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Functional outcomes of fixation of radial neck fractures in children by Metaizeau technique: A case series

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Abstract
Radial neck fractures account for 1% of all fractures in children and 5% to 14% of traumatic elbow injuries. They are mainly caused by having fallen onto an out-stretched hand. Classification: O'Brien and Judet classification.
The purpose of this study was to review the functional outcomes of the management of radial neck fractures in pediatric age group using Métaizeau technique.
A prospective observational analysis was performed on 8 patients who underwent closed reduction and internal fixation with elastic intramedullary nailing using Métaizeau technique for fracture neck of the radius. Pediatric patients in the age group of 3-12 years with Judet type 3 and Judet type 4 radial neck fractures were taken for our study. The patients were followed up for a period of 3 months and thorough radiological and clinical examination was carried out with due attention to any complication. The final results were scored on the basis of Mayo Elbow Score.
As per the above criteria we recorded 3 excellent, 2 fair outcomes for type 3 fractures, whereas for type 4 fractures 1 excellent, 1 fair and 1 good outcomes. Neurovascular deficit or deep infection was not reported. We did not notice any penetration of the nail into the joint.
With Metaizeau technique, there were reported poor results of about 10% in literature. Our results support the Métaizeau technique and postulate that the usage of a nail with reshaped tip may help in avoiding revision surgery by minimizing the loss of reduction.

Keywords: Metaizeau technique, neck fractures, judet classification

Introduction

Introduction and Classification

Radial neck fractures are relatively rare in children, accounting for 1% of all fractures in children and 5% to 14% of traumatic elbow injuries [1]. There are two anatomical types of radial neck fracture: the most common is the metaphysical fracture of the radial neck, followed by the epiphyseal separation fracture (Salter-Harris II) [2].
All ages are concerned, with a peak frequency around 9-10 years [3]. The mechanism is essentially indirect; they are common FOOSH injuries which are caused by having fallen onto an out-stretched hand [4].
These fractures are classified according to the O'Brien and Judet classification, which have been suggested to be the both effective guides in both treatment and prognosis [5].

Judet Classification

The Judet classification identifies 4 types of fractures, depending on the angulation of the radial head [6].

Table 1: Judet Classification

Type I	Un-displaced
Type II	< 30 degrees
Type III	30-60 degrees
Type IV a	60-80 degrees
Type IV b	More than 80 degrees

Fig 1: Judet Classification

O'Brien Classification
Type 1 - < 30 degrees
Type 2 - 30-60 degrees
Type 3 - > 60 degrees

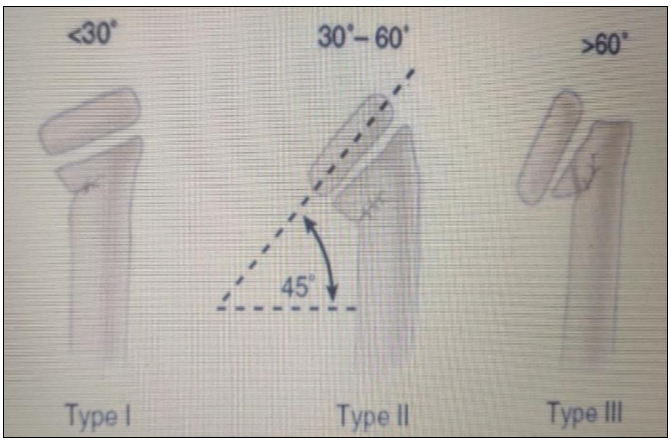

Fig 2: O' Brien Classification

In recent years, the functional outcomes of radial neck fractures in children are discussed as a consequence of treatment methods. Non-operative option with cast immobilisation was suggested for minimally displaced or non-displaced fractures [7-9]. The acceptable angulation for nonsurgical treatment was based on the age of the patient and ranging within 30-60° degrees in most of the discussions. However, there is a general covenant that displaced (Judet type-III and type-IV) fractures may need reduction and stabilisation. In displaced radial neck fractures, several options were described, including Manipulation under anaesthesia, percutaneous K-wire leverage (PKWL), Metaizeau technique and open reduction with or without internal fixation [10].

Aim
The purpose of this study was to review the functional outcomes of the management of radial neck fractures in paediatric age group using Métaizeau technique.

