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Original Research Article

Comparison between Conservative Casting and Operative Treatment by K-Wire in Gartland Type II Supracondylar Fracture in Children

Dr. Avishek Bhadra[1*], Dr. Mohammed Gulam Mustofa[2], Dr. A.K.M Zahid Hasan Hemal[3], Dr. Sabbir Ahmed[4], Dr. Ashikur Rahman[5]

[1]Assistant Professor, Department of Orthopaedics, President Abdul Hamid Medical College Hospital, Kishoreganj, Bangladesh
[2]Associate Professor, Department of Orthopaedics, President Abdul Hamid Medical College Hospital, Kishoreganj, Bangladesh
[3]Resident Surgeon, Department of Orthopaedics, Mymensingh Medical College Hospital, Mymensingh, Bangladesh
[4]Assistant Registrar, Department of Orthopaedics, President Abdul Hamid Medical College Hospital, Kishoreganj, Bangladesh
[5]Indoor Medical Officer, Department of Orthopaedics, President Abdul Hamid Medical College Hospital, Kishoreganj, Bangladesh

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Abstract: ***Background:*** Supracondylar fractures are the most common elbow fractures in children, with Gartland type II fractures posing treatment controversies regarding conservative casting versus operative fixation. Optimal management remains debated to achieve the best functional and radiological outcomes while minimising complications. ***Aim of the Study:*** The aim of this study was to compare conservative casting and operative treatment by K-wire in Gartland type II supracondylar fracture in children. ***Methods:*** This observational comparative study was conducted in the Department of Orthopaedics, President Abdul Hamid Medical College Hospital, Kishoreganj, Dhaka, Bangladesh from January 2024 to May 2025. This study includes 50 paediatric patients presenting with Gartland type II supracondylar fractures of the humerus. The participants were divided into two groups each containing 25 patients: Group a included patients treated with conservative casting and Group B include patients treated with K-wire fixation. ***Result:*** Excellent outcomes were observed in 64% of Group A and 80% of Group B. The operative group showed significantly better extension recovery (mean extension lag: 2.2° vs. 3.4°, p=0.01). Baumann's angle, flexion range, and fracture union times were similar between groups. Hospital stay was significantly shorter in the conservative group. Complications differed, with loss of reduction and malunion in Group A, and pin site infections and nerve injuries in Group B. ***Conclusion:*** Both conservative casting and operative K-wire fixation are effective for Gartland type II fractures. Operative treatment showed trends towards better extension outcomes and fewer reductions lost, while conservative management effectively avoided surgical risks with reduced hospital stay.

Keywords: Supracondylar Fracture, Gartland Type II, Children, Conservative Casting, K-Wire Fixation, Functional Outcome, Complications.

INTRODUCTION

Supracondylar fractures of the humerus represent the most common elbow injuries in children, constituting nearly 50–70% of all paediatric elbow fractures and occurring predominantly in children aged 5 to 8 years [1, 2]. These injuries typically result from a fall on an outstretched hand with the elbow in hyperextension, which transmits axial loading forces to the distal humerus, leading to fracture across the supracondylar region [1-3]. The anatomical and biomechanical vulnerability of this region is attributed to its thin cortical bone structure and narrow cross-sectional area, making it susceptible to failure under hyperextension forces [4, 5]. The Gartland classification system remains the gold standard for categorising supracondylar fractures and guiding treatment decisions, dividing fractures into Type I (undisplaced), Type II (displaced with an intact posterior cortex), and Type III (completely displaced with no cortical contact) [6, 7]. Gartland Type II fractures, specifically, are extension-type injuries characterised by cortical disruption with a

