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Original Article

# Clinical Auditing on Rehabilitation of Supracondylar Fracture of Humerus among Children at a Tertiary Care Hospital

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## Abstract

***Background:*** *Supracondylar Humeral Fractures in Children (SCFH) are one of the most common paediatric fractures. This study evaluated the impact of exercise compliance on functional outcomes in patients following the removal of casts and K-wires who were treated either conservatively or with closed reduction and fixation, respectively.*

***Materials and methods:*** *This observational study at Chattagram Maa-Shishu O General Hospital (July 2023–June 2024) included 100 children (2–14 years) with SCFH treated by casting or CRIF. The purposive sampling technique was used. Data were collected via a pretested semi-structured questionnaire and analyzed using SPSS version 26.0. ROM was assessed post-treatment using Flynn's criteria at 2, 4 and 6 weeks, comparing outcomes between adherent and non-adherent exercise groups.*

***Results:*** *Among the patients, 64% were male and 36% female. Most were aged 2–9 years (91%) notably 4–6 years (34%) and 2–3 years (32%). Adherent patients who exercised had significantly better ROM outcomes than non-adherent ones. In the CRIF group, 84.2% of adherent patients achieved good ROM versus 15.0% of non-adherent. In the cast group, 80.6% of adherent patients achieved good ROM versus 10.7% of non-adherent. Non-adherence increased the odds of poor outcomes by 28.7 times in the cast group (p=0.001) and 25.1 times in the CRIF group (p=0.03). Key barriers to follow-up were financial issues (60%) and lack of awareness (40%).*

***Conclusion:*** *Compliance with exercise is a major determinant of functional outcome following SCFH treatment in children regardless of treatment technique. The stark contrast in outcomes between compliant and non-compliant patients highlights the need for standardized rehabilitation protocols, like collaborative interventions between musculoskeletal or orthopaedics physiotherapists and orthopedic surgeons, to improve exercise compliance in pediatric orthopedic care.*

**Key words:** Exercise; Rehabilitation; ROM; SCFH.

## INTRODUCTION

Clinical auditing is a quality improvement process that critically evaluates patient care against set standards to enhance healthcare outcomes. The Health Insurance Organization identifies it as "A quality improvement process that aims to enhance patient care and outcomes through systematic assessment of care against explicit criteria and the implementation of change".[1] Supracondylar humeral fractures represent approximately 16-18% of all Paediatric fractures and 50-70% of all elbow fractures in children aged 2-14 years.[2] These fractures occur with the greatest frequency between the ages of 5-8 years, which is a time of life during which the area of the supracondylar is thin and liable to injury.[3] The pattern of fracture takes place at the anatomical location exactly overlying the distal humeral condyles, where the bone is narrower, hence a structural point of weakness during falling.[4]

The mechanism of injury is typically hyperextension trauma of the elbow on a fall onto an extended hand. Secondary varus or valgus forces are often included in this initial mechanism, as they influence the resultant fracture pattern and potential complications.[5] The Gartland classification system remains the most widely utilized scheme for SCFH classification and treatment planning. Type I fractures are non-displaced or minimally displaced (<2mm) with cortical continuity. Type II fractures are partially displaced with an intact posterior cortical hinge, while Type III fractures are completely displaced without cortical contact between fragments.[6] Type IV fractures (multidirectional instability with circumferential periosteal disruption) and the subdivision of Type III into posteromedial and posterolateral displacement patterns with varying neurovascular risk profiles were more recently incorporated into this system.[7] Type I fractures are typically managed conservatively with immobilization in a cast, while Type II and III fractures typically require closed reduction with percutaneous pinning or open reduction with internal fixation.[8] The most important treatment goals are anatomic reduction, stable fixation, and preservation of neurovascular structures.[9] Nevertheless, despite improvements in surgical methods, problems are still widespread and include cubitus varus deformity, compartment syndrome, neurovascular injuries (i.e. To the ulnar and anterior interosseous nerves) elbow stiffness, and malunion.[10] The severity of these complications rises with fracture severity, the postponement of treatment after 12 hours and suboptimal rehabilitation protocols.[11] While there has been a fall in malunion rates and global improvement in earlier outcomes with surgery improvement, rehabilitation after surgery still is a valuable step towards maximum long-term functioning. Rehabilitation post-SCFH surgery is hugely different from previously. Former excessive immobilizations (4-6 weeks) have been done away with in favor of controlled mobilization routines initiated 3-4 weeks post-pin fixation.[12] Current evidence also shows that systematized rehabilitation protocols reduce stiffness in the elbow by a very significant amount, improve recovery from range of motion and enhance functional outcomes.[12] Active exercises, started at the pin removal time, are key in preventing complications as well as recovering normal biomechanics of the elbow.[13] Not with standing the acknowledgment of the key function of rehabilitation, significant differences in post-operative SCFH practice across institutions exist. These vary in practice and include immobilization duration, initiation time of physical therapy, exercise regimens, and follow-up intervals.[14] Differences may be contributors to suboptimal outcomes and are an area to improve quality through evidence-based practice-based standard protocols. This study critically evaluates the current post-operative rehabilitation procedures for Paediatric SCFH within our tertiary care center against current standards and new evidence. By highlighting potential gaps in rehabilitation approaches and implementing targeted interventions, we anticipate maximizing functional outcomes, reducing rates of complications and establishing standardized protocols for this common Paediatric injury. This observational study will provide critical information for the development of evidence-based rehabilitation procedures tailored to decrease late complications and disability in children.

