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A STUDY OF FUNCTIONAL OUTCOME OF SURGICAL MANAGEMENT OF DISTAL HUMERUS FRACTURES WITH BICOLUMNAR PLATING

Orthopaedics

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ABSTRACT

Background: Distal humerus fractures account for ~2% of all fractures and 30% of elbow fractures, posing challenges due to complex anatomy and limited bone stock. Without proper surgical management, these injuries often lead to significant functional impairment. This study evaluated functional outcomes following bicolumnar plating in distal humerus fractures. **Methods:** This prospective study included 20 patients treated at Basaveshwara Teaching and General Hospital, Kalaburagi, between May 2023 and December 2024. All underwent open reduction and internal fixation (ORIF) with bicolumnar plating via posterior approach and olecranon osteotomy. Outcomes were assessed using Mayo Elbow Performance Score (MEPS) and Visual Analog Scale (VAS) at 3, 6, 12 weeks, and 6 months. Statistical analysis evaluated correlations between outcomes and factors like age, injury mechanism, fracture type, and complications. **Results:** The cohort included 50% males and 50% females, with 40% aged over 60. Falls caused 60% of injuries; road traffic accidents (RTAs) caused 40%. AO classification showed 55% type 13.C1, 40% type 13.C2, and 5% type 13.C3 fractures. Complications were seen in 15% (stiffness, ulnar neuropraxia, superficial infection at 5% each). Final outcomes at 6 months were excellent in 20%, good in 65%, and fair in 15%. Mean VAS scores improved significantly from 8.80 at 3 weeks to 2.10 at 6 months ($p<0.001$). Younger patients had significantly better outcomes ($p=0.04$). **Conclusion:** Bicolumnar plating offers good to excellent outcomes in 85% of cases, with younger patients showing better recovery. This technique provides stable fixation, enabling early mobilization critical for optimal functional recovery.

KEYWORDS

Distal humerus fractures; Bicolumnar plating; Functional outcome; MEPS; AO classification; Parallel plating; Orthogonal plating

INTRODUCTION:

Distal humerus fractures, though relatively rare (~2% of all fractures), account for 30% of elbow fractures and are among the most challenging injuries for orthopaedic surgeons. They often result from high-energy trauma in young adults or low-energy falls in elderly osteoporotic patients. Without optimal management, these fractures carry high morbidity, often leading to prolonged disability, limited elbow motion, and chronic pain.

The complex anatomy of the distal humerus-with its irregular shape, thin cortices, and limited surfaces for fixation-complicates surgical treatment. Anatomically, the distal humerus forms a three-dimensional triangle, with medial and lateral columns converging on a thin central trochlea. This design enables complex elbow function but complicates fixation. Restoring alignment and achieving stable fixation are crucial for functional recovery, as emphasized by O'Driscoll et al., who described the "distal humerus triangle" to guide surgical reconstruction.

Bicolumnar plating has become the gold standard for distal humerus fixation. By applying plates to both medial and lateral columns, it offers superior biomechanical stability compared to single-plate constructs. Korner et al. showed dual-plate constructs resist torsional and bending forces better, reducing failure risks. Modern pre-contoured, low-profile plates further improve fixation, especially in osteoporotic bone, by allowing precise application and better distal purchase.

METHODOLOGY

This prospective interventional study was conducted in the Department of Orthopaedics, Basaveshwara Teaching and General Hospital attached to Mahadevappa Rampure Medical College, Kalaburagi, from May 2023 to December 2024.

A total of 20 patients were included, selected using purposive sampling. Sample size was calculated using the formula $N = Z^2pq/d^2$, where $Z = 1.96$, $p = 4.8\%$ (prevalence), $q = 95.2\%$, and $d = 10\%$ (error), giving a size of 17.54, rounded to 20 to account for a 10% attrition rate.

Inclusion Criteria:

- AO/OTA Type B and C distal humerus fractures
- Age >18 years, any gender
- Fit for surgery

Exclusion Criteria:

- Ipsilateral limb fractures
- Open fractures > Gustilo Anderson Type III
- Pathological fractures
- Unwilling patients

On admission, detailed history was taken, including injury mechanism, time to presentation, and prior treatment. Clinical examination assessed local limb condition, deformity, swelling, skin integrity, neurovascular status, and other injuries.