***Corresponding Author:** Dr. Avishek Bhadra
Assistant Professor, Department of Orthopaedics, President Abdul Hamid Medical College Hospital, Kishoreganj, Dhaka, Bangladesh

hinge of intact posterior cortex, allowing partial stability but posing risks of angulation and malalignment if not adequately managed [1-8]. The management of Gartland Type II fractures remains controversial despite clear treatment algorithms for Types I and III. While Type I fractures are universally treated with conservative immobilisation and Type III fractures with operative fixation, the optimal treatment modality for Type II fractures continues to be debated in paediatric orthopaedics [1-7]. Conservative treatment typically involves closed reduction under sedation or anaesthesia followed by immobilisation with the elbow in flexion, aiming to utilise the tension of flexor muscles and intact posterior hinge to maintain reduction [9, 10]. The advantages of conservative casting include avoidance of surgical risks, anaesthesia-related complications, and pin tract infections, making it an attractive choice, especially in stable, minimally displaced fractures [9, 10]. However, conservative treatment is associated with risks such as loss of reduction, secondary displacement, malunion with cubitus varus deformity, and the need for subsequent surgical intervention if reduction fails [11, 12]. On the other hand, operative treatment involving closed or open reduction with percutaneous K-wire fixation has become widely adopted for displaced supracondylar fractures due to its ability to provide stable fixation, prevent redisplacement, and allow early mobilisation with predictable functional outcomes [13, 14]. Despite these advantages, K-wire fixation carries risks including pin tract infection, iatrogenic nerve injury, and complications related to general anaesthesia [11-15]. Furthermore, while surgical treatment ensures anatomical alignment, concerns remain about potential injury to neurovascular structures during wire placement and postoperative stiffness if rehabilitation is delayed [12-15]. The literature remains inconsistent regarding the superiority of conservative versus operative treatment in Gartland Type II fractures. Some studies advocate conservative casting for stable reductions to avoid surgical morbidity, while others recommend K-wire fixation even in Type II fractures to minimise the risk of displacement, malunion, and the need for secondary procedures [1-16]. This inconsistency underscores the lack of consensus and highlights the importance of evaluating treatment outcomes in different clinical settings to guide practice. Moreover, despite the high incidence of paediatric supracondylar fractures globally, there is limited high-quality comparative data specifically focused on Gartland Type II fractures in many regional and institutional contexts, restricting the development of standardised treatment protocols tailored to population-specific needs [16, 17]. This study aims to compare the functional and radiological outcomes, complication rates, and treatment effectiveness of conservative casting versus operative treatment using K-wire fixation in children with Gartland type II supracondylar fractures.

Objectives: To compare conservative casting and operative treatment by K-wire in Gartland type II supracondylar fracture in children.

METHODOLOGY & MATERIALS

This observational comparative study was conducted in the Department of Orthopaedics at President Abdul Hamid Medical College Hospital, Kishoreganj, Dhaka, Bangladesh, over a period of seventeen months from January 2024 to May 2025. Total 50 paediatric patients presenting with Gartland type II supracondylar fractures of the humerus were included in the study. After obtaining informed written consent from the guardians, participants were divided into two equal groups of 25 each: Group A consisted of patients managed conservative casting under sedation or anaesthesia, followed by immobilisation in an above-elbow posterior slab or circumferential cast with the elbow flexed at approximately 90 degrees. Group B included patients who underwent operative treatment by closed or open reduction and percutaneous fixation using Kirschner wires (K-wire) under general anaesthesia, followed by immobilisation in an above-elbow slab. Patients were selected based on predefined inclusion criteria, which comprised children aged below 15 years presenting with extension-type supracondylar fractures classified as Gartland type II, confirmed radiologically, who were treated either conservatively with closed reduction and casting or operatively with closed or open reduction and percutaneous K-wire fixation. Exclusion criteria included patients with open fractures, fractures associated with neurovascular injuries requiring urgent surgical exploration, pathological fractures, or those with incomplete follow-up data. Post-treatment follow-up was performed at weekly intervals for the first three weeks and subsequently at six weeks, three months, and six months. All collected data were recorded systematically and analysed using SPSS software version 26. Continuous variables such as age were expressed as mean ± standard deviation, while categorical variables like gender distribution and outcome grades were presented as frequencies and percentages. Statistical significance between treatment groups was evaluated using Chi-square test for categorical variables and independent sample t-test for continuous variables, with a p-value <0.05 considered statistically significant. Ethical approval for this study was obtained from the Institutional Review Board (IRB) prior to commencement.

