Scholars Journal of Applied Medical Sciences
Abbreviated Key Title: Sch J App Med Sci
ISSN 2347-954X (Print) | ISSN 2320-6691 (Online)
Journal homepage: https://saspublishers.com

OPEN ACCESS

Medicine

Comparative Analysis of Anatomical Plating vs. Tension Band Wiring in the Management of T-Y Intercondylar Fracture (AO Type-13C1 & 13C2) of Distal Humerus

Dr. Rajib Kumar Paul[1*], Dr. Md Sahedur Rahman[2], Dr. Tanveer Hasan[3], Dr. A F M Ashikul Haq[4], Dr. Jyotirmoy Sarkar[5], Dr. Shagorika Paull[6], Dr. M M Rafiquzzaman[7], Dr. Amiya Kumar Das[8]

[1]Jr. Consultant (Sports Medicine & Arthroscopy), Resident Surgeon (Orthopedic & Traumatology), Khulna Medical College Hospital, Khulna, Bangladesh
[2]Jr. Consultant (Orthopedic surgery), Khulna Medical College Hospital, Khulna, Bangladesh
[3]Assistant Registrar, Pediatric Orthopedic Surgery, Khulna Medical College Hospital, Khulna, Bangladesh
[4]Jr. Consultant (Anesthesia), Upazila Health Complex, Rupsha, Khulna, Bangladesh
[5]Jr. Consultant (Orthopedic Surgery), Upazila Health Complex, Tala, Sathkhira, Bangladesh
[6]Residents Anesthesia, Jashore Medical College Hospital, Jashore, Bangladesh
[7]Medical Officer, (Orthopedic Surgery), Khulna Medical College Hospital, Khulna, Bangladesh
[8]Medical Officer, Upazila Health Complex, Phultola, Khulna, Bangladesh

DOI: https://doi.org/10.36347/sjams.2026.v14i02.021 | **Received:** 23.11.2025 | **Accepted:** 27.01.2026 | **Published:** 20.02.2026

***Corresponding author:** Dr. Rajib Kumar Paul
Jr. Consultant (Sports Medicine & Arthroscopy), Resident Surgeon (Orthopedic & Traumatology), Khulna Medical College Hospital, Khulna, Bangladesh

Abstract **Original Research Article**

Background*:** T-Y-Intercondylar fractures (AO Type-13C1 & 13C2) of the distal humerus are complex intra-articular injuries that pose significant challenges in achieving stable fixation and optimal functional recovery. The principle is anatomical reduction and rigid fixation. Anatomical reconstruction plating and double tension band wiring are commonly employed techniques, each with distinct biomechanical, clinical and socioeconomical implications. ***Objective*:** To compare Double Anatomical Plating (Group I) and Tension Band Wiring (TBW) (Group II) in the management of T-Y Intercondylar distal humerus fractures AO type 13C1 & 13C2 in respect to pain, elbow range of motion (ROM), mayo elbow performance score (MEPS), functional outcomes, cost benefit ratio and postoperative recovery. ***Method*:** A prospective, randomized comparative study was conducted at a tertiary orthopedic center Khulna Medical College Hospital in Khulna, Bangladesh, from January 2024 to March 2025. Twenty-four adult patients with closed, fresh bicondylar intra-articular distal humerus fractures AO Type 13C1 & 13C2 were randomized into two groups: Group I (n = 12) underwent open reduction and internal fixation with Double Anatomical Plates and screws, while Group II (n = 12) received Tension Band Wiring (TBW). Clinical assessment, pain scoring, range of motion (ROM) evaluation, Mayo Elbow Performance Score (MEPS) and functional outcomes were recorded and analyzed using SPSS version 15, with $p < 0.05$ considered statistically significant. ***Results*:** The majority of patients in both groups were aged 18–30 years (Group I: 58.33%, Group II: 54.17%), with a slight female predominance in Group II (58.33%). AO type 13C2 fractures were more frequent (Group I: 66.67%, Group II: 75.00%). Postoperative assessment showed that no pain was reported more frequently in Group I (33.33%) than Group II (25.00%), and loss of elbow motion beyond functional margin was lower in Group I (8.33%) compared to Group II (25.00%). Excellent functional outcomes were higher in Group I (33.33% vs. 25.00%), whereas good outcomes were similar in both groups (41.67%). Fair and poor outcomes were slightly higher in Group II. ***Conclusion: Double Anatomical plating (Group I) demonstrated modest advantages over tension band wiring (Group II) in terms of pain control, range of motion preservation, and excellent functional recovery. Both techniques, however, provided acceptable overall outcomes, and choice of fixation should be guided by fracture complexity, patient factors, and resource availability.

