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ORIGINAL ARTICLE

Kapanji Technique in Pediatric Head and Neck Radius Fractures

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Abstract

Background: ***Most pediatric head and neck fractures are type I and type II, which contain the radius bone and are undisplaced or minimally displaced. Closed reduction and cast immobilization can treat these fractures successfully.***

Aim and objectives: ***To evaluate the radiological & functional results of closed reduction of the Kapandji technique in pediatric head and neck radius fractures.***

Patients and methods: ***A prospective study was performed on Ten pediatric patients who were receiving treatment at Ahmed Maher Teaching Hospital & Al-Hussein University Hospital in Cairo, Egypt from January 2022 to December 2023. Functional results of this technique were evaluated using DASH and Mayo Elbow Performance Score (MEPS).***

Results: ***The average age of the studied patient was 7.2 (range 3 to 12) yrs. 8 patients (80%) were boys & two (20%) were girls, with male to female ratio was 4:1. Regarding pain degree, None in 6 (60%) mild in 4(forty percent), moderate in 0 (0%) & severe in 0 (0%). 7(70%) had excellent MEPS, 2(20%) had good MEPS, 1(10%) had medium, 0(0%) had poor MEPS. The mean duration of follow-up was two years, with a range of 1/2 to 2 years.***

Conclusion: ***Kapandji pinning is a straightforward &less invasive treatment that could potentially replace the open procedure for treating displaced fractures of the radius neck & head in infants following unsuccessful closed reduction.***

Keywords: kapandji technique; Pediatric head; Pediatric neck; Radius fractures

1. Introduction

Ten percent of all fractures in pediatric patients are elbow fractures. Proximal radius fractures, which account for up to 14% of juvenile elbow fractures, are rather uncommon, in contrast to adult fractures. Children from seven to twelve years old are the most commonly affected by radial head and neck fractures. 89% of the cases are radial neck fractures. Up to 39% of radial head or neck fractures have a concurrent fracture, which is frequently overlooked during the first radiograph interpretation process. The way that children with radial neck fractures are treated depends on the degree of angulation, displacement, and skeletal maturity. The majority of cases, Judet types I and II fractures with angulations less than thirty degrees, are either totally or partially immobile. When closed reduction and casting are used to treat these fractures, favorable outcomes are possible.[1] Nevertheless, there is a consensus that surgically treating displaced radial neck fractures with angulations above thirty degrees (Judet type III & IV fractures) is advisable.[2,3,4] Judet type III & IV fractures can be treated in a variety of ways, such as with percutaneous pin reduction [5], elastic stable intramedullary nailing (ESIN)[6], or open reduction with or without internal fixation.[7] Periosteal blood arteries primarily supply the proximal radial epiphysis with blood as it moves from the distal to the proximal orientation. Damage to the blood vessels, such as after a fracture or open reduction dissection, can cut off blood flow to the radial head, which can lead to avascular necrosis or the growth plate closing.[8,9] According to Metaizeau

et al.[10] the ESIN method is to elevate the epiphysis by putting a pin into the radius's medullary canal and forcing it towards the proximal end until it reaches the lower half. This technique allows for the decrease and fixing of fractures outside the joint capsule but within the bone marrow, using a combination of closed reduction and minimally invasive internal fixation while preserving the soft tissue attachments.[11] The study aimed to assess the radiological and functional result of the closed reduction of the Kapandji technique in pediatric head and neck radius fractures.

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2. Patients and methods

This prospective study was done on Ten pediatric patients who sought medical attention at the Emergency Room of Ahmed Maher Teaching Hospital & Al-Hussein University Hospital in Cairo, Egypt, between January 2022 and December 2023.

Inclusion criteria: Age: 3 to 12 years old, Closed or open fracture. (Gustilo grade 1), Mason classification type II and III and Radial head and neck fractures.

Exclusion criteria: Age >12 and <3, highly comminuted fracture head radius, and Mason classification type I and IV.