RESULT

The baseline demographic and clinical characteristics of the participants in both groups are presented in Table I. The mean age of children in Group A (conservative casting) was 6.4 ± 2.1 years, while in Group B (K-wire fixation) it was 6.6 ± 2.3 years, showing no statistically significant difference (p=0.72). The gender distribution was comparable between the groups, with males constituting 60% in Group A and 64% in Group B (p=0.78). Regarding the side of injury, the right side was involved in 52% of cases in Group A

and 56% in Group B, with no significant difference (p=0.79). Table II shows the comparison of functional and radiological outcomes between the groups. Based on Flynn's criteria, an excellent outcome was observed in 64% of patients treated conservatively and in 80% of those treated operatively, though the difference was not statistically significant (p=0.18). Good outcomes were recorded in 20% of Group A and 16% of Group B, fair outcomes in 12% and 4%, and poor outcome was noted in only one patient (4%) in Group A and none in Group B. The mean Baumann's angle was comparable between the groups, measuring 74.2 ± 3.6 degrees in Group A and 75.6 ± 3.2 degrees in Group B (p=0.19). The mean duration of hospital stay, however, was significantly shorter in Group A (1.2 ± 0.6 days) compared to Group B (3.4 ± 1.0 days), with a p-value of <0.001. The mean time to fracture union was similar between the groups, being 4.6 ± 0.8 weeks in Group A and 4.4 ± 0.7 weeks in Group B (p=0.32). Table III depicts the comparison of range of motion at final follow-up. The mean elbow flexion achieved was 130.2 ± 5.6 degrees in the conservative group and 132.4 ± 4.8 degrees in the operative group, showing no significant difference (p=0.08). However, the mean extension lag was significantly higher in Group A (3.4 ± 1.8 degrees) compared to Group B (2.2 ± 1.4 degrees), with a p-value of 0.01, indicating better extension outcomes in the operative group. Table IV outlines parental satisfaction levels. In Group A, 56% of parents reported being very satisfied, compared to 76% in Group B, although this difference did not reach statistical significance (p=0.12). A satisfied response was noted in 32% and 20% of parents in Groups A and B, respectively, while neutral or unsatisfied responses were reported by 12% in Group A and 4% in Group B. Table V summarizes the complications observed in both groups. In the conservative group, loss of reduction occurred in 12% of cases, malunion was observed in 8%, and one patient (4%) required reoperation. In the operative group, no cases of loss of reduction or malunion were reported; however, pin site infection occurred in 8% and iatrogenic nerve injury was noted in 4% of cases. None of the differences reached statistical significance but reflect the differing complication profiles of each treatment modality. Pre-operative, intraoperative and post-operative radiographs are shown from Figure 1-5.

Table I: Comparison of baseline characteristics between the study groups (N=50)

Variable	Group A (Conservative Casting) (n=25)	Group B (K-wire fixation) (n=25)	p-value
Mean Age (years)	6.4 ± 2.1	6.6 ± 2.3	0.72
Gender			
Male	15 (60%)	16 (64%)	0.78
Female	10 (40%)	9 (36%)	
Side Involved			
Right	13 (52%)	14 (56%)	0.79
Left	12 (48%)	11 (44%)	

Table II: Comparison of outcome between the study groups (N=50)

Outcome Variables	Group A (Conservative Casting) (n=25)	Group B (K-wire fixation) (n=25)	p-value
Functional Outcome by Flynn's Criteria			
Excellent	16 (64%)	20 (80%)	0.18
Good	5 (20%)	4 (16%)	
Fair	3 (12%)	1 (4%)	
Poor	1 (4%)	0 (0%)	
Radiological Outcome – Mean Baumann's Angle			
Mean±SD (Degrees)	74.2 ± 3.6	75.6 ± 3.2	0.19
Duration of Hospital Stay			
Mean duration (days) ± SD	1.2 ± 0.6	3.4 ± 1.0	<0.001
Time to Fracture Union			
Mean time (weeks) ± SD	4.6 ± 0.8	4.4 ± 0.7	0.32