Keywords: Distal Humerus Fracture, T-Y Intercondylar Fracture (AO Type 13C1 & 13C2), Double Anatomical Plating, Tension Band Wiring, Elbow Function, Olecranon Osteotomy Orthopedic Surgery, Trauma Surgery.

INTRODUCTION

Fractures of the distal humerus represent a complex spectrum of injuries that pose significant challenges to orthopedic surgeons due to their intricate anatomy and the need for precise restoration of the articular surface anatomically. Among these, T-Y intercondylar fractures of the distal humerus are relatively uncommon but severe injuries, often resulting from high-energy trauma such as road traffic accidents (RTA) or falls from height (FFH) [1-3]. These fractures frequently involve the articular surface and both medial and lateral condyle of humerus, making anatomical reduction and rigid stable fixation and early mobilization essential for optimal functional recovery of the elbow joint.

The primary goals in the management of T-Y intercondylar fractures include anatomical reduction of the articular surface, rigid internal fixation, and early initiation of elbow motion to prevent stiffness. Failure to achieve stable fixation may lead to complications such as non-union, malunion, post-traumatic arthritis, and restricted range of motion [4-5]. As a result, various surgical techniques have been developed to address these fractures, each aiming to provide sufficient stability while minimizing soft-tissue disruption.

Anatomical plating has emerged as a widely accepted method for treating distal humeral fractures, particularly complex intra-articular patterns. Pre-contoured anatomical plates allow for column-specific fixation, improved biomechanical stability, and accurate restoration of the distal humerus geometry. This technique facilitates early mobilization and has been associated with favorable union rates and functional outcomes [6, 7]. However, anatomical plating requires extensive surgical exposure, which may increase the risk of soft-tissue complications, infection, and ulnar nerve irritation.

Tension band wiring (TBW), on the other hand, is a cost-effective and less technically demanding method traditionally used in simple fracture patterns. In selected cases of T-Y intercondylar fractures, TBW converts tensile forces generated during elbow motion into compressive forces at the fracture site, promoting union. Despite its advantages, concerns remain regarding its ability to provide adequate stability in comminuted fractures, as well as risks of hardware prominence, loss of reduction, and delayed mobilization [8, 9].

Given the differences in biomechanical principles, surgical complexity, cost, and complication profiles between anatomical plating and tension band wiring, there is ongoing debate regarding the optimal fixation method for T-Y intercondylar fractures of the distal humerus. Comparative studies evaluating functional outcomes, union rates, complications, and range of motion are therefore essential to guide evidence-based clinical decision-making, particularly in resource-limited settings.

Objective

This study aims to compare anatomical plating and tension band wiring in the management of T-Y intercondylar fractures of the distal humerus, with emphasis on radiological union, functional outcomes, postoperative complications, and overall patient recovery.

METHODOLOGY

This was a prospective, randomized comparative study conducted at a tertiary-level orthopedic referral center Khulna Medical College Hospital in Khulna, Bangladesh, from January 2024 to March 2025. Adult patients presenting with T-Y -type bicondylar intra-articular fractures of the distal humerus were evaluated for eligibility during the study period. Ethical approval was obtained from the institutional review board, and informed written consent was taken from all participants prior to enrollment.

A total of thirty patients meeting the selection criteria were initially included in the study. During the follow-up period, six patients were lost due to non-compliance or inability to attend scheduled visits and were therefore excluded from final analysis. The remaining twenty-four patients were randomly allocated into two equal groups using a simple randomization method. Group I consisted of twelve patients treated with open reduction and internal fixation using double anatomical reconstruction plates and screws, while Group II included twelve patients treated with tension band wiring (TBW).

Patients aged between 18 and 50 years of either sex with displaced, closed, fresh (within two weeks of injury) bicondylar intra-articular fractures of the distal humerus were included. Only fractures corresponding to Type II (separation of capitulum and trochlea without significant rotation) and Type III (separation with rotatory deformity) patterns were selected. Patients with open fractures, pathological fractures, polytrauma, active infection or septic focus, fractures older than two weeks, and those with open epiphyseal plates were excluded from the study.

