A COMPARATIVE STUDY BETWEEN OUT COMES OF CONSERVATIVE AND SURGICAL MANAGEMENT OF DIAPHYSEAL FRACTURES BOTH BONE FOREARM IN CHILDREN

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ABSTRACT: BACKGROUND: Both bone forearm fractures are common orthopedic injuries in paedtric age group and optimal treatment is dictated not only by fracture characteristics but also patient age and factors like bone's ability to remodel with remaining growth.

AIMS, SETTINGS & DESIGN: Generally, these fractures can be successfully managed with closed reduction and casting, however operative fixation may also be required. The most favorable method of fixation has not been clearly established and hence we proposed to compare outcomes of conservatively managed patients of diapyseal fractures of both bone forearm versus surgical intervention patients in paediatric age group.

METHODS & MATERIAL: In the study of 50 cases, 33 patients were treated by CR+POP application, 11 cases were treated by OR+IF with Plates & Screws and 6 cases were treated by CR+IF with Intramedullary nailing.

STATISTICAL ANALYSIS USED: All information gathered in the study was recorded and analysed with use of the SPSS software package (version 13, SPSS Inc., Chicago, IL).

RESULTS & CONCLUSION: In our study of 50 cases, 33 cases were treated by closed reduction and POP application. Fracture union was seen in all cases between 8 to 12 weeks. At the end of 3 months, 28 patients developed full range of movements with no functional deformity or complaints. One patient had 10-degree loss of pronation, 3 patients had 20-degree loss of pronation [Good] and only 1 patient had 30-degree loss of supination and 10-degree loss of pronation and also complained of pain on strenuous work [fair]. According to the criteria set by Price et al., 29 patients had excellent result, 2 had good result and 2 had fair results in treatment of forearm fracture's in children by closed reduction and plaster of paris (POP) application.

KEYWORDS: Both bone fracture, children, closed reduction, open reduction, intramedullary nailing.

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INTRODUCTION: Fractures of the forearm account for 41.1% of the fractures in the paediatric population and are the relatively most common types of fractures encountered.[1] The majority of these are the fractures of distal radius or ulna. Diaphyseal radial and ulnar fractures make up approximately one-eighth of the total number of forearm fractures. The treatment of diaphyseal fractures of forearm bones in children remains a significant surgical challenge. Treatment options range from conservative to surgical methods. Conservative treatment includes closed reduction and POP application.[2,3] Surgical treatment comprises of closed reduction & internal fixation with intramedullary nails & open reduction & internal fixation with plates.[4,5] Each of these proposed methods has its limitation in certain types of these fractures. The residual deformity following malunited fractures does not always correct, especially in older children.[6,7,8] The conservative methods pose problems like deformity which does not always correct more so in older children, loss of motion, non-union and mal-union but whereas with recent advancement & development in the field of surgical instrumentation, surgical experience and improved rehabilitation techniques has put surgical treatment on the upper hand. The onus of the decision lies with the operating surgeon considering various factors to be taken into account like patient age and fracture characteristics (displacement, angulation and rotation) and economic restraints. Generally, it has been accepted that children younger than 10 years of age have a better remodeling capacity than children older than 10 years.[6,9] Off-ended fractures, rotational mal-alignment and angulation of >10° are other proposed criteria. Most forearm fractures in younger children can be successfully treated with immobilisation by plaster casting following closed reduction.[9,10,11]

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Intramedullary (IM) nailing[12] and plate fixation with screws[13] are the most commonly deployed techniques for operative management of mid-shaft forearm fractures and are quite effective in treating midshaft forearm fractures in paediatric age group. Although a small number of studies have been done to compare both the methods they have not been able to compare endpoints and functional outcomes. The purpose of this study is to determine the outcome of various methods of treatment of diaphyseal fractures of forearm in children and to analyze the complications and causes of failure.

MATERIALS & METHODS: Fifty cases of diaphyseal fractures of forearm in children were treated at JSS Hospital by conservative to surgical methods. Closed reduction and POP application, open reduction and internal fixation with plates and screws, closed reduction and internal fixation with intramedullary nails were the different modes of treatment. Clearance was obtained from ethical committee. The inclusion criteria's were all closed diaphyseal fractures with age less than 14 years. The exclusion criteria were patients with Galeazzi fractures, Monteggia fractures and open/compound fractures. The vital signs were recorded, vascular injuries; compartment syndrome & peripheral nerve injuries were carefully looked for and clinical diagnosis was confirmed by taking antero-posterior & lateral radiographs. The fractures were classified based on Orthopaedic Trauma Association for fractures of the radius and ulna.