## MATERIALS AND METHODS

This observational study, which was conducted over a substantial time frame spanning from July 2023 to June 2024, took place within the confines of the Orthopedics department located at the Chattagram Maa-Shishu O General Hospital. A total of 100 patients diagnosed with SCFH, whose ages varied from 2 years old to as old as 14 years old, all of whom had undergone conservative treatment methods either through immobilization utilizing a plaster cast (n=36) or had received treatment via closed reduction and internal fixation employing pinning techniques (n=64), were systematically enrolled in this study. This study employed a purposive sampling method, which was meticulously executed by thorough clinical inspections that were subsequently validated by X-ray imaging of the affected elbow joint, captured in both Anteroposterior (A/P) and lateral views to ensure accurate assessment. Following the imaging and clinical evaluations, the classification of the fractures experienced by the patients was performed according to the established Gartland classification system, which is widely recognized in orthopedic practice for categorizing such injuries. Patients who had received treatment through open reduction and internal fixation, were excluded from participation in this study to maintain the integrity of the data collected. Follow-up of the patients was done at 2nd, 4th and 6th weeks after being asked to initiate active exercise following the removal of plaster cast or K-wires. Outcomes of this study were appraised with the help of Flynn's criteria.[2] These outcomes were then compared between patients who adhered to the exercise regimen and those who didn't.

| Results Rating | Cosmetic Factor (Loss of Carrying Angle in degrees) | Functional Factor (Motion Loss in degrees) |
|---|---|---|
| Excellent | 0–5 | 0–5 |
| Good | >5–10 | >5–10 |
| Fair | >10–15 | >10–15 |
| Poor | >15 | >15 |

Data were analyzed using SPSS version, with significance set at $p<0.05$. Descriptive statistics (Frequencies and percentages) were used for demographic variables, treatment types, follow-up attendance, reasons for missed appointments, complications, and ROM outcomes. Chi-square tests assessed associations between exercise adherence and ROM recovery. Binary logistic regression was applied to identify predictors of poor ROM outcomes, with results expressed as odds ratios (OR) and 95% Confidence Intervals (CI). Exercise adherence emerged as a


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significant predictor and stratified analysis by treatment modality (Cast vs. CRIF) further confirmed this association. Statistical analysis was performed using SPSS version 26.0.