Preoperative evaluation: All patients underwent the following: Full detailed history, general examination, and local examination of the limb (inspection and motion).

surgical procedure;

Under general anesthesia, the patient's arm was positioned in a supine position on a radio-translucent table without the use of a tourniquet. Just before the anesthetic started, each patient had one dose of a third-generation cephalosporin intravenously. While manually inserting a K wire into the fracture site, the back side of the forearm was bent downward to protect the posterior interosseous nerve. The kapandji technique for fixing distal radius fractures involved using a k-wire as a lever. An image intensifier was used to determine that the radial neck fracture had been correctly realigned after the procedure. Following the reduction, the K-wire was moved to the ulnar side in the same distal direction as when it was first inserted. We did this to make sure the K-wire wouldn't cause any problems with skin buckling if the two routes weren't perfectly aligned. Smaller children were fitted with a 1.4K wire, whereas larger children were fitted with a 1.6K wire. The lateral side of the fracture was reinforced with an extra intrafocal pin in case any residual translation was detected. Following the removal of the protruding K-wire, a long-arm splint was utilized to neutralize the forearm. The K-wire was removed and arm activities could be resumed after four to six weeks of wearing a splint.

Statistical Analysis

Data collected were reviewed, and the collected data was coded manually. These numerical codes were fed to the computer, where statistical analysis was done using the Statistic Package for Social Science Version 22 (SPSS 22) for Windows. A) Descriptive statistics: Quantitative data were presented as mean and standard deviation (mean ± SD). Qualitative data were expressed as numbers and percentages. And B) Analytical statistics

The Chi-square test (X^2) was used to compare groups based on qualitative data. When comparing quantitative data from more than two separate samples of normally distributed data, the one-way ANOVA test is used. An interval of 95% was used for the coefficient. Using these probability (P) values, we were able to determine the significance level: Statistical significance was determined when $P<0.05$.

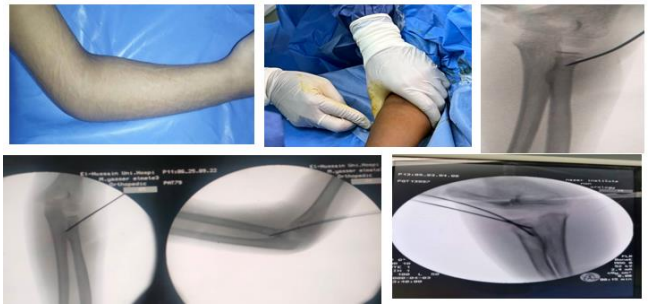

Figure 1: (A-F) Shows Surgical technique

Postoperative evaluation:

Patients underwent a review at 1&2months. The postoperative & final follow-up evaluations utilized the same methods as the preoperative measurements to determine angulation & translation. The mean duration of follow-up was 2 years, with a range of 1/2 to 2 years.

Clinical & radiological evaluation: The most recent follow-up test measured the severity of abnormalities in the full extension &flexion of the elbow &the pronation/supination of the forearm. The degree to which the carrying angle had increased was assessed in the last follow-up evaluation by comparing the affected side to the control limb. Radial head deformity was evaluated by comparing the radial head diameter to the distal humeral condyle diameter in an anterior-posterior radiograph taken at the most recent follow-up appointment. The presence of radial head overgrowth was indicated by a ratio lower than two.

3. Results

We conducted a prospective study on 10 pediatric patients attending at Al-Hussein university hospital and Ahmed Maher Teaching hospital at the time from January 2022 to December 2023.

The average amount of pain in the studied patients was 2.9(range 1 to 5). Regarding pain degree, None in 6 (60%) mild in 4(40%), moderate in 0(0%) and severe in 0(0%). visual analogue scale (VAS) was significantly lower after treatment compared to before treatment (<0.001*)

The average MEPS after treatment in the studied patient was 86(range 80 to 95).7(70%) had excellent MEPS, 2(20%) had good MEPS, 1(10%) had medium, 0(0%) had poor MEPS. MEPS was significantly improved after treatment compared to before treatment.

The average DASH score in the studied patient was 87.5 (range 75 to 100) before

treatment. The average DASH score was 31.1(range 20 to 45). Dash score was significantly lower after treatment compared to before treatment.

Nine out of ten patients had a symmetrical carrying angel, and the range of motion deficits for flexion, extension, pronation, and supination were 0–10°, 0–5°, and 0–15°, respectively.