Method
A prospective observational analysis was performed on 8 patients who underwent closed reduction and internal fixation with elastic intramedullary nailing using Métaizeau technique for fracture neck of the radius in our hospital.

Patient selection
Paediatric patients in the age group of 3-12 years with Judet type 3 and Judet type 4 radial neck fractures which were unilateral were taken into consideration for our study.
Patients with concomitant head injuries, polytrauma patients with concomitant same limb injuries, patients with old and pathological fractures were excluded from our study.

Preoperative investigations and preparation
After a detailed history regarding the mode of trauma and local examination of the patients radiological investigations were ordered. A standard AP and true lateral radiographs of the elbow joint were taken and the fractures were classified accordingly.
All routine blood investigations, chest xray and other tests were done required for fitness for surgery and patient was taken up for surgery.

Surgical procedures
Standard operation table with radiolucent hand table was used, and the patient was positioned supine. Pillows as side support used to secure head and body. Tourniquet applied but not inflated, (in case if it needed open reduction).
Initially Closed reduction under general anaesthesia was attempted by applying traction to the extended elbow with the forearm in supination, followed by placing Varus stress to the elbow while applying direct pressure over the radial head (Patterson maneuvre). In difficult reductions, the Israeli technique was used that is pronating and flexing the supinated and extended elbow while the thumb stabilizes the proximal radial fragment with direct pressure. Two people applied traction. If manual reduction was successful, then an elastic intramedullary nail (a diameter of 0.7 times of the narrowest width of radius) was used for fixation. The nail tip was cut into a diamond/rhombus shape under sterile conditions for fixation of the nail at three points in the radial head; that is at the tip and on both sides of the flat proximal end of the nail in the proximal fragment. This reshaping helped in preventing the nail from slipping through the fracture site while passing the nail across the fracture as well as during the rotational manoeuvre of the nail to reduce the proximal fragment. The nail was inserted from proximal to the distal physis of radius and advanced through the fracture site into the radial head. The nail tip was positioned to the radial head, and the fracture ends were distracted before the nail was rotated up to 180° in combination with manual reduction, and following which, the elbow range of motion was assessed.

