Annals of Clinical and Medical Case Reports

Research Article

ISSN 2639-8109 | Volume 10

Comparison of Functional Outcomes of above Elbow Backslab Versus Close Reduction and Percutaneous Pinning in Supracondylar Humerus Fracture in Kids

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Received: 07 Mar 2023
Accepted: 18 Apr 2023
Published: 27 Apr 2023
J Short Name: ACMCR

Citation:

Khan I, Comparison of Functional Outcomes of above Elbow Backslab Versus Close Reduction and Percutaneous Pinning in Supracondylar Humerus Fracture in Kids. Ann Clin Med Case Rep. 2023; V10(17): 1-6

Keywords:

Supracondylar fracture; Closed reduction and percutaneous pinning (CRPP); Backslab

1. Abstract

Closed reduction and percutaneous pinning under image intensifier is now the treatment of choice for most of the displaced supracondylar fractures of the humerus in children.

1.1. Objective: To compare the functional outcomes of above elbow backslab versus close reduction and percutaneous pinning in supracondylar humerus fracture in kids.

1.2. Materials And Methods: This Randomized Controlled Trial was conducted in the Department of Orthopedics, Lady Reading Hospital, Peshawar Pakistan from October 2022 to April 2023 on sixty patients (30 patients with closed reduction and percutaneous pinning = Group A, 30 patients with closed reduction and back slab= Group). Non – Probability Consecutive Sampling Technique was used. Patient age 5 to 14 years, Both genders and Patients presenting within 48 hours after trauma with Gartland III supracondylar humerus fracture as per operational definition were included in the study while Patients with open fracture, Patients with vascular injury and Patients with multiple humerus fractures were excluded from the study.

1.3. Results: Age of the patients ranged from 5 to 14 years. Mean age of the patients who received CRPP was 10.04±2.014 years while mean age of the patients who received Backslab was 11.04±1.323 years. Excellent outcomes were observed in 19 patients (63.3%) in CRPP group versus 17 patients (56.7%) in backslab group.

1.4. Conclusion: In pediatric patients presenting with type II and III supracondylar fractures, when compared to backslab, CRPP was associated with higher overall satisfactory results according to Flynn's criteria.

2. Introduction

Supracondylar humerus fracture account for 60 percent of all elbow fractures in kids with a maximum incidence between 4 and 7 years of age [1]. The fracture typically happens to owe to a falling out of an elbow joint hyperextension of an extended side. The distal fragment displaces posteriorly (extension). The distal humerus has a thin area of bone at the olecranon fossa sandwiched between the medial and lateral columns. The central thinning predisposes this area to fracture as the olecranon is hyperextended into the fossa [2]. These fractures were previously handled with casting or traction in the closed decrease [3]. The method, however, has usually been abandoned due to problems in keeping appropriate alignment and circulation with the limb at the same time, especially with displaced bones (type II and III Gartland) [4]. The present technique for treating displaces fractures is closed decrease with percutaneous pin stabilisation, allowing casting in larger elbow extension [5].

Two significant complications connected with this fracture's percutaneous pinning are iatrogenic ulnar nerve injury and decrease loss, cubitus varus / valgus growth or deformity of hyperextension [6] There continues a discussion about the ideal pin setup that gives sufficient stability of the fracture to preserve reductions in bondage and to minimize the risk of neurovascular damage. One popular technique of fixation is the cross-pin configuration, where on the pin is placed at the lateral epicondyle and the other at the

medial epicondyle [7].

In a study by Shoaib MK et al, percutaneous pinning showed excellent outcomes in 65% patients compared 30% excellent outcomes in casting [8]. In another study by Xie and colleagues, excellent outcomes were observed in 83% patients who underwent percutaneous pinning as compared to 20% patients who had casting [3].