At the last follow-up appointment, two patients exhibited a greater carrying angle on one side of their body compared to the other. Because of an extension deficiency, one patient could not have their carrying angle assessed. One patient had a radial head deformity, but there was no correlation between the radiological abnormality and the clinical outcome.

Eight cases accomplished exceptional results by the time of the final follow-up evaluation using the grading method developed by Steele et al., one case achieved acceptable results, and one case achieved fair results. An olecranon fracture, which was treated conservatively, was present in the instance that yielded fair results. A functional, aesthetic, or social impairment was not reported by this patient during the last follow-up appointment.

Table1.Distribution of the age and sex in the studied group.

	Studies patients =10	
Average	7.2	
SD	2.82055944	
MIN	3	
MAX	11	
	No	%
Males	8	80%
Females	2	20%

Table2. Pain and DASH score in the studied group.

	Studies patients before treatment =10	Studies patients after treatment=10	P value
Average	5.9	2.9	<0.001 *
SD	1.449138	1.728840331	
MIN	4	1	
MAX	8	5	
Median	6	3.5	
pain			
None	0(0%)	6(60%)	<0.001 *
Mild	2(20%)	4(40%)	
Moderate	4(40%)	0(0%)	
Severe	4(40%)	0(0%)	
DASH score			
Average	87.5	31.1	<0.001 *
SD	8.89756521	6.19	
MIN	75	20	
MAX	100	45	

Table 3. Mayo Elbow Performance Score (MEPS)

	Studies patients before treatment=10	Studies patients after treatment=10	P value
Average	48	86	<0.001*
SD	12.88	5.163977795	
MIN	30	80	
MAX	70	95	
		Studies patients =10	
Excellent		7(70%)	
Good		2(20%)	
Medium		1(10%)	
Poor		0(0%)	

Table 4. Radiological follow up of the studied group

Case	Postop [illegible]	Angulation, last follow-up	Flexion deficit	Extension deficit	Pronation [illegible]	Supination deficit	Increased carrying angle	Enlarged radial head (ratio)	Clinical results
1	0°	2°	0°	0°	0°	0°	0°	Normal	Excellent
2	8°	12°	0°	0°	0°	0°	0°	Normal	Excellent
3	8°	11°	0°	0°	0°	0°	0°	Normal	Excellent
4	6°	6°	0°	0°	0°	0°	0°	Normal	Excellent
5	8°	10°	5°	0°	0°	0°	0°	Normal	Excellent
6	5°	7°	0°	0°	0°	5°	3°	Overgrowth (1.88)	Excellent
7	8°	8°	5°	0°	0°	0°	0°	Normal	Excellent
8	0°	4°	0°	0°	0°	0°	0°	Normal	Excellent
9	4°	4°	5°	0°	15°	10	0°	Normal	Good
10	4°	10°	0°	0°	5°	5°	5°	Normal	Excellent

Table 5. Scores for clinical results of treatment of radial neck fractures

Grade	Loss of flexion-extension	Pronation	Supination	Increased carrying angle
Excellent	0° to 5°	75° to 90°	70° to 85°	0° to 5°
Good	6° to 10°	60° to 74°	55° to 69°	6° to 10°
Fair	11° to 15°	45° to 59°	40° to 54°	11° to 15°
Poor	>15°	<45°	<40°	>15°

CASE PRESENTATION

Figure 2. A girl 8 years old presented with right radial head physeal fracture after falling on

her elbow without complications with intact neurovascular bundle. A: Preoperative X ray B: Intra-operative pinning insertion. C: After 2 weeks follow up D: After one month and removal of the k-wire. E: After 3 months. F: Regain ROM after 3months.

