B, et al. Three-dimensional mapping of distal humerus fracture. J Orthop Surg Res. 2021 Dec; 16:1-7. https://doi.org/10.1186/s13018-021-02691-0
21. Zhao W, Yuan H, Zhang Y, Guo Y, Basnet S, Li S, et al. A novel configuration for the fixation of intra-articular C2. 3 distal humerus fractures with the potential for minimally invasive surgery: a biomechanical evaluation and finite element analysis. J Shoulder Elbow Surg. 2024 May 1;33(5):1138-49. https://doi.org/10.1016/j.jse.2023.09.034
22. Li G, Cui Y, Hua X, Liu F, Li D, Lu J, et al. Management of extra-articular fracture of the distal humerus with the upside-down use of PHILOS plates in front of the humerus: a retrospective study of 20 patients after 28.3 months. BMC Musculoskeletal Dis J. 2024 Nov 25;25(1):952. https://doi.org/10.1186/s12891-024-08098-2
23. Garg R, Vezeridis PS, Monica JT, Mudgal CS. The "Bag of Bones" Treatment of Comminuted Intra-articular Distal Humerus Fractures in the Elderly. HAND. 2024 Jan 5:15589447231218300.. https://doi.org/10.1177/15589447231218300
24. Tarallo L, Montemagno M, Delvecchio M, Costabile L, Porcellini G, Donà A, et al. AO/OTA B and C articular fractures of the distal humerus: What are the boundaries between Total Elbow Arthroplasty and ORIF? Injury. 2024 Sep 1; 55:111479. https://doi.org/10.1016/j.injury.2024.111479
25. Korman A, Aframian A, Domos P. Operative versus non-operative treatment of extra-articular distal humeral shaft fractures: a retrospective comparative study evaluating clinical and radiological outcomes. European J Orthop Surg Tra. 2024 Apr;34(3):1327-32. https://doi.org/10.1007/s00590-023-03785-7
26. Zdero R, Brzozowski P, Schemitsch EH. Biomechanical Design Optimization of Distal Humerus Fracture Plates: A Review. BioMed Research International. 2024;2024(1):6015794. https://doi.org/10.1155/2024/6015794
27. Kumar S, Rashmi K, Pandit VA, Anshuman K. Evaluation of results of different methods of treatment of intra articular fractures of the elbow. Int J Acad Med Pharm. 2024;6(4):1052-5. https://doi.org/10.29252/beat-060406

28. Jain S, Ajmeriya R, Priyadarshi S, Gupta VK. A Novel Surgical Treatment Strategy for Fixation of Intra-articular Distal Humerus Fractures: Prospective Analysis of Functional Outcomes. J Orthop Dis Tra. 2024 Jan 1;7(1):28-34. http://dx.doi.org/10.4103/jodp.jodp_65_23
29. Chitnavis S. Functional Outcome of Distal Humerus Intra-Articular Fractures Treated with Pre-contoured Anatomical Locking Plates. J Clin Orthop. 2024 Jan;9(1) 233-7. http://dx.doi.org/10.13107/jcorth.2024.v09i01.622
30. Bashir A, Shah SW, Shakoor MA, Khan SA. Comparison of outcome of lambda plate versus double plate fixation in AO Type C fractures of distal humerus in adults. The Professional Med J. 2024 Dec 1;31(12):1730-7. https://doi.org/10.29309/TPMJ/2024.31.12.8481