Though casting and closed reduction with percutaneous pinning, both treatment options are offered to patients for supracondylar humerus fracture, no latest research has been performed in our local population on the functional outcomes of both techniques. The results of the international literature on this subject are contrasting. Therefore, I planned to determine the functional outcomes of back-slab versus closed reduction and percutaneous pinning for supracondylar fracture in kids in our local population. The results will provide information regarding the effectiveness of both techniques. The results can also be used by researchers in future on this subject.

3. Materials and Methods

This Randomized Controlled Trial was conducted in the Department of Orthopedics, Lady Reading Hospital, Peshawar Pakistan from October 2022 to April 2023 on sixty patients (30 patients with closed reduction and percutaneous pinning = Group A, 30 patients with closed reduction and back slab= Group). Non – Probability Consecutive Sampling Technique was used. Patient age 5 to 14 years, Both genders and Patients presenting within 48 hours after trauma with Gartland III supracondylar humerus fracture as per operational definition were included in the study while Patients with open fracture, Patients with vascular injury and Patients with multiple humerus fractures were excluded from the study.

After taking approval from the research review board of the hospital, 60 patients fulfilling the inclusion criteria were enrolled from the indoor department of the hospital. Informed consent was taken from all study participants ensuring confidentiality and fact that there was no risk involved while taking part in the study. Baseline information including age, gender, BMI, laterality of the limb and time since injury (hours) were noted.

Detailed history and medical examination was performed. Patients were randomized in Group A and B through block randomization. Patients in group A underwent closed reduction and percutaneous pinning under general anesthesia. Fracture was closely reduced under image intensifier and elbow was flexed maximally and stabilized with sterile roll gauze. First pin was passed in displaced fragment. For medial and lateral pinning upper extremity was rotated externally and internally respectively. 2 cross K-wires were passed while crossing with each other at 30 degrees angle and engaged the opposite cortex of humerus. K-wires were left protruded through skin up to 4 mm for easy removal later on even in the OPD. No external support was applied. Patients in Group B underwent closed reduction and above elbow back-slab. Procedure for casting was done under analgesia/anesthesia in operation theatre. Fractures were closely reduced and stabilized with back slab/cast and elbow flexed beyond 90 degree with forearm in pronation or supination according to postero-medial or postero-lateral displacement of distal fragment respectively. Back slab was removed after 04 weeks. Functional outcomes in both groups were assessed 4 weeks after the completion of treatment. Functional outcomes were noted as per operational definition using Flynn's criteria.

All the data was recorded by the researcher himself on especially designed

Data was analyzed using statistical analysis program IBM SPSS version 23. Frequencies and percentages were computed for qualitative variables including gender, laterality of the limb and functional outcomes. Mean ± standard deviation were computed for quantitative variables including age, BMI and time since injury. Functional outcomes of both groups were compared. Effect modifiers like age, gender, BMI, laterality of the limb and duration since injury were controlled through stratification. Post – stratification chi square test was applied. p value ≤ 0.05 was considered statistically significant.

4. Results

In this study, age of the patients ranged from 5 to 14 years. Mean age of the patients who received CRPP was 10.04±2.014 years while mean age of the patients who received Backslab was 11.04±1.323 years. Mean BMI, disease duration of CRPP versus Backslab were 22.137±1.8570 versus 22.111±1.7124 kg/m2, 5.15±0.696 versus 5.83±0.898 days respectively as shown in table 1.

Table 2 shows frequency and percentage of the patients in CRPP versus Backslab respectively.

Frequency and percentage of the patients according to gender are shown in table 3.

Table 4 shows frequency and percentage of the patients according to BMI in both groups while table 5 shows frequency and percentage of the patients according to disease duration in CRPP and Backslab respectively.

Table 6 shows frequency and percentage of patients according to laterality of the limb.

Functional Outcomes are shown in table 7. 19 patients (63.3%) had excellent outcomes in CRPP group while 17 patients (56.7%) had excellent outcomes in closed reduction and backslab group.