The techniques used for closed reduction with POP cast were vertical technique or horizontal technique with or without C-arm. Closed reduction with intramedullary nail fixation was done with contoured square nails, Kirschner nails or rush nails which was introduced proximally or distally in the ulna but were always introduced distally in the radius. For open reduction with internal fixation with plate and screw was done by Henry's anterior approach to the shaft of the radius or Thompson's approach to proximal and middle thirds of Radius with posterior approach to shaft of the ulna.

STATISTICAL ANALYSIS: All information gathered in the study was recorded and analysed with use of the SPSS software package (version 13, SPSS Inc., Chicago, IL). The paired Student t-test (parametric data) or the Wilcoxon signed-rank test (nonparametric data) was used to compare differences between the groups. The grip strength values were individually compared with age- and sex-matched control values for the normal population using the Mann–Whitney U-test. The values of maximum radial bow and its location were compared to normative values using the single tailed t-test.

RESULTS: In the study of 50 patients, 5 patients were below the age of 5 years. All the 5 patients were treated with CR & POP application. There were 17 patients in the age group of 5-10 years in which 15 of the patients were treated with CR & POP application and 2 of the patients were treated with OR+IF with Plates & Screws after an attempt for percutaneous pinning was made [Table-6]. There were 28 patients in the age group of 10-14 years in which 13 were treated with CR & POP application, 9 patients were treated with OR+IF with Plates & Screws and 6 patients were treated with CR + IF with intramedullary nailing. The clinical outcome was graded with a scale used by Price et al and similar to that proposed by Daruwalla.[6,9]

In this study a predominance of males [82%] was seen than females [18%] [Table-1]. Left side [52%] was more common than right [46%] [Figure-1]. Fall [78%] was the commonest mode of injury, followed by road traffic accident [22%] [Table-2]. Simple both bones fracture [22A3] was the commonest type of fracture [80%], followed by 22B3 [8%], 22A2[8%], 22A1[2%] and 22C3[2%] [Table-3]. Both bones fracture [92%] were commonest type of fracture than single bone fracture [8%] [Table-4]. Fracture of Middle 1/3rd [84%] was common than proximal 1/3rd [6%] and distal 1/3rd [10%] [Table-5]. Thirty three cases were treated with CR & POP application. Cases were followed up for 8 to 12 weeks. Radiological union occurred in all cases. There were 29 cases with excellent results, 2 with good results and 2 with fair results. Eleven cases were treated with OR+IF with Plates & Screws [Table-7]. Radiological union occurred in all cases. Patients were followed for 14 to 16 weeks. There were 9 patients with excellent results, 1 with good result and 1 with poor result. Six cases were treated with CR+IF with Intramedullary nails. Patients were followed for 16 weeks. Radiological union occurred in all cases. There were excellent results with 4 cases and good results with 2 cases [Table-8]. Forty three patients developed full range of movements by 4 months. Six patients with mild loss of movement, [20 degrees] and 1 with significant loss of movement [20 degrees]. Results were based on Price et al. scoring system. Pain developed on strenuous work in 3 patients and 1 patient developed pain on daily work. The other complications were loss of forearm rotation of,11-30 degrees in 4 patients & loss of 30 - 90 degrees in 2 patients. The other complications seen were, re-fracture of ulna in 1 patient treated by conservative method, superficial infection in 1 patient & deep infection in one patient treated by OR+IF with plates & screws.

DISCUSSION: Functional outcome forms one of the major factors for consideration of treatment modality following a midshaft both-bone fracture in paediatric age group. The pathophysiology like tough periosteum, an open physis and rapid remodeling in pediatric age group being different allows treatment with non-operative technique with full restoration of forearm function. However, these characteristics feature prominently in younger children but diminish with age, with older children having unpredictable remodeling capacities. A number of studies in the literature have revealed that some children do not regain full forearm function following conservative management.[6,9,14] The studies have concluded that angular and rotatory deformities of the forearm of 10° or less result

in minimum significant loss of forearm rotation. In our study of 50 cases, 33 cases were treated by closed reduction and POP application. Fracture union was seen in all cases between 8 to 12 weeks. At the end of 3 months, 28 patients developed full range of movements with no functional deformity or complaints. One patient had 10-degree loss of pronation, 3 patients had 20-degree loss of pronation [Good] and only 1 patient had 30-degree loss of supination and 10-degree loss of pronation and also complained of pain on strenuous work [fair]. According to the criteria set by Price et al., 29 patients had excellent result, 2 had good result and 2 had fair results in treatment of forearm fracture's in children by closed reduction and POP application.