## RESULTS

**Table I** Demographic profiles of study population (n=100)

| Demographic Profile | (n) | (%) |
|---|---|---|
| **Residence** | | |
| City corporation | 53 | 53% |
| Outside city corporation | 47 | 47% |
| **Gender** | | |
| Male | 64 | 64% |
| Female | 36 | 36% |
| **Age** | | |
| 2-3 years | 32 | 32% |
| 4-6 years | 34 | 34% |
| 7-9 years | 25 | 25% |
| 10-12 years | 9 | 9% |
| **Attended School** | | |
| Yes | 49 | 49% |
| No | 7 | 7% |
| Not applicable | 44 | 44% |

Table I presents the demographic profiles of 100 children (n=100) with supracondylar fractures. Residence distribution is minimal in terms of urban predominance (53% from city corporations, 47% from Outside city corporations). There were nearly twice as many males (64%) as females (36%) as one would expect in normal patterns of injury among children. Mean age was 5.49 (± 2.69 years). Distribution by age indicates that most patients were in the age range 2-9 years (91%), with the greatest numbers in the age groups 4-6 years (34%) and 2-3 years (32%) followed by 7-9 years (25%) and only 9% in the 10-12 years age range. This distribution is as would be expected from the established peak incidence of supracondylar fractures early in childhood. School attendance information shows 49% of the children were in school, and 44% were not of school age (Implied as "Not applicable") to put the activity levels and potential injury mechanisms into context. The demographic profile shows a representative sample of pediatric supracondylar fracture patients with expected age and gender distribution according to the epidemiological trends described in the literature.

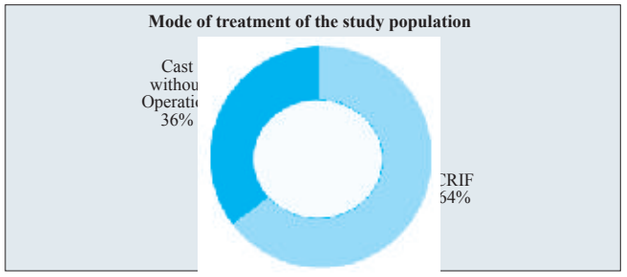


**Figure 1** Mode of treatment of the study population

The donut graph in Figure 1 illustrates the prevalence of the treatment modalities in the 100 supracondylar fractures. As can be seen, Closed Reduction and Internal Fixation (CRIF) was the most frequently employed treatment modality, covering a proportion of approximately 64%. The remaining 36% were treated using a cast without operation. This trend follows the trend in clinical practice where CRIF is applied most commonly in the case of displaced fractures that require to be stabilized, while casting without surgery is most commonly applied to non-displaced or minimally displaced fractures.

**Table II** Follow-up visits of the Study Population at Different Weeks (n=100)

| Follow-up | (n) | (%) |
|---|---|---|
| **At 2nd week** | | |
| Attended | 82 (54 patients underwent CRIF +28 patients underwent Cast Surgery) | 82% |
| Lost to Follow-up | 18 (10 patients underwent CRIF +8 patients underwent Cast Surgery) | 18% |
| **At 4th week** | | |
| Attended | 80 (51 patents underwent CRIF + 29 patients underwent Cast Surgery) | 80% |
| Lost to Follow-up | 20 (13 patents underwent CRIF + 7 patients underwent Cast Surgery) | 20% |
| **At 6th week** | | |
| Attended | 83 (55 patents underwent CRIF + 28 patients underwent Cast Surgery) | 83% |
| Lost to Follow-up | 17 (9 patents underwent CRIF + 8 patients underwent Cast Surgery) | 17% |

Table II documents patient follow-up attendance at regular follow-up visits between the 2nd to 6th week following plaster cast or K-wires removal. At the 2nd week follow-up, 82% were present (54 CRIF patients and 28 cast patients), and 18% were lost to follow-up. Attendance fell slightly at the 4th week visit to 80% (51 CRIF patients and 29 cast patients), 20% failed to attend. Follow-up at the 6th week was improved, at 83% (55 CRIF patients and 28 cast patients) returning, and 17% lost to follow-up.

**Table III** Factors contributing to Missed Follow-up Appointments of the study population (n=100)

| Reasons for lost to follow-ups | (n) | (%) |
|---|---|---|
| Lack of awareness | 40 | 40% |
| Transport cost | 11 | 11% |
| Ticket cost | 7 | 7% |
| Both ticket and Transport Cost | 42 | 42% |

Table III indicates why pediatric patients with supracondylar fractures missed follow-up visits. The strongest reason was lack of awareness and accounted for 40% of the missed visits. This was an indication of a lack of patient-side awareness of


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the need for rehabilitation exercises when physicians had indeed provided postoperative instructions - the need for improved communication channels and enhanced patient education. Both transport and ticket costs accounted for the most burden (42%), which indicates that follow-up compliance is heavily influenced by economic factors. Stand-alone transportation costs (11%) and ticket costs (7%) occurred less but remained big contributors, accounting for a total of 17%. These findings underscore the multifaceted nature of follow-up barriers, as both knowledge gaps and socioeconomic factors were major contributors. The prevalence of cost factors (60% combined) shows that financial assistance programs would significantly improve follow-up compliance. These data are beneficial to guide the planning of tailored interventions that may enhance follow-up attendance and, consequently, potentially enhance clinical outcomes through enhanced continuity of care and rehabilitation surveillance.