Table 8-12 shows stratification of functional outcomes with respect to age, gender, BMI, disease duration and laterality of the limb respectively in both CRPP and Backslab respectively.

Table 1: Mean ± Standard Deviation According to Age, disease Duration and BMI

BASELINE CHARACTERISTICS	MEAN ± STANDARD DEVIATION	
	CRPP	BACKSLAB
Age (yrs)	10.04±2.014	11.04±1.323
Disease Duration (days)	5.15±0.696	5.83±0.898
BMI (Kg/m²)	22.137±1.8570	22.111±1.7124

N = 60 (CRPP = 30, Backslab = 30)

Table 2: Frequency and Percentage of Patients According to Age Groups (CRPP vs. Backslab)

AGE (years)	CRPP		BACKSLAB	
	Frequency	Percent	Frequency	Percent
≤10 years	12	40	9	30
>10 years	18	60	21	70
Total	30	100	30	100

N = 60 (CRPP = 30, Backslab = 30)

Table 3: Frequency and Percentage of Patients According to Gender (CRPP vs. Backslab)

GENDER	CRPP		BACKSLAB	
	Frequency	Percent	Frequency	Percent
MALE	15	50	18	60
FEMALE	15	50	12	40
Total	30	100	30	100

N = 60 (CRPP = 30, Backslab = 30)

Table 4: Frequency and Percentage of Patients According to BMI (CRPP vs. Backslab)

BMI (kg/m²)	CRPP		BACKSLAB	
	Frequency	Percent	Frequency	Percent
≥20	21	70	19	63.3
<20	9	30	11	36.7
Total	30	100	30	100

N = 60 (CRPP = 30, Backslab = 30)

Table 5: Frequency and Percentage of Patients According to Disease Duration (CRPP vs. Backslab)

DISEASE DURATION (days)	CRPP		BACKSLAB	
	Frequency	Percent	Frequency	Percent
≤7	21	70	24	80
>7	9	30	6	20
Total	30	100	30	100

N = 60 (CRPP = 30, Backslab = 30)

Table 6: Frequency and Percentage of Patients According to Laterality of the limb (CRPP vs. Backslab)

LATERALITY	CRPP		BACKSLAB	
	Frequency	Percent	Frequency	Percent
RIGHT	20	66.7	18	60
LEFT	10	33.3	12	40
Total	30	100	30	100

N = 60 (CRPP = 30, Backslab = 30)

Table 7: Frequency and Percentage of Patients According to Functional Outcomes (CRPP vs. Backslab)

FUNCTIONAL OUTCOMES	CRPP		BACKSLAB	
	Frequency	Percent	Frequency	Percent
Excellent	19	63.4	17	56.7
Good	10	33.3	11	36.7
Fair	1	3.3	2	6.6
Poor	0	0	0	0
Total	30	100	30	100

N = 60 (CRPP = 30, Backslab = 30)

Table 8: Stratification of Age with respect to Functional Outcomes (CRPP vs. Backslab)

AGE (years)	GROUP	FUNCTIONAL OUTCOMES					P value
		Excellent	Good	Fair	Poor	Total	
≤10	**CRPP**	08(66.7%)	03(25.0%)	01(8.3%)	00(0.0%)	12(100.0%)	**0.066**
	BACKSLAB	05(55.6%)	03(33.3%)	01(11.1%)	00(0.0%)	09(100.0%)	
	TOTAL	13(61.9%)	06(28.6%)	02(9.5%)	00(0.0%)	21(100.0%)	
>10	**CRPP**	11(61.1%)	07(38.9%)	00(0.0%)	00(0.0%)	18(100.0%)	**0.374**
	BACKSLAB	12(57.1%)	08(38.1%)	01(4.8%)	00(0.0%)	21(100.0%)	
	TOTAL	23(58.9%)	15(38.5%)	01(2.6%)	00(0.0%)	39(100.0%)	

N = 60 (CRPP = 30, Backslab = 30)