4. Discussion

When treating radial neck fractures in children, the usual approach is to use a posterior splint or a long arm cast with the elbow flexed. If the angle is less than thirty degrees, whether it was before or after the accident or when it was manually realigned, this is an absolute must. [12]

Nevertheless, there is an ongoing dispute regarding the optimal therapy for angulation-related radial neck fractures in pediatric patients above thirty degrees. The level of radial neck angulation, along with the patient's age and the intensity of the trauma, determines the prognosis of this disorder. [13]

Bernstein et al. suggested using non-surgical methods to repair fractures with a radial head angulation of sixty degrees in 6-year-old patients. However, they recommended surgical intervention for cases where the radial head angulation exceeds thirty degrees in twelve years. patients.[13]

Steele et al. established a categorization system based on angulation translation. Grade I refers to angulation between zero to thirty degrees, with less than ten percent translation. Grade II corresponds to angulation between thirty-one to sixty degrees, with translation ranging from Eleven to fifty percent. Grade III involves angulation between sixty-one to ninety degrees, with translation ranging from fifty-one to ninety percent. If the angle is more than 90 degrees and the translation is more than 90, the condition is grade IV. Results in grade I cases were favorable when pain medication and a simple splint were used for 7–10 days. Grades II and III patients were treated with manual reduction or percutaneous leverage fixation, and grades IV patients were treated with open reduction with internal fixation. [12]

The patients included in the study had an average age of 7.5 (ranging from 3 to 12 years). There were eight male patients (80%) and two female patients (20%), for a ratio of four men to two women. The most common way someone could get hurt was by falling on an extended arm. They all managed to avoid further harm. We made sure that every patient was admitted no later than seven days following their accident, and that the reduction process was completed within 48 hours of arrival. The follow-up period ranged from two years on average to two years in the extremes.

Based on Steele et al.'s grading methodology, the percutaneous treatment described was successful and resulted in significant improvement in all cases of isolated lesions to the proximal radius. None of the children required further open reduction surgery due to the percutaneous method's failure or re-displacement.[12]

The radial head's average angulation was 65.8° prior to surgery, 4.69° following surgery, and 7.1° during the most recent follow-up evaluation.

Extension: 0 to 10 degrees; Flexion: 0 to 5 degrees; Supination: 0 to 15 degrees; and Pronation: 0 to 10 degrees were the corresponding ranges of motion deficiencies. Almost all of the patients (n=9) showed symmetrical features in the elbow's carrying angle.

During the most recent follow-up evaluation, patients' carrying angles were found to be higher on the contralateral limb than on the contralateral limb. The absence of extension prevented the evaluation of one patient's carrying angle. There was no association between the radiological abnormality and the clinical result; however, one case of radial head distortion was identified.

Walcher et al. demonstrated that their percutaneous technique successfully and effectively decreased isolated proximal radius lesions in five patients, which we found to be in contrast to our own results. As a result of the percutaneous method's success or displacement, no child needed additional open reduction surgery. The young patients did not complain, and the functional results were good, which may be because the joint capsule and soft tissues were unharmed. [14]

The findings of Kalem et al. They found that eighty-two percent of the patients had great results, eighteen percent had good ones, and that the reduction quality was outstanding (77–214, 89%) according to the radiological results. [15]

Complications, such as failure of bone healing, infection, nerve damage caused by medical intervention, and abnormal bone growth around the joint, were rare. The angle at which the ulna and radius bones did not fuse was between the greenstick olecranon fracture and the radial neck fracture. There seems to be no restriction on further development in the proximal radial epiphysis.

Klitscher et al. achieved outstanding outcomes in eighty-two percent of cases and satisfactory outcomes in five percent of cases, as measured by the MEPS score.[16]

Tarallo et al. reported that the only "minor" consequence seen was 3 cases of radial head enlargements that were not accompanied by any symptoms.[17]

The study conducted by Cha et al.only focused on treating reducible comminuted fractures with a radial neck angulation grade of 3 or above. The approach used in their study involved a noninvasive operative procedure. No issues were reported. [18]

Kalem, At the 26-month follow-up, the single patient who had avascular necrosis happily made a full recovery and got a very good score. [15]

One thing that the study didn't have was Some of the problems with this study were that it didn't follow the carrying angle over the long run, it had a small sample size, its follow-up period was brief, and there weren't very many patients despite having 80% statistical power.

4. Conclusion

In the event that closed reduction has been unsuccessful in treating displaced fractures of the radius neck and head in children, the Kapandji approach is a straightforward and minimally invasive procedure that has the potential to substitute the open operation. It is advised that percutaneous K-wire fixation be used for children who have substantially displaced radial neck fractures and require surgery. This will allow for a satisfactory restoration of radial neck alignment and range of motion.

Disclosure

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Conflicts of interest

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