Treatment of Delayed Supracondylar Humerus Fracture in Paediatric Patients with Closed Callostasis: Our Hospital Experience

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Abstract

Introduction: Supracondylar fractures of humerus (SCHFs) are frequently encountered in children. Delayed presentation of such fractures is particularly common. The absence of established guidelines for managing late-presenting SCHFs poses a clinical challenge. Objective: This study aimed to evaluate delayed SCHFs treated by the closure of Callostasis and percutaneous fixation. Study design: prospective cohort study. Place and Duration: This study was conducted in Ghulam Muhammad Mahar Medical College Sukkur from May 2022 to May 2023. Methodology: Children having Type III Gartland SCHFs with a delay of ≥7 days were included in the study. Children having Fractures with neurovascular injuries or requiring ORIF were excluded. Patients received treatment involving closed reduction followed by percutaneous cross-wire fixation under fluoroscopic guidance. A careful closed Callostasis was used to avoid excessive force. In cases where closed reduction was infeasible, the procedure was converted to open reduction. After verification of optimal alignment and pin placement with C-arm imaging, protruding K-wire ends were bent and left external. A long-arm cast or splint was applied with the elbow flexed and the forearm supinated. Outcomes were assessed using humerocaptellar angle, Flynn's criteria, and Baumann's angle. Results: The study included 50 patients with a mean age of 6.5±2.8 years (range: 2-12 years). The average presentation delay was 12.8±4.6 days, and the mean postoperative follow-up spanned 14.2±3.6 months. At the one-year follow-up, 46 (92%) patients demonstrated full range of motion (ROM), while 4 (8%) patients exhibited deficient ROM in both flexion and extension, primarily due to non-compliance with the prescribed treatment regimen. Flynn's criteria indicated excellent outcomes in 72% of cases. Conclusion: Closed osteoclasis, reduction, and percutaneous pinning offer a viable and effective method for addressing delayed displaced SCHFs.

Keywords: Supracondylar humerus fractures, pediatric patients, Delay in presentation, closed Callostasis

1. Introduction

SCHFs represent a frequent orthopedic challenge in the paediatric population, often arising from falls, sports-related injuries, and everyday accidents [1]. The management of acute *SCHFs* in children is a well-documented and standardized procedure, with established guidelines in the medical literature [2]. However, the delayed presentation of such fractures is a distinctive and relatively common clinical scenario, particularly prevalent in low-resource or third-world countries due to various factors, including limited access to healthcare services, socio-economic constraints, and a lack of awareness [3].

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Delayed presentations of paediatric *SCHFs* pose unique challenges for clinicians. Unlike acute cases, where prompt surgical intervention is the standard procedure, delayed cases require a nuanced approach [4]. Unfortunately, the available medical literature lacks uniform guidelines for managing late-presenting *SCHFs*, leading to considerable variability in clinical practice. Therefore, there is a compelling need to explore and evaluate alternative strategies to address this challenging subset of cases [5].

The goal of this study is to help us learn more about the clinical and radiological outcomes of children with delayed SCHFs who have had a certain type of surgery that includes closed Callostasis, reduction, and percutaneous fixation [6]. By looking into how well this intervention works, we hope to learn more about how to handle cases that have been ignored and maybe find a way to help people in these tough situations [7].

Recently, there has been a growing interest in optimizing the treatment of paediatric orthopedic injuries [8]. As healthcare systems and medical technologies advance, so do the options available for managing these fractures. Therefore, it is crucial to conduct comprehensive studies that reflect contemporary practices and insights into the management of paediatric orthopedic injuries, such as delayed *SCHFs*. While the medical literature has some information on the topic, there remains a dearth of recent studies investigating innovative approaches to treatment, making this research highly relevant and timely [9].

The study looks at a group of people who were prospectively included and had a Type III Gartland SCHF with an arrival delay of seven days or more. Cases with neurovascular injuries or needing open reduction and internal fixation (ORIF) were not included. In evaluating the functional and radiological outcomes, we employ established assessment tools such as the humerocaptellar angle, Flynn's criteria, and Baumann's angle [10].

This research examines 50 paediatric patients, spanning a diverse age range (2–12 years), who presented with delayed *SCHFs*. By carefully documenting the demographics, clinical profiles, and follow-up data, our study strives to elucidate the advantages and limitations of closed Callostasis in managing these complex cases.

2. Methodology

In a prospective cohort study, patients meeting specific criteria were included: Gartland Type III *SCHFs* with a delay of at least seven days and visible fractures on X-rays with accompanying callus formation. Excluded were cases with open fractures, those needing open surgical reduction, vascular or nerve injuries, concurrent ipsilateral fractures, prior elbow fractures, or those lost to follow-up.

Patients received treatment involving closed reduction followed by percutaneous cross-wire fixation under fluoroscopic guidance. A careful closed Callostasis was used to avoid excessive force. In cases where closed reduction was infeasible, the procedure was converted to open reduction. After verification of optimal alignment and pin placement with C-arm imaging, protruding K-wire ends were bent and left external. A long-arm cast or splint was applied with the elbow flexed and the forearm supinated. Patients were discharged after the operating surgeon evaluated postoperative X-rays.