In our study, 6 cases were operated with closed reduction and internal fixation. According to the criteria set by Price et al, 4 patients had excellent results and 2 patients had good results. In this study, 11 cases of both bone forearm fractures were treated by OR+IF with plates and screws. Nine patients developed full range of movements with no functional deformity or complaints. One patient developed superficial infection and complained of mild pain on strenuous work [good] and 1 patient developed deep infection, 20 degrees loss in both supination and pronation [Table-9, Table-10] with pain on daily work.[poor]. Overall 9 cases had excellent results 1 patient had good results and 1 patient had poor results.

CONCLUSION: To conclude, CR+POP application is the first line of treatment in young children less than 10 years with simple and stable fractures. In the age group of above 5 years displaced fractures can be treated with CR + IF with intramedullary nailing but this procedure is contraindicated in unstable fractures, soft tissue interposition & comminuted fractures. OR+IF with plates and screws offers excellent results in children aged more than 10 years, with displaced, unstable, irreducible or comminuted fractures of the forearm.

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Age in years		SEX		Total
		Male	Female	
Below 5	Frequency	3	2	5
	Percent	7.3%	22.2%	10.0%
5-10	Frequency	13	4	17
	Percent	31.7%	44.4%	34.0%
10- 14	Frequency	25	3	28
	Percent	61.0%	33.3%	56.0%
Total	**Frequency**	**41**	**9**	**50**
	Percent	**100.0%**	**100.0%**	**100.0%**

Table 1: Distribution of sample by age and sex

CC=. 238; P<. 223 (NS): Chi-square for age only = 15.88; P<. 000 (HS)

Mode of injury	Frequency	Percent
Fall	39	78.0
RTA	11	22.0
Total	**50**	**100.0**

Table 2: MOI- mode of injury

X^2=15.68; P<. 000 (HS).

Type of fracture	Frequency	%	Valid %	Cumulative %
22A3	40	80.0	80.0	80.0
22B3	4	8.0	8.0	88.0
22A2	4	8.0	8.0	96.0
22A1	1	2.0	2.0	98.0
22C3	1	2.0	2.0	100.0
Total	50	100.0	100.0	

Table 3: Type of fracture -Orthopaedic trauma association classification

X^2=113.40; P<. 000 (HS)

Bone involvement	Frequency	Percent
BB	42	84.0
U	1	2.0
R	3	6.0
Green stick BB	4	8.0
Total	50	100.0

Table 4: Distribution of the involvement of the bone

X^2=93.20; P<. 000 (HS)

Site	Frequency	Percent
Proximal 1/3	3	6.0
Middle 1/3	42	84.0
Distal 1/3	5	10.0
Total	**50**	**100.0**

Table 5: Distribution of site of fracture

X^2=57.88; P<. 000 (HS)

Treatment		Age			Total
		Below 5	5-10	10-14	
CR+POP	Frequency	5	15	13	33
	Percent	100.0%	88.2%	46.4%	66.0%
OR + IF PLATES	Frequency		2	9	11
	Percent		11.8%	32.1%	22.0%
K WIRE	Frequency			3	3
	Percent			10.7%	6.0%
RN	Frequency			1	1
	Percent			3.6%	2.0%
CR + SQ NAIL	Frequency			2	2
	Percent			7.1%	4.0%
Total	**Frequency**	**5**	**17**	**28**	**50**
	Percent	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Table 6: Treatment & Age Cross tabulation

CC=. 436; P<. 165 (NS)

Treatment		Type of fracture					Total
		22A3	22B3	22A2	22A1	22C3	
CR+POP	F	31		2			33
	%	77.5%		50.0%			66.0%
OR + IF PLATES	F	6	4			1	11
	%	15.0%	100.0%			100.0%	22.0%
K WIRE	F			2	1		3
	%			50.0%	100.0%		6.0%
RN	F	1					1
	%	2.5%					2.0%
CR + SQ NAIL	F	2					2
	%	5.0%					4.0%
Total	**F**	**40**	**4**	**4**	**1**	**1**	**50**
	%	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Table 7: Cross tabulation of Treatment & Type of fractures