Table III: Comparison of Range of Motion (ROM) between the study groups (N=50)

Range of Motion (ROM) at Final Follow-up	Group A (Conservative Casting) (n=25)	Group B (K-wire fixation) (n=25)	p-value
Flexion (degrees)	130.2 ± 5.6	132.4 ± 4.8	0.08
Extension lag (degrees)	3.4 ± 1.8	2.2 ± 1.4	0.01

Table IV: Comparison of satisfaction level between the study groups (N=50)

Satisfaction Level	Group A (Conservative Casting) (n=25)	Group B (K-wire fixation) (n=25)	p-value
Very satisfied	14 (56%)	19 (76%)	0.12
Satisfied	8 (32%)	5 (20%)	
Neutral/unsatisfied	3 (12%)	1 (4%)	

Table V: Complications observed in study groups (N=50)

Complication Type	Group A (Conservative Casting) (n=25)	Group B (K-wire fixation) (n=25)	p-value
Loss of reduction	3 (12%)	0 (0%)	0.07
Malunion	2 (8%)	0 (0%)	0.15
Pin site infection	NA	2 (8%)	0.15
Iatrogenic nerve injury	NA	1 (4%)	0.31
Reoperation required	1 (4%)	0 (0%)	0.31

Figure 1: Preoperative anteroposterior and lateral radiographs showing displaced Gartland type II supracondylar fracture of the humerus in a child

Figure 2: Intraoperative fluoroscopic image demonstrating reduction and alignment assessment during percutaneous K-wire fixation of a supracondylar fracture

Figure 3: Intraoperative fluoroscopic image demonstrating reduction manoeuvre and alignment assessment in a paediatric supracondylar humerus fracture

Figure 4: Post-operative radiographic image illustrating fracture reduction after fixation in extension type supracondylar humerus fracture

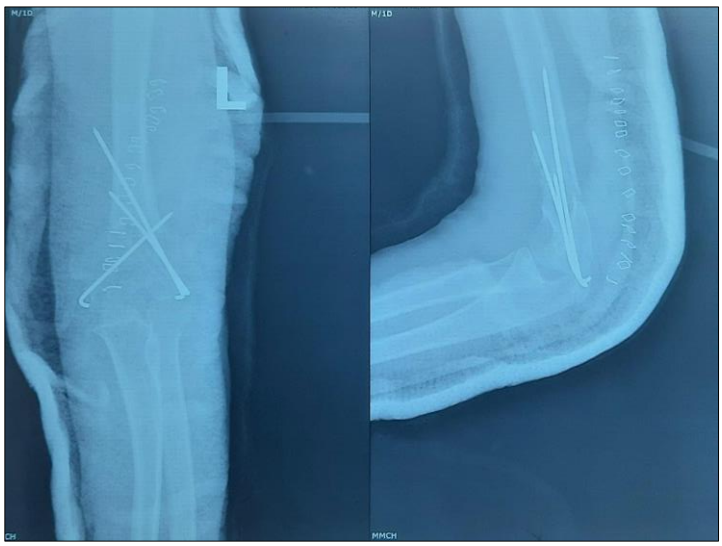

Figure 5: Postoperative radiograph (anteroposterior and lateral views) showing cross K-wire fixation in a Gartland type II supracondylar fracture of the humerus