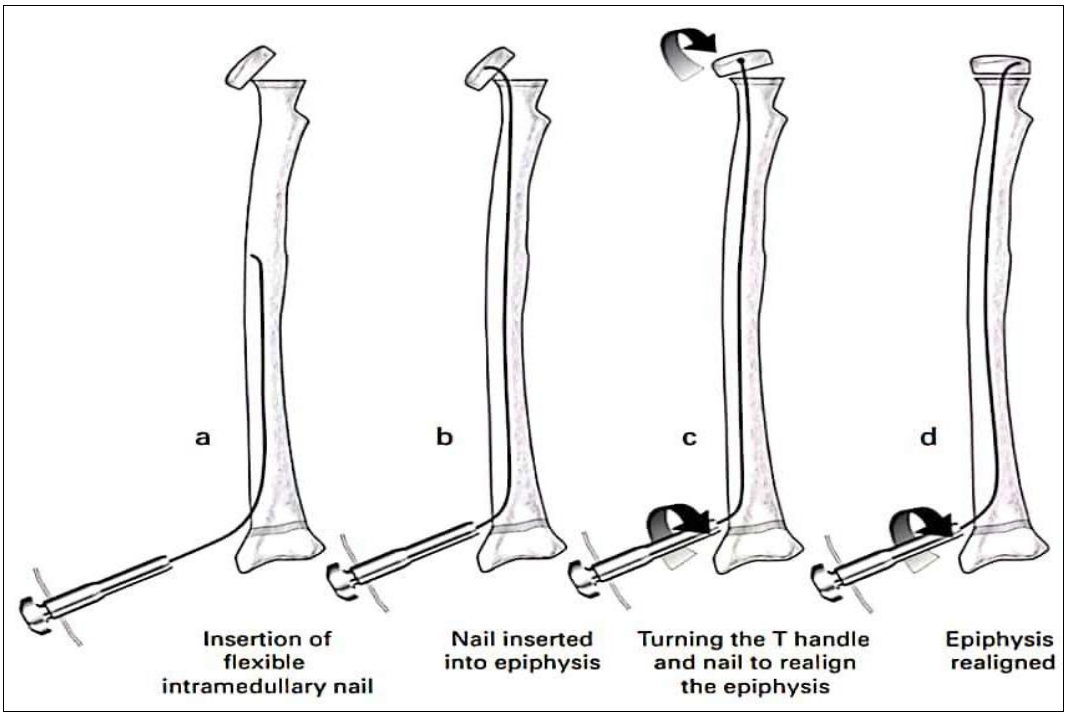

Fig 3: Metaizeau Technique

Post-op protocol

The injured arm was immobilised in the functional position using an above elbow slab for two weeks. Early range of movement exercises was encouraged after removal of the slab.

Follow up

The patients were regularly followed up for a period of 3 months and thorough radiological and clinical examination was carried out at each visit. Attention was given to any complication presented by the patient.

In the end, the final results were scored on the basis of "Mayo Elbow Score" and were graded accordingly.

Table 2: Mayo elbow performance score

			1st follow up (after 1 week)	2nd follow up (after 3 weeks)	3rd follow up (after 6 weeks)	4th follow up (after 12 weeks)
1. Pain	None	45				
	Mild	30				
	Moderate	15				
	Severe	0				
2. Motion	Arc>100	20				
	Arc 50-100	15				
	Arc <50	5				
3. Stability	Stable	10				
	Moderate instability	5				
	Gross instability	0				
4. Function	Comb hair	5				
	Feed	5				
	Hygiene	5				
	Shirt	5				
	Shoe	5				
Total						

Remarks: a) Excellent >90 b) Good 75-89 c) Fair 60-74 d) Poor <60.

Results

In our study we reported 5 patients with Type 3 fractures and 3 patients with Type 4 fractures.

Table 3: Results

	Judet type 3	Judet type 4	Total
Excellent	03	01	04
Fair	02	01	03
Good	00	01	01
Poor	00	00	00
Total	05	03	08

As per the clinical evaluation criteria mentioned above we recorded 3 excellent, 2 fair outcomes for type 3 fractures whereas for type 4 fractures we recorded 1 excellent 1 fair and 1 good outcomes.

Neurovascular deficit or deep infection was not reported in our patients. We did not notice any penetration of the nail into the joint with this technique in our study.

Fig 4: Pre-op and immediate post-op X-rays

Fig 5: Clinical images at final follow-up

Discussion

In general, the non-surgical option is suggested for children younger than five years of age, who present with full pronation and supination, and a radial neck-shaft angle of less than 50°-60° [11-14].

The non-surgical option can also be considered in children up to 10 years of age with an angle of <30°. Fractures with angulation more than 30° should undergo an attempt of closed reduction [15-16].

Fractures with large angles and displacement may need percutaneous K-wire leverage. These fractures need proper fixation as removal of K-wire immediately may cause loss of reduction, and in these cases, closed intramedullary pinning (CIMP) as proposed by Métaizeau is an appropriate non-invasive closed reduction method [17].

In a retrospective analysis [17] of 151 children, two (10.5%) of nineteen fractures treated with intramedullary nailing lost reduction and required additional intervention. Several other studies quoted similar results with metazieau technique. Moreover, the worse outcome has been reported for Judet-IV fractures than for Judet-III fractures [11].

In our study, we found no poor results secondary to loss of reduction.

We didn't come across with the slippage of the nail through the fracture site while inserting it into the proximal fragment. Epiphyseal plate damage during reduction using CIMP is a possibility, especially in impacted fractures. Due to its facility to achieve stable fixation to the proximal fragment, the distraction of the fragments and reduction of the proximal fragment with the rotation of the nail was poised without scuffling the growth plate. Due to assurance in fixation, it was more comfortable to initiate an early range of movement, which avoid any formation of tissue adhesions and consequent stiffness of the joint in these patients.

Conclusion

Our results support the Métaizeau technique and postulate that the usage of a nail with reshaped tip may help in avoiding revision surgery by minimising the loss of reduction. In our series, though, not big enough to substantially conclude and extrapolate the effectiveness of this technique, we have not noticed any poor outcomes due to loss of reduction. Our results are within the acceptable range of satisfactory outcomes, if not more towards the better end of the outcomes quoted in literature.

Conflict of Interest

Not available

Financial Support

Not available

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