CC=. 713; P<. 000 (HS)

Treatments		RESULTS				Total
		Excellent	Good	Fair	Poor	
CR+POP	Frequency	28	3	2		33
	Percent	66.7%	60.0%	100.0%		66.0%
OR + IF PLATES	Frequency	10			1	11
	Percent	23.8%			100.0%	22.0%
K WIRE	Frequency	1	2			3
	Percent	2.4%	40.0%			6.0%
RN	Frequency	1				1
	Percent	2.4%				2.0%
CR + SQ NAIL	Frequency	2				2
	Percent	4.8%				4.0%
Total	**Frequency**	**42**	**5**	**2**	**1**	**50**
	Percent	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Table 8: Comparison of Results with respect to treatment {Price et al criteria}

CC=.500; P<.161 (NS)

Supination		Treatment				
		CR+POP	OR+IF PLATES	K WIRE	RN	CR+SQ NAIL
FROM	Frequency	31	10	3	1	2
	Percent	66.0%	21.3%	6.4%	2.1%	4.3%
50	Frequency	1				
	Percent	100.0%				
60	Frequency		1			
	Percent		100.0%			
80	Frequency	1				
	Percent	100.0%				
Total	Frequency	33	11	3	1	2
	Percent	66.0%	22.0%	6.0%	2.0%	4.0%

Table 9: Cross tabulation between Treatment and Supination

CC=. 291; P<. 970 (NS).

		Treatment				
Pronation		CR+POP	OR+IF PLATES	K WIRE	RN	CR+SQ NAIL
FROM	Frequency	29	10	2	1	2
	Percent	65.9%	22.7%	4.5%	2.3%	4.5%
70	Frequency	3	1	1		
	Percent	60.0%	20.0%	20.0%		
80	Frequency	1				
	Percent	100.0%				
Total	Frequency	33	11	3	1	2
	Percent	66.0%	22.0%	6.0%	2.0%	4.0%

Table 10: Cross tabulation of Treatment with Pronation

CC=. 226; P<. 952 (NS).

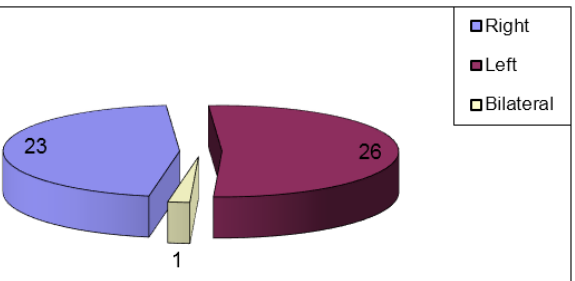

Fig. 1: Graph showing distribution of sample by side

Fig. 2: Instruments used for Nailing

Fig. 3: Intramedullary Nails

Closed Reduction & Internal Fixation of Both Bones

Fig. 4: Fracture of both bones of the forearm

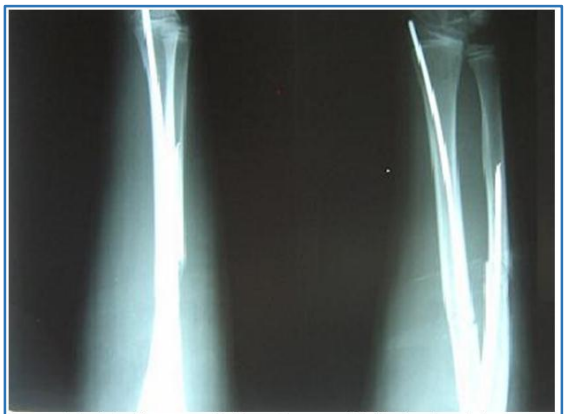

Fig 5: Intramedullary Square Nails for both bones

Closed Reduction & Internal Fixation of Single Bone

Fig. 6: Fracture of both bones of Forearm

Fig. 7: Single bone fixation with Intramedullary Kirschner's Wire

OR & IF with Plates & Screws:

Fig. 8: Incision for the shaft of the radius by Henry's approach

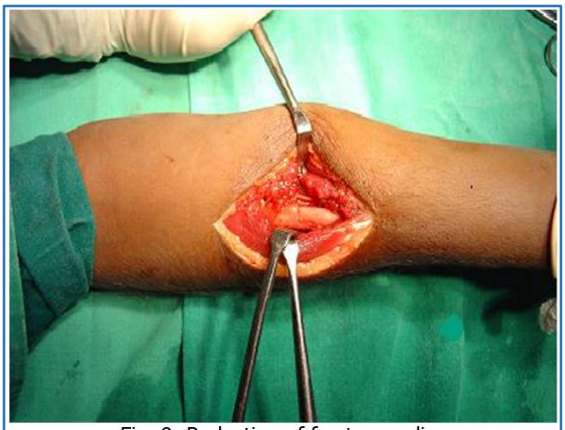

Fig. 9: Reduction of fracture radius

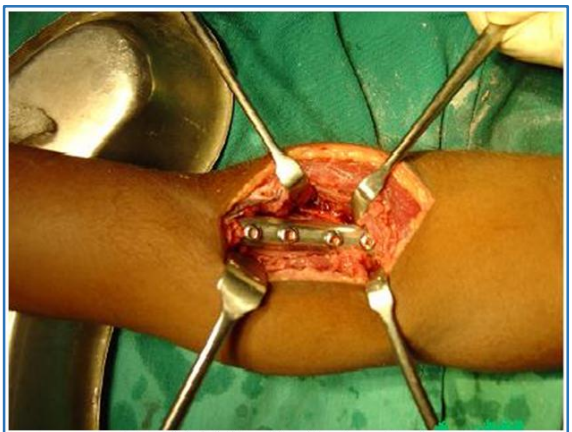

Fig. 10: Plating for fracture Radius

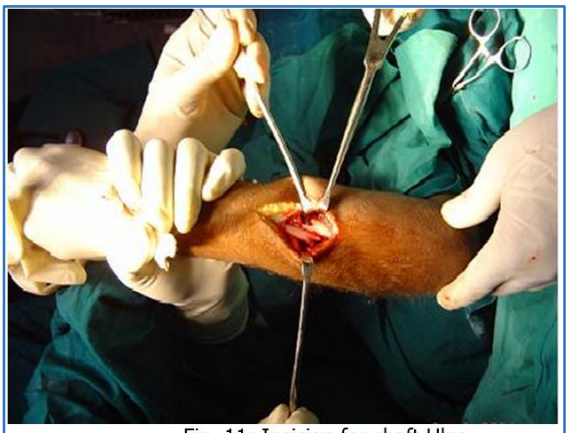

Fig. 11: Incision for shaft Ulna

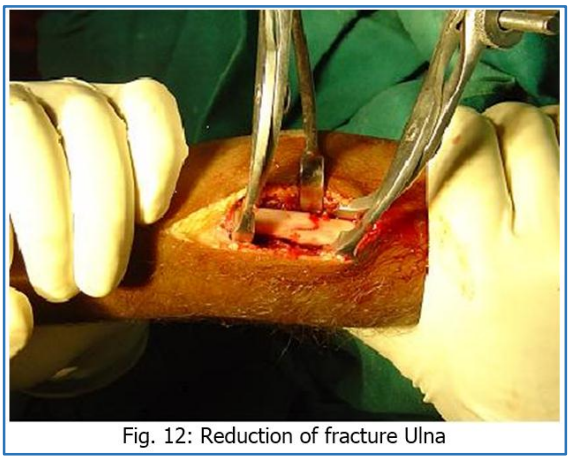

Fig. 12: Reduction of fracture Ulna

Fig. 13: Plating of fracture Ulna

RESULTS:

Fig. 14: Closed Reduction & POP application

Fig. 15: Closed Reduction & Internal Fixation

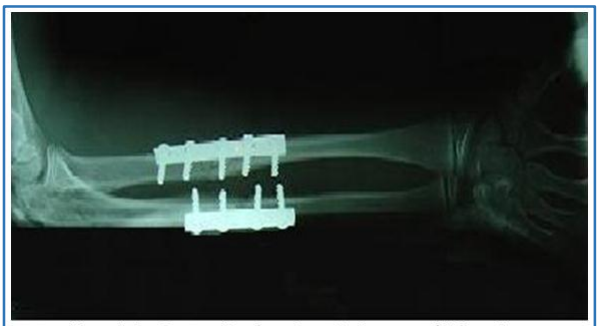

Fig. 16: Open Reduction & Internal Fixation