DISCUSSION

The current study compared conservative casting and operative treatment using K-wire fixation in children with Gartland type II supracondylar fractures, focusing on demographic profiles, functional outcomes, radiological alignment, range of motion, parental satisfaction, and complication rates. The baseline demographic characteristics, including mean age (~6.5 years), male predominance, and right-sided injury distribution, were comparable between groups and align with previous studies reporting similar age and gender distributions in paediatric supracondylar fractures [11-18]. Functional outcomes, assessed by Flynn's criteria, showed a higher proportion of excellent results in the operative group (80%) compared to the conservative group (64%), although the difference was not statistically significant. This trend is consistent with findings by Hussain *et al*., [19], who reported predominantly excellent to good outcomes in operatively treated fractures due to improved maintenance of reduction. Abubeih *et al*., [20]. Similarly found excellent outcomes in ~80% of operatively treated patients. The conservative group in the present study also demonstrated favourable outcomes, with 64% achieving excellent and 20% good results, supporting previous literature suggesting that conservative treatment remains a viable option for stable Type II fractures [19]. The mean Baumann's angle was comparable between groups, measuring 74.2° in the conservative group and 75.6° in the operative group, indicating satisfactory restoration of coronal alignment regardless of treatment modality. This finding is supported by Young *et al*., [21], who reported near-normal Baumann's angles in both treatment groups. Mean hospital stay was significantly shorter in the conservative group (1.2 days) compared to the operative group (3.4 days), reflecting the avoidance of surgical admission in conservative management. Hussain *et al*., [19], similarly reported shorter hospital stays with conservative treatment, which is advantageous in low-resource settings and for reducing healthcare costs. The mean time to fracture union was similar between groups in this study (~4.5 weeks), aligning with previous reports that fracture union rates do not differ significantly between conservative and operative treatments when reduction is maintained [19]. Range of motion analysis showed comparable elbow flexion between groups (130.2° in conservative vs. 132.4° in operative), similar to findings by A Kumar [22], and Young *et al*., [21], who reported flexion recovery above 130° in both modalities. However, the extension lag was significantly higher in the conservative group (3.4°) compared to the operative group (2.2°), indicating better restoration of extension in surgically managed patients. Young *et al*., [21], previously noted lower extension deficits in operative groups due to anatomical reduction stability. Parental satisfaction in this study was higher in the operative group, with 76% of parents reporting being very satisfied compared to 56% in the conservative group, though this difference was not statistically significant. This trend is supported by Wilson & Wilson [23], who reported higher parental satisfaction with surgical treatment due to perceived definitive management, reduced anxiety regarding re-displacement, and earlier return to function. Regarding complications, the conservative group had a 12% rate of loss of reduction and 8% malunion, with one reoperation, consistent with D Kumar [11], and Gahlowt [12], who reported loss of reduction and malunion as common complications in conservative casting, potentially leading to cubitus varus deformity requiring corrective osteotomy. In contrast, the operative group had no cases of loss of reduction or malunion but demonstrated an 8% pin site infection rate and 4% iatrogenic nerve injury, aligning with reported risks of K-wire fixation [22-24]. Rupp *et al*., [25], emphasized the importance of meticulous surgical technique to minimise these complications, including careful medial pin placement to avoid ulnar nerve injury. Overall, while operative treatment demonstrated a trend towards better functional and extension outcomes with higher parental satisfaction and lower loss of reduction rates, conservative casting remained effective in the majority of stable Type II fractures, avoiding surgical risks and reducing hospital stay. These findings underscore the importance of individualised treatment decisions based on fracture stability, surgeon expertise, and parental preference, while highlighting the need for further high-quality comparative studies to establish definitive treatment guidelines for Gartland type II supracondylar fractures.

Limitations of the Study

In our study, there was small sample size and absence of control for comparison. Study population was selected from one center in Kishoreganj city, so may not represent wider population. The study was conducted at a short period of time.

CONCLUSION AND RECOMMENDATIONS

This study demonstrates that both conservative casting and K-wire fixation are effective for treating Gartland type II supracondylar fractures in children. While operative fixation provided slightly better extension outcomes and higher parental satisfaction with fewer losses of reduction, conservative treatment effectively avoided surgical risks and shortened hospital stay. Given the comparable overall outcomes, treatment choice should be tailored to each patient's fracture stability and clinical scenario to achieve optimal functional results with minimal complications in paediatric orthopaedic practice.

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