Most patients presented through the emergency department of Khulna Medical College Hospital following high-energy trauma, while some were admitted via the outpatient department (OPD) room no 105 Resident surgeon (Ortho and Trauma). A detailed history was taken, and thorough clinical and radiological evaluations were performed upon admission. Initial management focused on stabilization following Advanced Trauma Life Support (ATLS) principles. After confirmation of diagnosis, patients underwent standard preoperative preparation and counseling

regarding the nature of injury, treatment options, possible complications, and postoperative expectations. Pre-anesthetic evaluation was completed, and patients were kept nil per oral (NPO) for at least six hours prior to surgery.

All surgeries were performed under aseptic conditions in a clean operating theater using standard posterior approaches to the elbow. Implant selection, including appropriate-sized plates, screws, Kirschner wires, and stainless-steel wires, was determined based on preoperative radiographic assessment of both injured and contralateral elbows. Prophylactic intravenous antibiotics, typically a second-generation cephalosporin, were administered at induction of anesthesia and continued for three days postoperatively, followed by oral antibiotics for seven days. Postoperative rehabilitation protocols were similar for both groups, emphasizing early elbow mobilization as tolerated.

Data were collected using a structured data sheet and compiled manually according to predefined variables. Statistical analysis was performed using SPSS software (version 15). Descriptive statistics were used to summarize demographic and clinical characteristics, and percentages were calculated to determine the distribution of findings. Appropriate statistical tests were applied to compare outcomes between the two groups, with a p-value of less than 0.05 considered statistically significant.

RESULTS

Among the 24 patients included in the study, the majority in both treatment groups belonged to the 18–30-year age group, accounting for 58.33% in Group I and 54.17% in Group II. Patients aged 31–40 years constituted 25.00% of Group I and 29.17% of Group II, while those aged 41–50 years represented the smallest proportion in both groups (16.67% and 16.66%, respectively). Gender distribution in Group I was equal, with males and females each comprising 50.00% of patients, whereas Group II showed a female predominance (58.33%) compared to males (41.67%). Regarding the affected limb, left-sided involvement was more common in Group I (75.00%), while right-sided injuries predominated in Group II (65.00%).

Table 1: Percentage Distribution of Patients by Age Group, Gender, and Affected Limb (n = 24)

Variable	Category	Group I (%)	Group II (%)
Age group (years)	18–30	58.33	54.17
	31–40	25.00	29.17
	41–50	16.67	16.66
Gender	Male	50.00	41.67
	Female	50.00	58.33
Affected limb	Left	75.00	35.00
	Right	25.00	65.00

In terms of clinical characteristics, Type III fractures were more frequent in both groups, accounting for 66.67% in Group I and 75.00% in Group II, while Type II fractures comprised a smaller proportion in each group. Pain assessment revealed that severe pain was more common in Group I (50.00%) compared to Group II (25.00%), whereas mild pain was observed only in Group II (8.33%). Very severe pain was reported equally in both groups (33.33%). Evaluation of elbow range of motion showed that most patients in both groups experienced loss of motion within the functional margin, accounting for 66.67% in Group I and 58.33% in Group II. However, loss of range of motion beyond the functional margin was higher in Group II (25.00%) compared to Group I (8.33%), while complete preservation of range of motion was slightly more frequent in Group I (25.00%) than in Group II (16.67%).

Table 2: Percentage Distribution of Patients According to Clinical Characteristics

Clinical Characteristics	Category	Group I: Reconstruction Plate & Screw (%)	Group II: Double Tension Band Wiring (%)
Type of fracture	Type II	33.33	25.00
	Type III	66.67	75.00
Pain score	Mild (10)	0.00	8.33
	Moderate (20)	25.00	25.00
	Severe (30)	50.00	25.00
	Very severe (40)	33.33	33.33
Range of motion (ROM) status	No loss of range of motion	25.00	16.67
	Loss within functional margin	66.67	58.33
	Loss beyond functional margin (45°–100°)	8.33	25.00

Assessment of postoperative elbow pain demonstrated that a higher proportion of patients in Group I reported no pain (33.33%) compared to Group II (25.00%). Occasional pain was the most common symptom in both groups, observed in 41.67% of patients in Group I and 50.00% in Group II. Heavy activity–related pain was reported equally in both groups (25.00%). Notably, none of the patients in either group experienced light activity–related pain or pain at rest.

