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ORIGINAL ARTICLE

FUNCTIONAL OUTCOME OF OPEN REDUCTION AND INTERNAL FIXATION VIA THE ANTERIOR APPROACH FOR CAPITELLUM FRACTURES IN ADULT PATIENTS

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ABSTRACT

Background: Capitellum fractures are rare intra-articular injuries of the distal humerus that require anatomical reduction and stable fixation for optimal functional recovery. The anterior approach to the elbow allows direct visualization of the articular surface and may facilitate early mobilization with minimal soft-tissue disruption. The purpose of the present study was to evaluate the clinical and functional outcomes of patients undergoing ORIF of capitellum fractures using headless Herbert screws via the anterior approach at a tertiary care center.

Materials & Methods: This prospective case series study was conducted in the Department of Orthopaedic Surgery, MTI-Khyber Teaching Hospital, Peshawar, from June 2023 to October 2024, involving 29 adult patients (17 male, 12 female) with isolated capitellum fractures. All patients underwent open reduction and internal fixation using headless Herbert screws via the anterior approach. Patients were followed for 6 months. Functional outcome was assessed using the Mayo Elbow Performance Index (MEPI). Data were analyzed using SPSS version 26.0.

Results: The mean age of patients was 33.48 ± 8.58 years. The mean time to radiological union was 11.90 ± 1.29 weeks. The mean flexion-extension arc was 142.77 ± 3.03 degrees, and the mean supination-pronation arc was 165.27 ± 2.03 degrees. The mean MEPI score was 85.24 ± 10.68. According to the MEPI score, 16 (55.2%) patients achieved excellent results, 7 (24.1%) good, 4 (13.8%) fair, and 2 (6.9%) poor outcomes. No cases of avascular necrosis, implant failure, or deep infection were observed.

Conclusion: Open reduction and internal fixation of isolated capitellum fractures using headless Herbert screws via the anterior approach provides excellent to good functional outcomes in the majority of patients with a low complication rate in the short term. This technique is a safe and effective surgical option for adult patients.

KEY WORDS: Anterior Elbow Approach; Bone Screws; Capitulum; Elbow Joint; Herbert screw; Intra-Articular Fractures; Treatment Outcome.

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INTRODUCTION

Fractures involving the distal humerus represent a clinically significant subset of upper limb injuries due to their intra-articular nature and potential for long-term functional impairment. Among these, fractures of the capitellum are relatively rare, accounting for approximately 1% of all elbow fractures and 6% of distal humeral fractures.[1,2] These injuries occur predominantly following axial loading transmitted through the radial head when an individual falls on an outstretched hand, and they often produce coronal shear fragments.[3,4] Despite their rarity, capitellum fractures are clinically important because they involve the articular surface of the elbow joint, where even minor incongruity can result in stiffness, chronic pain, instability, and early degenerative arthritis. Recent systematic evidence indicates that postoperative complications remain considerable, including persistent elbow pain (21%), radio capitellar arthritis (19%), hardware-related issues (17%), and heterotopic ossification (13%), highlighting the need for optimal treatment strategies. [5] treatment options for capitellar fractures have evolved from conservative management to operative fixation. Contemporary orthopedic practice favors open reduction and internal fixation (ORIF) aimed

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at achieving anatomical reduction, stable fixation, and early mobilization to restore joint congruity and prevent stiffness. [6,7] Several surgical approaches have been described, including lateral, posterolateral, and anterior approaches. The anterior approach to the elbow, though less commonly used, offers the distinct advantage of direct visualization of the articular surface of the capitellum, which is often difficult to expose adequately through traditional lateral approaches. [8] This may facilitate more anatomical reduction, particularly in comminuted fractures or those with extension into the trochlea. Various fixation methods have been employed, including K-wires, cannulated screws, and headless compression screws. Headless Herbert screws provide the advantage of compression across the fracture site while being buried beneath the articular cartilage, thus avoiding hardware-related complications and allowing for early mobilization. [8] However, due to the low incidence of these fractures and the diversity of fracture patterns, there remains no universal consensus regarding the optimal surgical approach, fixation method, or postoperative protocol. [1] Given the scarcity of local data, especially in low and middle-income settings, and the absence of standardized management protocols, there is a need to evaluate clinical outcomes of different fixation techniques and surgical approaches in our population. Understanding functional outcomes, complications, and radiological union in such cases will contribute to improved evidence-based decision-making and help develop context-specific treatment strategies. Therefore, the purpose of the present study was to evaluate the clinical and functional outcomes of patients undergoing ORIF of capitellum fractures using headless Herbert screws via the anterior approach at a tertiary care center. The findings of this study will add to the existing pool of knowledge, will become a base for further research, and will help to standardize patient care as per standard protocol.