Preoperative workup included complete blood count, coagulation profile, renal/liver function tests, ESR, PT, INR, electrolytes, HIV, HBsAg, blood grouping, urine examination, random blood sugar, ECG, and chest X-ray. Radiological evaluation included AP and lateral elbow radiographs; CT with 3D reconstruction was done in selected cases. Written informed consent was obtained in the patient's vernacular language after explaining the injury, treatment options, possible outcomes, and risks.

Surgery was performed under anesthesia as determined by the anesthetist. Patients were positioned in lateral decubitus with the affected arm supported and elbow at 90° flexion. A posterior midline incision was used(Image 1 : A1), followed by trans-olecranon approach. The ulnar nerve was identified and protected throughout(A2). After exposure, fracture fragments were reduced anatomically and temporarily fixed with K-wires, ensuring meticulous articular reconstruction. Definitive fixation was done using bicolumnar plating—one plate on the medial column, another on the lateral column. Plates were secured with appropriate screws after confirming reduction and alignment under fluoroscopy(A3 to A5).

Image1: Intra operative images

Postoperatively, patients received antibiotics, analgesics, and anti-inflammatories. The limb was immobilized in an above-elbow posterior slab at 90° flexion for 1–2 weeks, with immediate active finger movements encouraged. Wound inspection was done at 48 hours; sutures were removed on day 14. After slab removal, supervised rehabilitation began with passive, then active-assisted, and active elbow exercises. Strengthening exercises started at 6–8 weeks once healing was confirmed. Patients were followed at 3, 6, 12 weeks, and 6 months, with outcomes assessed using MEPS and VAS. Data were analyzed using IBM SPSS v25, with $p < 0.05$ considered significant.

Pre-op x-ray Post-op X-ray X-ray at 6-months

Image2: Xray images.

Flexion Extension Supination Pronation

Image 3: Ramge of movements at 6 month followup

RESULTS

This study evaluated functional outcomes in 20 patients with distal humerus fractures treated with bicolumnar plating. Demographic analysis revealed equal gender distribution (50% male, 50% female) with the largest age group being over 60 years (40%), followed by 30-39 years (20%). The left side was affected in 65% of cases. Falls were the predominant mechanism of injury (60%), while road traffic accidents accounted for 40%. Most fractures were closed (75%), with open fractures comprising 25% (15% GA type 1, 10% GA type 2). According to AO classification, 55% were type 13.C1, 40% were type 13.C2, and 5% were type 13.C3. Most patients (80%) had no comorbidities, while 10% had diabetes mellitus, 5% had hypertension, and 5% had both conditions.

Table 1: Patient Demographics And Injury Characteristics

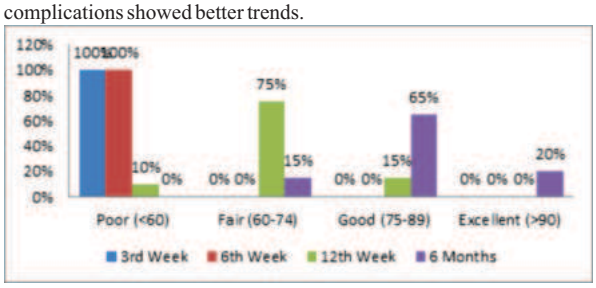
Parameter	Category	Frequency	Percentage (%)
Age Groups	<30 years	3	15.0
	30-39 years	4	20.0
	40-49 years	2	10.0
	50-59 years	3	15.0
	>60 years	8	40.0
Gender	Male	10	50.0
	Female	10	50.0
Side Affected	Left	13	65.0
	Right	7	35.0
Mechanism	Fall	12	60.0
	RTA	8	40.0

Table 3: Functional Outcomes And Pain Assessment

Follow-up Period	MEPS Classification	Frequency	Percentage (%)
3rd Week	Poor (<60)	20	100.0
6th Week	Poor (<60)	20	100.0
12th Week	Poor (<60)	2	10.0
	Fair (60-74)	15	75.0
	Good (75-89)	3	15.0
6 Months	Fair (60-74)	3	15.0
	Good (75-89)	13	65.0
	Excellent (>90)	4	20.0

