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A Prospective Study of Open Reduction and Temporary Internal Fixation of Radial Neck Fractures in Children with Failed Closed Reduction

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1. Introduction

Radial neck fractures in children are a relatively common traumatic injury that usually affects the radial neck (metaphysis) in children 9-10 years of age. Treatment depends on the degree of angulation and is surgical if angulation remains greater than 30 degrees after closed reduction is attempted. Median age is 9-10 years.no difference in incidence between sexes.5-10% of all pediatric elbow fractures and 1% of pediatric fractures overall. In our study we reduce open reduction and temporary internal fixation of radial neck in childrens which gives better functional and radiological outcome.

2. Materials and Method

This study includes 22 children with fractures of the radial neck fracture who were treated at SBMCH, Chromepet between January 2010 andDecember2015.The study was concluded in September 2018, so that atleast there was a minimum follow up period was 33 months. Fractures were classified according to the classification system as described by Judet *et al.;*

Grade	1	2	3	4a 4b	5
Radial head angulation	none	<30%	30–60°	60–80° >80°	Epiphyseal separation
Translation	<3 mm	<50%	>50%	>100%	

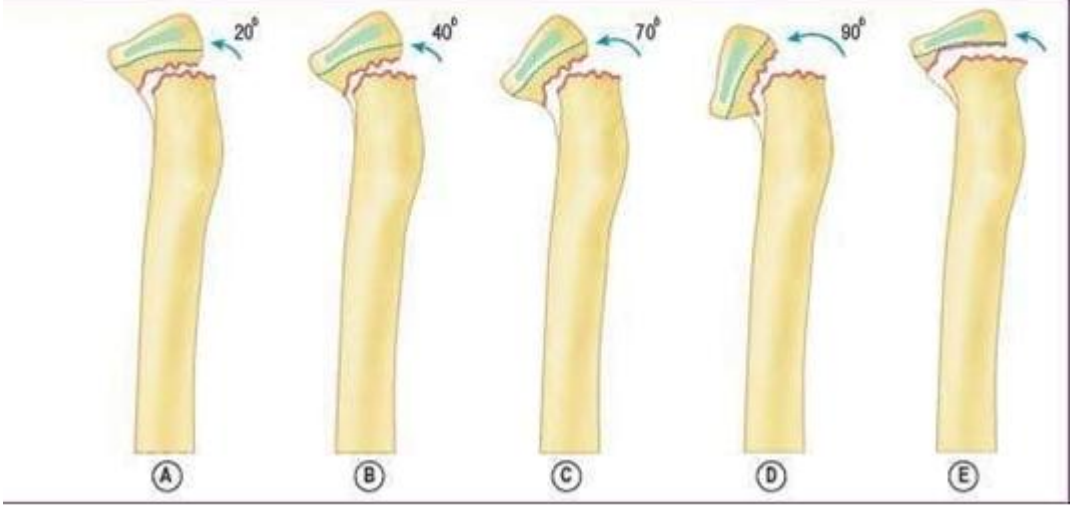

Figure 1: Judetet al.; classification of radial neck fractures

Inclusion criteria

- Closedfractures.
- Displaced radial neck fracture with an angulation of more than 30degree [All are Judet type-3 and type-4] in children with open physeal plates [6-16 years] in whom closed surgical method has failed.
- The time from injury to surgery ranged from 1 day to 10days.

Exclusion Criteria

- Judet type 1 and 2fractures.
- Open fractures.
- Fractures older than 10days.

Children were initially tried by closed method and had notachievedacceptable reduction.The open reduction was performed through posterolateral approach for elbow (Kocher approach).The fracture was reduced under vision

and fixed with 1.5mm smooth single K-wire. In five patients two K-wires had to be used. All K-wires were passed from the proximal fragment to distal metaphyseal or diaphyseal cortex without crossing the capitulum. The K-wire was left protruding out of the skin and was bent over to prevent migration. A long arm cast with the forearm in a neutral position was applied for 21days.Five associated olecranon fractures were treated byclosed reduction and fixation with dual percutaneousk-wires. All children were evaluated clinically and radiologically at the end of 8 and 12 weeks, and thereafter at 6 monthly intervals. The follow-up period ranged from 33 to 60 months, with a mean of 44months.The patients were evaluated for range of motion [ROM], radiological evaluation of alignment, functional results using the Mayo elbow performance score [MEPS] , and early or late complications.

	No. of points *
Pain (45 points)	
None	45
Mild	30
Moderate	15
Severe	0
Range of motion (20 points)	
$>100^0$ flexion arc	20
50^0-100^0 flexion arc	15
$<50^0$ flexion arc	5
Stabiliity (10 points)	
Stable	10
Mild instability ($<10^0$ of varus-valgus laxity)	5
Gross instability ($\geq 10^0$ of varus-valgus laxity)	0
Daily Function (25 points)	
Combing hair	5
Feedingoneself	5
Hygiene	5
Putting on shirt	5
Putting on Shoes	5
Maximum possible (total)	100

*The outcome is rated as follows: excellent, 90 to 100 points; good, 75 to 89 points; fair; 60 to 74 points; or poor, less than 60 points

3. Results

Table 1: Sex distribution of Patients

Gender	N	Percentage
Male	16	72.73 %
Female	6	27.27 %
Total	22	100 %

In this study of all 22 patients,72.73% (n=16) were males and 27.27% (n=6) were females.