**Table IV** ROM Progress Measurement by Exercise Adherence Based on Flynn's Criteria After Cast Removal of the Study Population (n=36)

| Group | Flynn's criteria | After 2 weeks (n=15) | (%) | After 4 weeks (n=20) | (%) | After 6 weeks (n=22) | (%) |
|---|---|---|---|---|---|---|---|
| Exercise Adherent group | Excellent | 14 | 50% | 15 | 51.7% | 18 | 64.3% |
| | Good | 1 | 3.5% | | | 2 | 7.1% |
| | Fair | | | 4 | 14.3% | 2 | 7.1% |
| | Poor | | | 1 | 3.5% | | |
| Non-Adherent group | Flynn's criteria | After 2 weeks (n=10) | (%) | After 4 weeks (n=9) | (%) | After 6 weeks (n=6) | (%) |
| | Excellent | | | | | | |
| | Good | | | | | | |
| | Fair | 4 | 14.3% | 2 | 7.1% | | |
| | Poor | 6 | 21.4% | 7 | 25% | 6 | 21.4% |

Table IV demonstrates the range of motion (ROM) follow-up measurements in 36 patients after cast removal, categorized by exercise compliance according to Flynn's criteria. The outcomes are taken into account at three time points: 2nd, 4th and 6th weeks post-removal. At the 2nd week postoperative, the adherent patients fared better, with 50% of them experiencing "Excellent" ROM and 3.5% "Good." Non-adherent patients fared worse, with only 10.7% doing "Excellent," 14.3% "Fair," and 21.4% "Poor." By week 4, there was a gap in the exercise-adherent group, 51.7% were "Excellent" ROM, and 14.3% were "Fair" with only 3.5% "Poor." In the non-adherent group, no one was at "Excellent" rank, but 7.1% were "Fair" and 25% "Poor." At 6th week, exercise-adherent patients remained improving with 64.3% with "Excellent" ROM, 7.1% "Good," and 7.1% "Fair." All non-adherent patients (21.4%) remained in the "Poor" range.

**Table V** ROM Progress at Follow-up Weeks Based on Flynn's Criteria after CRIF of the study population (n=64)

| Group | Flynn's criteria | After 2 weeks (n=40) | (%) | After 4 weeks (n=35) | (%) | After 6 weeks (n=45) | (%) |
|---|---|---|---|---|---|---|---|
| Exercise Adherent group | Excellent | 35 | 64.8% | 25 | 54.3% | 32 | 58.1% |
| | Good | 5 | 9.2% | 4 | 8.7% | 13 | 23.6% |
| | Fair | | | 6 | 13% | | |
| | Poor | | | | | | |
| Non-Adherent group | Flynn's criteria | After 2 weeks (n=14) | (%) | After 4 weeks (n=11) | (%) | After 6 weeks (n=10) | (%) |
| | Excellent | | | | | | |
| | Good | | | | | | |
| | Fair | 1 | 1.8% | 0 | 0% | 1 | 1.8% |
| | Poor | 13 | 24% | 11 | 23.9% | 9 | 16.3% |

Table V scrutinizes ROM outcomes in 64 patients who underwent Closed Reduction and Internal Fixation (CRIF) stratified by exercise adherence at three follow-up time points. In the 2nd week following K-wire removal in the CRIF treatment group, adherent patients (n=40) had generally good outcomes, with 64.8% showing excellent ROM and 9.2% good ROM. In contrast, nearly all non-adherent patients showed poor recovery, with only 1.8% showing fair results and 24% poor results. During the 4th week assessment, 54.3% of the compliant patients achieved excellent ROM, with additional patients experiencing good (8.7%) and fair (13%) outcomes. All non-compliant patients (23.9%) continued to have poor outcomes. At the 6th week assessment, it was also seen that the continuation of this trend, with 58.1% of adherent patients having excellent ROM and 23.6% good ROM, while nearly all non-adherent patients (16.3%) remained in the poor category, with only one patient (1.8%) achieving fair ROM. This trend, which was consistent across time points, demonstrates the huge and sustained impact of exercise adherence on functional recovery following CRIF for pediatric supracondylar fractures.