Table 3: Status of Elbow Pain

Symptoms	Group I (%)	Group II (%)
No pain	33.33	25.00
Occasional pain	41.67	50.00
Heavy activity–related pain	25.00	25.00
Light activity–related pain	0.00	0.00
Rest pain	0.00	0.00

Evaluation of treatment outcomes showed that excellent results were achieved in a higher proportion of patients in Group I (33.33%) compared to Group II (25.00%). Good outcomes were observed equally in both groups, accounting for 41.67% of patients each. Fair outcomes were more common in Group II (25.00%) than in Group I (16.67%). Poor outcomes were identical in both groups, occurring in 8.33% of patients.

Table 4: Distribution of Patients According to Treatment Outcome

Outcome	Group I (%)	Group II (%)
Excellent	33.33	25.00
Good	41.67	41.67
Fair	16.67	25.00
Poor	8.33	8.33

DISCUSSION

In the present study, the majority of patients in both treatment groups belonged to the younger age bracket of 18–30 years, representing 58.33% in Group I (Reconstruction Plate & Screw) and 54.17% in Group II (Double Tension Band Wiring). This aligns with prior studies, which reported that distal humeral fractures commonly occur in younger adults due to high-energy trauma such as road traffic accidents or falls from height [9-10]. The relatively smaller proportion of older patients in our series is consistent with global data suggesting that T/Y-condylar fractures are less common in older adults, except in cases associated with osteoporosis.

Gender distribution revealed equal representation in Group I and a slight female predominance in Group II, with females accounting for 58.33%. This pattern is similar to findings who noted near-equal male-to-female ratios in distal humeral fractures, although some studies report a male predominance due to higher exposure to trauma [11]. Regarding the affected limb, left-sided injuries were more common in Group I (75.00%), whereas right-sided injuries predominated in Group II (65.00%). Previous literature, shows no consistent pattern in limb involvement, suggesting that side predominance depends on the mechanism of injury rather than anatomical factors [12, 13].

In terms of fracture type, Type III fractures were more frequent in both groups, accounting for 66.67% in Group I and 75.00% in Group II, while Type II fractures were less common. This finding is consistent with studies which emphasized that T/Y-condylar fractures often involve comminuted intra-articular patterns, making stable fixation challenging [14]. The predominance of Type III fractures likely contributed to variability in postoperative pain and functional outcomes.

Postoperative pain assessment demonstrated that patients in Group I experienced higher rates of no pain (33.33%) compared to Group II (25.00%), while occasional pain was slightly higher in Group II (50.00%) than Group I (41.67%). Heavy activity–related pain was equal in both groups (25.00%), and no patients in either group reported pain at rest or during light activity. These findings are consistent with other study who reported that anatomical plating provides more stable fixation, facilitating early mobilization and better pain control compared to tension band wiring [15].

Functional outcomes favored Group I, with excellent results achieved in 33.33% of patients versus 25.00% in Group II. Good outcomes were equal in both groups (41.67%), while fair outcomes were higher in Group II (25.00%) compared to Group I (16.67%). Poor outcomes were identical in both groups (8.33%). These results support previous studies, highlighting that reconstruction plating offers superior biomechanical stability, early mobilization, and improved functional recovery, especially in complex fracture patterns [16].

Evaluation of elbow range of motion further reinforced these findings, with loss beyond the functional margin more frequent in Group II (25.00%) compared to

Group I (8.33%). Complete preservation of range of motion was slightly higher in Group I (25.00%) than in Group II (16.67%). This emphasizes the importance of stable fixation in allowing early mobilization and preventing elbow stiffness, as supported by studies [12]. Despite these differences, both methods achieved acceptable overall outcomes, indicating that tension band wiring remains a viable option for selected fracture patterns or in resource-limited settings.

CONCLUSION

In conclusion, this study demonstrates that reconstruction plating (Group I) provides slightly better outcomes than double tension band wiring (Group II) for T-Y intercondylar fractures of the distal humerus, with higher rates of excellent functional recovery, better preservation of elbow range of motion, and improved pain control. However, both techniques were effective in achieving acceptable overall outcomes, suggesting that tension band wiring remains a viable option for selected fracture patterns or in settings where anatomical plates are unavailable. The choice of fixation should therefore be guided by fracture complexity, patient characteristics, and available surgical resources.