VAS Pain Scores	Mean ± SD	p-value
3rd week	8.80 ± 0.41	-
6th week	7.40 ± 0.68	<0.001
12th week	5.55 ± 0.76	<0.001
6 months	2.10 ± 0.71	<0.001

MEPS scores showed poor results at 3–6 weeks, improving by 12 weeks (75% fair, 15% good) and optimal at 6 months (65% good, 20% excellent, 15% fair). VAS improved significantly from 8.80 at 3 weeks to 2.10 at 6 months ($p<0.001$). Fracture union was achieved in all: 60% by 12 weeks, 35% by 16 weeks, 5% by 20 weeks. Age significantly correlated with outcomes ($p=0.046$), with younger patients faring better. No significant correlation existed between mechanism of injury and outcomes ($p=1.000$), though simpler fractures and absence of complications showed better trends.



Graph 1: MEPS at different follow up periods

DISCUSSION

This prospective study demonstrated that surgical management of distal humerus fractures with bicolumnar plating yields favourable functional outcomes, with 85% of patients achieving good to excellent results at 6-month follow-up. The age distribution in our study, with 40% of patients over 60 years, reflects the typical bimodal pattern described by Charissoux et al.[6], who noted peaks in young adults from high-energy trauma and elderly patients with osteoporotic bone from low-energy falls. Our findings of significant age-related outcome differences ($p=0.04$) align with reports by Korner et al.[7], who documented superior functional outcomes in patients under 50 years (mean MEPS 85) compared to those over 50 years (mean MEPS 75), attributing this to better bone quality, enhanced healing potential, and superior rehabilitation capacity in younger patients. The challenge of managing distal humerus fractures in the elderly is compounded by reduced tolerance for extensive procedures and pre-existing degenerative changes, as highlighted by Kaiser et al.[8], while younger patients typically possess healthier articular cartilage and greater physiological reserve to overcome post-surgical complications.

Our fracture classification distribution, with 55% type 13.C1 and 40% type 13.C2 patterns, is comparable to Singh et al.[9], who noted similar predominance in their cohort. Although we did not find statistically significant correlation between AO classification and functional outcomes ($p=0.17$), the trend toward better results with less complex patterns aligns with Doornberg et al.[10], who concluded that increasing fracture complexity, particularly articular comminution, was associated with less favourable outcomes in their systematic review of 1163 fractures. Our low complication rate of 15% compares favourably to Chen et al.[12], who reported 25% complications, and Kundel et al.[13], who documented 30% complications, with our superior outcomes potentially attributable to meticulous soft tissue handling, ulnar nerve protection, and early supervised mobilization protocols.

The progressive functional improvement demonstrated in our study, with VAS scores decreasing from 8.80 to 2.10 ($p<0.001$) and MEPS scores evolving from universally poor to 85% good-excellent outcomes, aligns with the natural healing timeline described by Sanchez-Sotelo et al.[14]. The correlation between complications and functional outcomes, though not statistically significant ($p=0.16$), showed clear trends with all excellent-outcome patients experiencing no complications, while fair-outcome patients had either elbow stiffness or superficial infection, underscoring the importance of complication prevention. Our surgical approach using posterior exposure with olecranon osteotomy and bicolumnar plating adhered to O'Driscoll's principles [17] of dual-column plate positioning with interdigitating screws creating fixed-angle constructs, providing maximum stability against varus-valgus and rotational forces, likely contributing to our favourable outcomes, and supporting bicolumnar plating as the treatment of choice for displaced intra-articular distal humerus fractures.

CONCLUSION

This study demonstrates that surgical management of distal humerus fractures with bicolumnar plating is an effective treatment strategy, resulting in good to excellent functional outcomes in 85% of patients. The progressive improvement in Mayo Elbow Performance Scores and significant reduction in pain levels over the 6-month follow-up period validates the efficacy of this approach. While complications

occurred in only 15% of patients, their presence demonstrated a clear trend toward less favourable outcomes, highlighting the critical importance of meticulous surgical technique, appropriate soft tissue handling, and structured rehabilitation protocols. Based on our experience and results, we recommend bicolumnar plating as the treatment of choice for displaced intra-articular distal humerus fractures, with emphasis on anatomical reduction, stable fixation, and early supervised mobilization to optimize functional recovery.

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