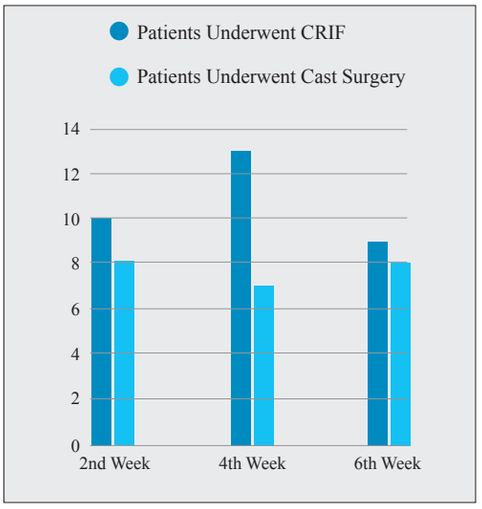


**Figure 2** Distribution of Study Population Based on Lost to Follow-up


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Figure 2 illustrates the interconnection of non-attendance in follow-up across the three phases of assessment by treatment modality. 18% of the patients who did not show up at appointments comprised 10 CRIF and 8 cast patients for the 2nd week follow-up. There was a rate of 20% in non-attendance from the 4th week follow-up with 13 CRIF patients and 7 cast patients who did not show up for appointments. By the 6th week follow-up, non-attendance had decreased modestly to 17%, comprising 9 CRIF patients and 8 cast patients. The follow-up non-attendance rates were quite uniform on the 2nd, 4th, and 6th week assessments, at between 17% and 20%. Such consistency would suggest that follow-up barriers were continuous rather than time-dependent. That is, the causes for which patients failed to attend their appointments were likely to be chronic ones—like economic difficulties, transport issues, or a lack of awareness regarding the need for rehabilitation—and not issues at a given follow-up point. This trend indicates that follow-up adherence was not strongly contingent upon the recovery phase but was instead determined by chronic barriers spread along the entire postoperative period. Awareness of this trend is crucial to shaping efficient interventions and strategically allocating resources to address these persistent barriers and improve patient compliance in the long run.

**Table VI** Association Between Exercise Adherence and ROM Outcome by Treatment Type

| Treatment Type | Exercise Adherence | Good ROM Outcome (n, %) | Poor ROM Outcome (n, %) | Total (n) | p-value | (Chi-Square) |
|---|---|---|---|---|---|---|
| Cast | Yes | 29 (80.6%) | 7 (19.4%) | 36 | 0.01 | 6.63 |
| | No | 3 (10.7%) | 25 (89.3%) | 28 | | |
| CRIF | Yes | 80 (84.2%) | 15 (15.8%) | 95 | 0.003 | 8.71 |
| | No | 6 (15%) | 34 (85%) | 40 | | |
| Combined | Yes | 109 (82.6%) | 23 (17.4%) | 132 | 0.004 | 8.17 |
| | No | 9 (13.6%) | 57 (86.4%) | 66 | | |

Table VI displays a stratified critical analysis of exercise adherence and ROM outcomes by treatment modality. In the cast group, 80.6% of adherent patients achieved good ROM as compared with only 10.7% of nonadherent patients, which is statistically significant (p=0.01). In the CRIF group, too, 84.2% of adherent patients achieved good ROM as compared with only 15.0% of nonadherent patients (p=0.003). On the combination of both treatment groups' data, the trend was the same, with 82.6% of adherent patients possessing good ROM against a mere 13.6% of nonadherent patients (p=0.004). These findings indicate that adherence to exercise is strongly related to favorable outcomes of ROM.