Table 9: Stratification of Gender with respect to Functional Outcomes (CRPP vs. Backslab)

GENDER	GROUP	Functional Outcomes					P value
		Excellent	Good	Fair	Poor	Total	
MALE	**CRPP**	09(60.0%)	05(33.3%)	01(6.7%)	00(0.0%)	15(100.0%)	**0.737**
	BACKSLAB	08(44.4%)	09(50.0%)	01(5.6%)	00(0.0%)	18(100.0%)	
	TOTAL	17(51.5%)	14(42.4%)	2(6.1%)	00(0.0%)	33(100.0%)	
FEMALE	**CRPP**	10(66.7%)	5(33.3%)	00(0.0%)	00(0.0%)	15(100.0%)	**0.608**
	BACKSLAB	09(75.0%)	02(16.7%)	1(8.3%)	00(0.0%)	12(100.0%)	
	TOTAL	19(70.4%)	07(25.9%)	01(3.7%)	00(0.0%)	27(100.0%)	

N = 60 (CRPP = 30, Backslab = 30)

Table 10: Stratification of BMI with respect to Functional Outcomes (CRPP vs. Backslab)

BMI (kg/m^2)	GROUP	Functional Outcomes				Total	P value
		Excellent	Good	Fair	Poor		
≥20	**CRPP**	13(61.9%)	6(28.6%)	01(4.8%)	00(0.0%)	21(100.0%)	**0.902**
	BACKSLAB	11(57.9%)	07(36.8%)	02(10.5%)	00(0.0%)	19(100.0%)	
	TOTAL	24(60.0%)	13(32.5%)	03(7.5%)	00(0.0%)	40(100.0%)	
<20	**CRPP**	6(66.7%)	4(33.3%)	00(0.0%)	00(0.0%)	9(100.0%)	**0.873**
	BACKSLAB	6(54.5%)	4(45.5%)	00(0.0%)	00(0.0%)	11(100.0%)	
	TOTAL	12(60.0%)	8(40.0%)	00(0.0%)	00(0.0%)	20(100.0%)	

N = 60 (CRPP = 30, Backslab = 30)

Table 11: Stratification of disease duration with respect to functional outcomes (CRPP vs. Backslab)

Duration (days)	GROUP	Functional Outcomes					P value
		Excellent	Good	Fair	Poor	Total	
≥7	**CRPP**	14(66.7%)	7(33.3%)	00(0.0%)	00(0.0%)	21(100.0%)	**0.337**
	BACKSLAB	13(54.2%)	9(37.5%)	2(8.3%)	00(0.0%)	24(100.0%)	
	TOTAL	27(60.0%)	16(35.6%)	2(4.4%)	00(0.0%)	45(100.0%)	
<7	**CRPP**	5(55.6%)	3(33.3%)	1(11.1%)	00(0.0%)	9(100.0%)	**0.71**
	BACKSLAB	4(66.7%)	2(33.3%)	00(0.0%)	00(0.0%)	6(100.0%)	
	TOTAL	9(60.0%)	5(33.3%)	1(6.7%)	00(0.0%)	15(100.0%)	

N = 60 (CRPP = 30, Backslab = 30)

5. Discussion

In children Supracondylar fracture of the humerus is the most common fracture around the elbow [9]. Type I (Gartland) fractures can be adequately managed by immobilization in an above elbow cast [10]. However, controversy exists regarding the optimal treatment for displaced supracondylar fracture (Gartland type II & type III). To correct the rotational malalignment if exist, open reduction is often necessary. However, a new closed reduction technique for the correction of this deformity using a Kirschner wire as a joystick has been introduced [11]. Lateral cross pinning technique (Dorgan's technique) is also recommended by some authors [12]. Multivariate analysis has revealed that a fracture below the level of humeral isthmus was significantly associated with poor prognosis in terms of the range of elbow movement, Flynn grade and angulation. Similarly, age over ten years was also a poor prognostic factor for attainment of the range of elbow movement [13]. [26] Weinberg et al in a biomechanical model compared four osteosynthesis techniques for management of supracondylar fracture and concluded that external fixators are a good alternative to cross pinning if the fracture reduction is difficult due to swelling [14]. In sagittal loading, the external fixators proved to be significantly more stable than crossed pinning [15]. Fahmy et al proposed a posterior intra focal pinning technique for extension type supracondylar fractures of humerus [16]. Li et al described a mini invasive technique using mosquito forceps for reduction of severely displaced supracondylar fractures [17].