REFERENCES

1. Hani, R. et al. 2017 Surgical treatment of the humeral pallet fractures in adults. Pan Afr. Med. J. 26 79. https://doi.org/10.11604/pamj.2017.26.79.10781
2. Kamineni, S. & Morrey, B. F. Distal humeral fractures treated with noncustom total elbow replacement. J. Bone Joint Surg. Am. 86(5), 940–947. https://doi.org/10.2106/00004623-200405000-00009 (2004).
3. Saragaglia, D., Rouchy, R. C. & Mercier, N. Fractures of the distal humerus operated on using the Lambda plate: report of 75 cases at 9.5 years follow-up. Orthop. Traumatol. Surg. Res. 99(6), 707–712. https://doi.org/10.1016/j.otsr.2013.04.007 (2013).
4. Schemitsch, E. H., Tencer, A. F. & Henley, M. B. Biomechanical evaluation of methods of internal fixation of the distal humerus. J. Orthop. Trauma. 8(6), 468–475 (1994).
5. Bégué, T. Articular fractures of the distal humerus. Orthop. Traumatol. Surg. Res. 100 (Suppl 1), 55–63. https://doi.org/10.1016/j.otsr.2013.11.002 (2014).
6. Paul, H. & Kim, M. D. Seth S. Leopold Gustilo-Anderson Classif. Clin. Orthop. Relat. Res. 470(11) 3270–3274. https://doi.org/10.1007/s11999-012-2376-6 (2012).
7. Cusick, M. C., Bonnaig, N. S., Azar, F. M., Mauck, B. M., Smith, R. A., & Throckmorton, T. W. (2014). Accuracy and reliability of the Mayo elbow performance score. The Journal of hand surgery, 39(6), 1146-1150. https://doi.org/10.1016/j.jhsa.2014.01.041
8. Lee, S. K., Kim, K. J., Park, K. H. & Choy, W. S. 2014 a comparison between orthogonal and parallel plating methods for distal humerus fractures: a prospective randomized trial. Eur. J. Orthop. Surg. Traumatol. 24(7) 1123–1131. https://doi.org/10.1007/s00590-013-1286-y
9. Jupiter, J. B., Ne, U., Holzach, P. & Allgöwer, M. Intercondylar fractures of the humerus: an operative approach. J. Bone Joint Surg. Am. 67 (2), 226–239 (1985).
10. Helfet, D. L. & Hotchkiss, R. N. Internal fixation of the distal humerus: a biomechanical comparison of methods. J. Orthop. Trauma. 4 (3), 260–264. https://doi.org/10.1097/00005131-199004030-00004 (1990).
11. S chwartz, A., Oka, R., Odell, T. & Mahar, A. Biomechanical comparison of two different periarticular plating systems for stabilization of complex distal humerus fractures. Clin. Biomech. 21 (9), 950–955. https://doi.org/10.1016/j.clinbiomech.2006.04.018 (2006).
12. Stoel, K., Cunneen, S., Morgan, R., Nicholls, R. & Stachowiak, G. Comparative stability of perpendicular versus parallel double-locking plating systems in osteoporotic comminuted distal humerus fractures. J. Orthop. Res. 26 (6), 778–784. https://doi.org/10.1002/jor.20528 (2008).
13. Tian, D., Jing, J., Qian, J. & Li, J. Comparison of two different double-platexation methods with olecranon osteotomy for intercondylar fractures of the distal humeri of young adults. Exper. Med. 6 (1), 147–151. https://doi.org/10.3892/etm.2013.1102 (2013).
14. Atalar, A. C. et al. Biomechanical comparison of orthogonal versus parallel double plating systems in intraarticular distal humerus fractures. Acta Orthop. Traumatol. Turc. 51 (1), 23–28
15. Penzkofer, R., Hungerer, S., Wipf, F., Von Oldenburg, G., & Augat, P. (2010). Anatomical plate configuration affects mechanical performance in distal humerus fractures. Clinical biomechanics, 25(10), 972-978. https://doi.org/10.1016/j.clinbiomech.2010.07.005 (2010).
16. DriscollSW Optimizing stability in distal humeral fracture xation. J. Shoulder Elb. Surg. 14, 186–194. https://doi.org/10.1016/j.jse.2004.09.033 (2005)