**Table VII** Binary Logistic Regression Results – Predictors of Poor ROM Outcome (Pooled Data)

| Variable | B | SE | Wald | p-value | Odds Ratio (OR) | 95% CI for OR |
|---|---|---|---|---|---|---|
| Intercept | -1.25 | 0.42 | 8.86 | 0.003 | - | - |
| No Exercise Adherence | 2.10 | 0.50 | 17.64 | 0.02 | 8.17 | 3.09 – 21.58 |

Table VII represents binary logistic regression estimates of poor range of motion (ROM) outcomes. The intercept (B = -1.25, p = 0.003) is the reference log odds of negative ROM outcomes when all the predictors are at zero. Being statistically significant, it indicates that the reference odds of negative ROM are significantly larger than zero and provide a useful point of reference for the model. The "No Exercise Adherence" variable (B = 2.10, p = 0.02) is an extremely strong predictor of adverse ROM outcomes. With an odds ratio of 8.17 (95% CI: 3.09-21.58) non-adherent patients were approximately 8 times more likely to experience adverse ROM outcomes compared to adherent patients. This large and statistically significant effect emphasizes the critical role that exercise adherence plays in rehabilitation to maximize the range of motion.

**Table VIII** Odds of Poor ROM Outcome by Group

| Group | Exercise Adherence | Poor ROM Outcome | Odds Ratio (95% CI) | p-value |
|---|---|---|---|---|
| Cast | Yes | 19.4% | Ref. | 0.001 |
| | No | 89.3% | 28.7 (6.4 – 129.1) | |
| CRIF | Yes | 15.8% | Ref. | 0.03 |
| | No | 85.0% | 25.1 (7.4 – 85.4) | |
| Pooled | Yes | 17.5% | Ref. | 0.004 |
| | No | 84.4% | 8.17 (3.09 – 21.58) | |

Table VIII contrasts exercise-adherent and non-adherent range of motion (ROM) results. Adverse ROM results were uncommon in exercise-adherent patients, occurring in only 19.4% of the Cast group, 15.8% of the CRIF (Closed Reduction Internal Fixation) group and 17.5% in all patients. This demonstrates that failure to regain motion was relatively uncommon when rehabilitation protocols were followed. On the other hand, non-adherent patients had significantly higher percentages of poor ROM: 89.3% in the Cast group, 85.0% in the CRIF group, and 84.4% in the combined data. The odds ratios also reflect this difference. Non-adherent Cast patients were 28.7-fold more likely to experience poor ROM outcomes than their adherent counterparts (95% CI: 6.4–129.1, p = 0.001), and non-adherent CRIF patients were 25.1-fold more likely (95% CI: 7.4–85.4, p = 0.03). Non-adherence tended to be linked to an 8.17-fold increase in the odds of poor ROM outcomes (95% CI: 3.09–21.58, p = 0.004). These findings emphasize the very important role of adherence to exercise in achieving effective results of rehabilitation regardless of the treatment method utilized.