Keeping in mind the difficulty and inconvenience of keeping the patients in hospital for long or calling for close follow up, we chose primary fixation with 'k' wires for displaced (Type II & Type III) supracondylar fractures of humerus. This treatment offers adequate stabilization, minimizes soft tissue trauma and promotes rapid recovery. Thus after fracture reduction, fixation with k-wires maintains reduction and allows early mobilization. Post operatively plaster cast with padded foam is given to increase the strength and allowing space for swelling [18]. A few studies suggest that the treatment of an uncomplicated displaced supracondylar fracture can be delayed up to the next day [3,19]. In our study none of the patients had any neurovascular complications at presentation as well as during hospital stay.

Regarding the choice of pinning technique, for displaced extension type supracondylar fractures controversy exists. Intact posterior periosteum prevents rotational misalignment in type II fractures. However, type III fractures are inherently unstable and completely displaced. Associated medial cortex commination adds to this instability further. This is the main reason put forth by the supporters of crossed pinning technique (besides the higher torsional rigidity of the crossed pinning construct) [20]. However there are studies which document that lateral pin fixation is as strong as crossed pinning while decreasing the risk of iatrogenic ulnar nerve injury also [21]. The risk of iatrogenic ulnar nerve injury varies widely and depends on the pin insertion technique. Iatrogenic nerve injuries after operative treatment of supracondylar fractures occur in as many as 3-4% of cases [22]. Brauer et al from a systematic review found that the probability of iatrogenic nerve injury is 1.84 times higher with cross pinning technique in comparison to lateral pinning [23]. However in this study, none of the patients in cross pinning group developed any iatrogenic ulnar nerve injury. Moreover, a separate medial incision to explore the ulnar nerve for medial pin insertion is recommended. In our study, only very few patients with gross swelling of elbow required an incision on medial side because the swelling precluded the palpation of ulnar nerve. In remaining patients, the ulnar nerve was palpable and was pushed backwards with thumb before inserting the medial pin. Based on clinical outcome in our study, there is no significant difference between the two pinning techniques.

According to Flynn criteria final outcome of operative treatment of pediatric supracondylar fractures by closed reduction and percutaneous pinning has yielded excellent result in 57-81% patients, good result in 13-23%, fair result in 3-6% and poor result in 2-14% of patients [24]. In present study, we achieved excellent result in 64% with CRPP and 60% with backslab. Similarly, in another study based on Flynn's criteria, cosmetic results were excellent in 37 (92.5%) patients and good in 3 (7.5%) patients, and functional results were excellent in 36 (90%) patients, good in 3 (7.5%)

patients, and poor in 1 (2.5%) patient. A surgical success rate of 97.5% was noted25. In our study, we observed flexion and extension at the time of final assessment quite similar to the findings of others study [24].

6. Conclusion

Although both techniques displayed impressive results in terms of reduction capabilities and complications, CRPP was superior. CRPP was associated with less loss of range of motion, less loss of carrying angle, and significantly higher overall satisfactory results according to Flynn's criteria as compared to closed reduction and backslab. Future research should be undertaken on larger populations, amplifying the rare findings. This, in turn, will lead to more understanding of the differences between the two management approaches. A future study with constant variables such as the extent of injury, age, gender, and etiology will provide more concrete evidence of which management technique yields more satisfactory results.

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