MATERIALS & METHODS

This prospective case series study was conducted in the Department of Orthopedic Surgery, MTI–Khyber Teaching Hospital, Peshawar, from June 2023 to October 2024. Ethical approval was obtained from the Institutional Research Board (Ref No. 757/DME/KMC). Written informed consent was obtained from all patients regarding the surgical procedure and their participation in the study. A total of 29 patients, aged 20 to 70 years, presenting with closed capitellum fractures with or without comminution or extension to the trochlear ridge, were included using a purposive sampling technique. Patients with open fractures, presentation more than 10 days after injury, posterior cortical comminution, ligamentous laxity, prior degenerative or inflammatory arthritis of the elbow, or those unfit for surgery were excluded from the study. All patients were admitted through the outpatient department and emergency services. All surgeries were performed by a consultant orthopedic surgeon experienced in upper limb trauma. All patients underwent detailed clinical evaluation, including history, physical examination, and neurovascular assessment. Radiological evaluation included standard anteroposterior and lateral elbow radiographs, followed by a CT scan to confirm fracture pattern and plan fixation. All procedures were performed under general anesthesia. Patients were positioned supine with the affected limb supported. The anterior limited approach to the elbow was utilized, allowing direct visualization of the capitellum. Fracture fragments were anatomically reduced and stabilized using headless compression Herbert screws under fluoroscopic guidance, as seen in Figures 1, 2, and 3. Care was taken to preserve soft tissue attachments and avoid neurovascular structures. Postoperatively, the elbow was immobilized in a posterior splint. Wound inspection was done regularly, and stitches were removed on the 12th postoperative day. Gradual mobilization of the elbow joint was initiated depending upon fixation stability and patient tolerance. Patients were followed up regularly, with the final assessment conducted at 6 months postoperatively. Clinical and radiological evaluations were performed to assess fracture union, range of motion, and complications. Functional outcome was measured using the Mayo Elbow Performance Index (MEPI) score. The MEPI is a 100-point scoring system comprising four domains: pain (45 points), range of motion (20 points), stability (10 points), and function (25 points). The scores were interpreted in **Table 1**. Data were entered and analyzed using SPSS version 25. Quantitative variables such as age, time to union, range of motion, and MEPI scores were presented as mean ± standard deviation, while qualitative variables such as gender and outcome categories were presented as frequencies and percentages.

Figure 1: Preoperative view

Figure 2: Lateral radiograph of the screws

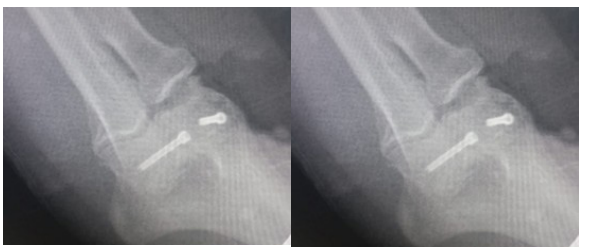

Figure 3: Anteroposterior radiograph of the screws

Table 1: Interpretation of Mayo Elbow Performance Index (MEPI)

Outcome Category	Score Range
Excellent	90–100
Good	75–89
Fair	60–74
Poor	<60

RESULTS

A total of 29 patients with capitellum fractures were included in the study. The mean age was 33.48 ± 8.58 years. The majority of patients, 19 (65.5%), were younger than 35 years, while 10 (34.5%) were older than 35 years. There were 17 males (58.6%) and 12 females (41.4%). The mean time to radiological union was 11.90 ± 1.29 weeks. The mean flexion–extension arc of motion was 142.77 ± 3.03 degrees, while the mean supination–pronation arc was 165.27 ± 2.03 degrees. The mean Mayo Elbow Performance Index (MEPI) score was 85.24 ± 10.68. The demographic and clinical characteristics of the patients are summarized in Table 2.

Table 2: Demographic and Clinical Characteristics of Patients (n = 29)

Variable	Value
Age (Years) mean ± SD	33.48 ± 8.58
Age < 35 Years n (%)	19 (65.5%)
Age > 35 Years, n (%)	10 (34.5%)
Gender, n (%) Male Female	 17 (58.6%) 12 (41.4%)
Time to fracture union (Weeks) (mean ± SD)	11.90 ± 1.29
Flexion–Extension Range of motion (Degrees) (mean ± SD)	142.77 ± 3.03
Supination–Pronation Range of Motion (Degrees) (mean ± SD)	165.27 ± 2.03
MEPI Score (mean ± SD)	85.24 ± 10.68

Based on the MEPI scoring system, 16 patients (55.2%) achieved excellent results, 7 patients (24.1%) had good, 4 patients (13.8%) demonstrated fair results, and 2 patients (6.9%) had poor outcomes, as summarized in Table 3.