Table 2: Age distribution of Patients

Age in Years	Male	Female	Total	Percentage
6-8 yrs	2	1	3	13.63%
8-10 yrs	2	0	2	9.10%
10-12 yrs	3	2		22.72%
12-14 yrs	3	1	4	18.19%
14-16 yrs	6	2	8	36.36%
TOTAL	16	6	22	100%

In this study Mean age was 13 in males and 11 in females. With 12 being the total mean.

Table 3: Radiological criteria for healed radial neck fractures

Radial Headangulation	Assessment Criteria
Anatomical	Excellent
>20 Degree	Good
20-40 Degree	Fair
>40 Degree	Poor

The joint's stability was graded as stable, mildly unstable or unstable. The functional score is determined on the basis of the patient's ability to perform normal activities of daily living. The total score ranges from 5 to 100 points, with higher scores indicating better function. If the total score is between 90 and 100 points, it can be considered excellent outcome; between 75 and 89 points is good; between 60 and 74 points is fair and less than 60 points ispoor.

Table 4: Distribution of Post op neck angle and MEPS SCORE

Results	Postopneck angle		MEPS Score	
	N	%	N	%
Excellent	12	54.55 %	7	31.81 %
Good	6	27.27 %	7	31.81 %
Fair	2	9.09 %	5	22.73 %
Poor	2	9.09 %	3	13.65 %
Total	22	100 %	22	100 %

Table 5: Correlation between timing of surgery and MEPSscore

Days Elapsed After Injury	MEPS Score				Total	%age
	Excellent	Good	Fair	Poor		
1-2 days	5	6			11	50 %
3-4 days	2	1			3	13.64 %
5-6 days			4		4	18.18 %
7-8 days			1	1	2	9.09%
9-10days				2	2	9.09%
TOTAL	7	7	5	3	22	100%

- Best results obtained when intervention was between1-4days.
- Intervening later than 6 days had compromised outcome.

Table 6: Age v/s MEPS Score

Age in Years	MEPS Score				N
	Excellent	Good	Fair	Poor	
6-8 yrs	2	1	0	0	3
8-10 yrs	1	1	0	0	2
10-12 yrs	2	1	1	1	5
12-14 yrs	2	0	1	1	4
14-16 yrs	2	2	2	2	8
Total	9	5	4	4	22
Percentage	40.92%	22.72%	18.18%	18.18%	100%

- Excellent to good results were noted in age group 6-12years.
- Compromised outcomes were noted in age group 12-16years.

Illustrative case 1–Showing excellent functional outcome

Pre-op roentgenography-AP view and Lateral view

Post op roentgenography AP & Lateral images

Illustrative Case 2: Showing compromised outcome

Clinical picture showing good outcome

Pre-oproentgenography

Post- op roentgenograpy

Clinical picture showing COMPROMISED outcome. Note the limitation of pronation on the right side

4. Discussion

In our series based on the clinical evaluation criteria presented, there are 40.92% (n=9) excellent, 22.72% (n=5) good, 18.18% (n=4) fair and 18.18% (n=4) poor results. Different authors have reported vast range of poor outcome following ORIF, with only excellent out come in 50% (n=12), 42% (n=13), and 38% (n=14) cases. Our conclusions are in disagreement with the majority of authors and widely reported literature that open reduction leads to unfavourable outcomes. Almost half the treated patient had an excellent outcome, indicating that in carefully selected cases outcome may be rewarding. Less invasive closed reduction methods must precede before open reduction. The open reduction method of treatment is associated with high incidence of complications like, avascular necrosis, proximal synostosis, heterotopic ossification, infection, premature physeal closure, radial head overgrowth and loss of ROM. These instances are higher than after closed reduction. Some radial neck fractures, in particular severely displaced, are impossible to reduce with closed method and require open reduction. Open reduction is inevitable in cases of comminuted fractures, interposition of the capsule or of the annular ligament between the head and the neck, totally displaced, and fracture dislocation. The factors which influence the final outcome of the radial neck fracture are age of the child, greater initial fracture displacement, delay in surgery, associated injuries, open treatment and residual angulation may contribute to poor outcomes. In our study it was clearly established that cases undertaken for surgery within 2 days had a 50% excellentoutcome.Delay inbetween and surgery adversely reflects the functional outcome. Age is also a good predictor for the long-term result. The remodelling process varies with the age of thepatient.The young children have greater remodelling potential and hence greater degrees of residual angulation can be accepted. However, the proximal physis of the radius is responsible for only 20–30% of the growth of the radius and therefore spontaneous fracture remodelling is compromised. In our study in the age group 6-10 years all 5 patients had excellent or good outcomes. But in the age group of 10-14 years only 5 outof9 patients had excellent to good results. In the age group 14-16 year 4 out of 8 patients had excellent to good results. In our study a residual angulation of 35 degree after closed reduction was considered acceptable, angle greater than 35 degree were considered as indication for open reduction internal fixation. Repetitive closed reduction attempts were deliberately avoided since they can cause irreparable physeal damage. In most published studies, concomitant injuries were associated with unfavourable results. In our series two patients who had associated olecranon fractures which needed dual k-wire fixation had poor outcomes.

5. Conclusion

In the management of paediatric radial neck fracture open reduction and internal fixation should be reserved for cases of residual angle more than 35 degrees or with gross comminution. Our study established that contrary to other available published literature, good results can be obtained in carefully selected cases with gentle manipulative surgery. Younger the age group and shorter the time for surgical intervention, better will be the clinical, radiological and functional outcome.

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