Following two-week assessments for six weeks, three-week intervals for the following six weeks, extended to six-week intervals for an additional three months, and finished with three-month intervals for a year. At each outpatient visit, X-rays of the elbow were taken in anteroposterior and lateral views. Cast and wire removal occurred 4-6 weeks post-operatively, coinciding with the initiation of physiotherapy for range-of-motion exercises. Clinical and radiographic outcomes were reviewed at six months and one year.

Clinical assessment included range of motion, functional evaluation, neurovascular examination, and carrying angle. Radiographic evaluation compared initial and final humerocapitellar and Baumann's angles. Grading followed Flynn's criteria.

3. Results

A total of 50 patients met the inclusion criteria for this study, all of whom presented with closed Gartland type III fractures. The mean delay in fracture presentation was 12.8 ± 4.6 days, ranging from 7 to 24 days. The mean follow-up period extended to 14.2 ± 3.6 months, with a range of 6 to 22 months. On average, patients spent 3.5 ± 2.1 days in the hospital, with a range of 1 to 9 days.

The functional and cosmetic assessment relied on Flynn's criteria, and based on this grading system, 32 (64%) patients achieved excellent results. At the one-year follow-up, 46 (92%) of the patients had full range of motion (ROM), while 4 (8%) had poor ROM in both flexion and extension. This was mostly because they didn't follow through with their treatment plan.

There were complications in 7 patients: 4 (8%) had pin tract infections; 1 had olecranon fracture addressed with two pins; 1 cubitus varus; 1 iatrogenic ulnar nerve injury; and 2 had preoperative medial nerve injuries. All nerve injury patients fully recovered within 3 months.

Table 1: Patient Demographics and Characteristics

Characteristic	Value
Total Patients	50
Gartland Type-III Fractures	50
Average Delay in the Presentation (days)	12.8 ± 4.6 (7-24)
Mean Follow-up Period (months)	14.2 ± 3.6 (6-22)
Mean Hospital Stay (days)	3.5 ± 2.1 (1-9)

Table 2: Functional and Cosmetic Assessment

Assessment	Number (Percentage)
Excellent Results (Flynn's Criteria)	32 (64%)
Full ROM at One-Year Follow-up	46 (92%)
Deficient ROM at One-Year Follow-up	4 (8%)

Table 3: Complications	
Complication	Number (Percentage)
Pin Tract Infections	4 (8%)
Olecranon Fracture during Reduction	1 (2%)
Cubitus Varus	1 (2%)
Iatrogenic Ulnar Nerve Injury	1 (2%)
Preoperative Medial Nerve Injuries	2 (4%)
Nerve Injury Recovery within 3 Months	All cases

4. Discussion

Displaced SCHFs, especially Gartland type III, are a tough orthopaedic problem that needs a well-thought-out treatment plan [11]. Late presentations are notably frequent in developing countries, posing additional complexities [12]. Neglected *SCHFs*, typically defined as those presenting more than two weeks after trauma, introduce distinctive treatment difficulties [13]. Closed reduction of such fractures becomes intricate due to swelling, contracted soft tissues, compromised skin condition, and the presence of a soft tissue callus at the fracture site, elevating the risk of perioperative and postoperative complications [14].

The relationship between delayed presentation and the likelihood of requiring conversion to open reduction is well documented [15]. The rate of conversion to open reduction is influenced by the duration of delay, with studies reporting a range from 3% to 46% for delays of a few hours, which can escalate to 75% for delays extending to days [16]. In our study, 8.6% of cases required conversion to open reduction. Notably, these cases exhibited delays exceeding 3 weeks, and the conversion was necessitated by thick callus formation or unique fracture characteristics, emphasizing the challenges associated with neglected fractures.

ORIF of *SCHFs* carry their own set of complications, including an increased risk of superficial and deep infections, postoperative disfigurement, and elbow stiffness [17]. In our study, 6.5% of patients experienced superficial pin tract infections, which were successfully managed with pin removal, oral antibiotics, and regular dressing.

Debate surrounds pin placement's biomechanical impact [18]. While some studies find no difference, others suggest superior stability with cross pins [19]. Medial pins carry ulnar nerve injury risk [20]. Our study used a modified mini-approach, resulting in only one case (2.2%) of ulnar nerve injury, resolved within three months.

Neglected *SCHFs* are typically managed with ORIF, resulting in varying functional outcomes and increased complications [21]. Skeletal traction followed by closed pinning, while providing fair function, has its downsides, including longer hospital stays and potential corrective osteotomies [22–23]. In contrast, Tiwari et al. reported superior outcomes with percutaneous pinning in cases with shorter delays, advocating for closed fixation over other methods [12]. In our study, we achieved excellent outcomes in 71.7% of patients, while 21.7% had good outcomes based on Flynn's grading criteria. These results are in line with other studies, demonstrating the feasibility of the closed osteoclasis, reduction, and percutaneous pinning techniques.

5. Conclusion

In conclusion, the method that uses closed Callostasis, reduction, and percutaneous k-wiring works well for delayed Gartland III SCHFs. It provides comparable outcomes to ORIF, with a low complication rate and strong union rates, making it a valuable choice in managing such complex fractures.

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