Table 3: Functional Outcome According to MEPI Score (n = 29)

Outcome Category	Frequency (n)	%age
Excellent	16	55.2%
Good	7	24.1%
Fair	4	13.8%
Poor	2	6.9%
Total	29	100%

DISCUSSION

This prospective case series demonstrates that open reduction and internal fixation of isolated capitellum fractures using headless Herbert screws through the anterior elbow approach yields favorable functional and radiological outcomes in adult patients. The majority of patients (79.3%) achieved excellent to good results according to the MEPI score, with a mean score of 85.24 ± 10.68. These findings indicate satisfactory restoration of elbow function and align with contemporary literature emphasizing the importance of anatomical reduction and stable fixation in intra-articular distal humeral fractures. [4,9] The demographic profile of our cohort, with a mean age of 33.48 years and male predominance (58.6%), is comparable to previously reported series where capitellum fractures are more common in young, active individuals sustaining high-energy trauma or falls on an outstretched hand. Similar age distributions have been reported by Majeed et al. and Paneri et al., reflecting the typical mechanism of injury

involving axial loading through the radial head. [1, 10] Radiological union was achieved at a mean of 11.9 ± 1.29 weeks in our study, which is consistent with findings reported in prior studies utilizing headless compression screws. Studies evaluating Herbert screw fixation have demonstrated union typically between 10 and 14 weeks, supporting the effectiveness of this implant in providing compression and stability without prominent hardware. The absence of implant failure in our series further supports the biomechanical reliability of headless compression screws for coronal shear fractures. [11-13] The functional range of motion observed in our study (mean flexion–extension arc 142.77° and supination–pronation arc 165.27°) compares favorably with previously published reports, which describe functional arcs ranging from 130° to 145° following ORIF of capitellum fractures. These results highlight the advantage of stable fixation combined with early mobilization protocols in preventing postoperative stiffness, one of the most common complications associated with elbow injuries.[1,14] The favorable outcomes observed in this study may be attributed in part to the use of the anterior approach, which allows direct visualization of the articular surface and facilitates precise reduction of coronal shear fragments. Previous literature has highlighted the limitations of lateral or posterior approaches in visualizing anterior articular fragments, particularly in comminuted or trochlear-extending fractures. Studies evaluating anterolateral or anterior approaches have reported comparable or superior outcomes due to improved exposure and reduced soft-tissue dissection. Our findings support these observations, as no cases of avascular necrosis, neurovascular injury, or implant prominence were encountered.[9,11,15]

When compared with systematic reviews reporting complication rates of up to 20% for persistent pain, 19% for radio capitellar arthritis, and 13% for heterotopic ossification, the complication rate in our cohort was minimal. This may be attributed to careful patient selection (isolated fractures without posterior comminution), meticulous surgical technique, and early rehabilitation. However, it is important to recognize that the relatively short follow-up period of 6 months may underestimate long-term complications such as post-traumatic arthritis. [4,5]

The proportion of fair and poor outcomes (20.7%) in our study is comparable with other clinical series, where suboptimal results are often linked to fracture comminution, delayed presentation, or patient-related factors such as poor compliance with physiotherapy. Although patients presenting after 10 days were excluded, subtle variations in fracture complexity may still have influenced outcomes.[4,10] The findings of this study reinforce the role of the anterior elbow approach combined with Herbert screw fixation as a reliable surgical option for isolated capitellum fractures. The technique allows stable fixation, early mobilization, and excellent restoration of joint congruity, which are essential for preventing stiffness and degenerative changes. In resource-limited settings, where delayed presentation and limited rehabilitation services are common, a surgical approach that facilitates early functional recovery is particularly valuable. Despite its strengths, this study has several limitations. First, the sample size was relatively small (n = 29), which may limit the generalizability of the findings. Second, the absence of a control or comparison group (e.g., lateral approach or alternative fixation methods) restricts the ability to draw definitive conclusions regarding the superiority of the anterior approach. Third, the follow-up duration of 6 months is relatively short for assessing long-term outcomes such as post-traumatic arthritis or avascular necrosis. Fourth, purposive sampling may introduce selection bias, as only patients with isolated fractures and favorable characteristics were included. Finally, advanced functional scoring systems or patient-reported outcome measures were not utilized, which may have provided a more comprehensive assessment of functional recovery. Future studies should include larger multicenter cohorts with longer follow-up durations and comparative designs to evaluate different surgical approaches and fixation techniques. Randomized controlled trials comparing anterior versus lateral approaches, as well as Herbert screws versus other fixation devices, would provide higher-level evidence to guide clinical decision-making.

CONCLUSION

In adult patients with isolated capitellum fractures, open reduction and internal fixation using Herbert screws via the anterior approach provides favorable short-term functional outcomes. This technique is a safe and effective surgical option, allowing for anatomical reduction under direct visualization and stable fixation that facilitates early mobilization.

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CONFLICT OF INTEREST
Authors declare no conflict of interest.
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AUTHORS' CONTRIBUTION

The following authors have made substantial contributions to the manuscript as under:

Conception or Design:	MS, MI
Acquisition, Analysis or Interpretation of Data:	MS, MI, AK, WK, AA
Manuscript Writing & Approval:	MS, MI, AK, WK, SUR

All the authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.