## DISCUSSION

This study provides robust evidence on the crucial importance of exercise adherence in rehabilitation after SCHF in children, regardless of treatment. Our findings demonstrate that exercise adherence is strongly associated with improved range of motion results and lower complication rates, substantiating the importance of standardized rehabilitation protocols in pediatric orthopedics practice.[15,16] Demographic profile of the population in our study was representative of established epidemiologic patterns of SCFH, where males presented in 64% of cases, and 91% of the patients were in the age group of 2-9 years. This predominance of males and younger children is consistent with previous reports of Omid et al. and Landin et al. where the same age and gender patterns among pediatric SCFH patients were noted.[2,17] The proportionate even distribution between urban (53%) and rural (47%) patients suggests that this pattern of injury traverses' geographical locations and socio-economic levels.[18] Our treatment strategies reflect modern clinical practice trends, with Closed Reduction and Internal Fixation (CRIF) as the preferred approach (64%) compared to cast immobilization (36%).[19] This concordance is understandable in so far as CRIF is generally reserved for displaced fractures (Gartland Types II and III), which again typically comprise the bulk of SCFH cases presenting to tertiary centers.[6,20,21] Of note was the consistent follow-up attendance rate of approximately 80-83% at all time points, indicating a relatively uniform pattern of patient compliance.[22] Nevertheless, the follow-up adherence obstacles in our study-financial limitations (60%) and unawareness (40%)-are major impediments to providing ideal care.[12] Targeted interventions are critical and may comprise mandatory hiring of orthopaedic or musculoskeletal physiotherapists to work in synergy with orthopaedic departments-a resource that is notably missing in most tertiary care centers in our nation. Furthermore, the creation of organized patient education programs, the use of reminder systems, and the introduction of financial support schemes may be crucial in enhancing follow-up adherence. s were 28.7 times more likely to have unfavorable ROM outcomes compared to compliant patients, while in the CRIF group, non-compliant patients had 25.1 times higher odds of unfavorable outcomes.[23] These findings support the definite requirement for compliance with exercise during rehabilitation, as with Wang et al. who demonstrated improved recovery of elbow ROM with organized rehabilitation protocols.[24] Complication rates were also greater in non-adherent patients, with 9% experiencing stiffness of the elbow compared to 4% in adherent patients. Additionally, 4% of non-adherent patients experienced loss of carrying angle, and 1% reported difficulty eating—complications not encountered in the exercise-adherent group.[25] These findings are consistent with previous study by Hung et al. who demonstrated the benefit of early controlled mobilization in reducing complication rates in orthopedic injury.[12] The logistic regression model also confirmed these results, with not exercising being a critical predictor of inadequate ROM results (OR: 8.17, 95% CI: 3.09-21.58). The effect size also points toward the crucial position that exercising plays in the success of recovery post-SCFH in children. Our findings differ from those reported by Schmale et al. who did not detect any functional benefit of physical therapy following supracondylar humeral fractures in their randomized controlled trial.[26] This may be because of variations in study design, patient groups, or the nature of the exercises and rehabilitation programs.[27,28] Unlike in their trial, our non-randomized observational study specifically aimed at patient adherence to prescribed active exercises, rather than the comparison of different rehabilitation modalities. This may account for the conflicting results.These findings hold important implications for pediatric SCFH treatment in the clinical setting. These suggest that single-handedly carrying out proper surgical or conservative therapy alone is not enough to achieve optimal outcomes, but rather an integrated approach involving organized rehabilitation protocols and measures to ensure high levels of exercise compliance is required to ensure maximum functional recovery in these patients.

## LIMITATIONS

This study has several limitations. First, because it was observational in nature, causal conclusions regarding the impact of exercise adherence on functional outcomes cannot be clearly established. Second, exercise adherence was conceptualized based on self-report rather than direct observation and consequently may be subject to recall bias. Third, the single-center study design and relatively short follow-up period may limit the generalizability of results and the ascertainment of long-term complications. Fourth, certain patient populations were excluded from the study plan—i.e. supracondylar humeral fracture patients underwent Open Reduction and Internal Fixation (ORIF) and non-giving informed written consent patients. These are potential limitations for generalizability of our data to all cases of SCFH.

## CONCLUSION

Compliance with exercise is also a major determinant of follow-up functional result after supracondylar humeral fractures of children, wherein non-compliant patients are at significantly high risk for poor motion and complications regardless of the kind of treatment adopted. Our data confirms that good rehabilitation is not only an adjunct but also a critical component of SCFH care with considerable implications on long-term functional results. The striking difference in results between adherent and non-adherent patients underscores the value of standardized rehabilitation protocols and focused interventions to enhance exercise adherence in pediatric orthopedic practice. Adoption of such measures could dramatically elevate the quality of care and functional outcomes for children with this common pediatric fracture.


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## RECOMMENDATIONS

Future research and policy decisions need to include compulsory hospital employment of Orthopaedics/ Musculoskeletal Physiotherapists to function in liaison with orthopedic departments, a liaison that does not exist in most tertiary care hospitals in our country. At the same time, future research needs to focus on developing standardized, evidence-based rehabilitation interventions according to different types of SCFH and treatment modalities. In order to facilitate exercise adherence, particularly in resource-poor settings, patient-centered interventions such as mobile health applications, gamification of exercises and telerehabilitation should be explored. Additionally, multi-center randomized controlled trials comparing a number of intervention approaches would provide more robust evidence to guide clinical practice and policy in pediatric orthopedic rehabilitation.

## DISCLOSURE

All the authors declared no competing interest.

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