

Metaizeau Technique for Displaced Radial Neck Fracture among Children in Erbil, Kurdistan Regional Government, Iraq

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Abstract

Background and objectives: Radial neck fracture if not properly managed can lead to complications including pain and avascular necrosis. The Metaizeau technique of closed intramedullary pinning is a treatment option and it is the aim of this study to assess its outcome.

Methods: Metaizeau technique was used in managing radial neck fracture of 21 children at two emergency hospitals in Erbil, Kurdistan region, Iraq. between July 2018 and September 2019. Postoperative outcome were assessed according to the Metaizeau classification and Mayo performance score to assess degree of residual angulation as well as for postoperative complications such as joint stiffness.

Results: Median follow up time was 10 months (7-12 months). The children's median age was nine years (6-11 years), among which 11 (52%) cases were females. According to Judet classification, 9 (43%) children had class IVb fracture while 8 (38%) had class IVa and only 4 (19%) cases had class III fracture. The median fracture angulation prior to the surgery was 75° (ranged between 50-85°). By the end of the follow up, 19 (90.5%) cases achieved excellent results according to the Metaizeau classification while the remaining two (9.5%) had good outcome with mild degree of angulation of 8° and 14° respectively.

Conclusions: Metaizeau method is technically easy with a simple learning curve and is highly effective with excellent functional outcomes and that the rate of postoperative complications is rare compared to reported cases of radial neck fracture managed with open reduction and internal fixation.

Key words: Radial neck fracture, Metaizeau technique, Children radial fracture.

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Introduction

Fracture of the radial head and neck comprises 1.7–5.4% of all fractures, with approximately 15–20% of these fractures involve the radial neck¹. In children, radial neck fracture account for 1% of all fractures². It is most commonly seen in children age between 4-14 years old who often have a history of falling onto an open, outstretched, hand³. Complications associated with this type of fracture among children include joint pain, cubitus valgus, radioulnar synostosis, avascular necrosis, early physal closure, elbow stiffness, periarticular ossification, and overgrowth of the radius head⁴. Different classification methods has been used to asses severity based on degree of angulation. The European authors typically apply the Judet system⁵ while North Americans would likely use O'Brien classification⁶ (Table 1). The optimal treatment method of displaced radial neck fracture in children remains a matter of controversy. Radial neck fractures can be treated with methods such as closed reduction and casting, closed reduction intramedullary fixation (Metaizeau technique), reduction and fixation with percutaneous Kirschner wire (K-wire)⁷ and open reduction⁸. Undisplaced or minimally

displaced fractures usually have an excellent outcome, whereas displaced and comminuted fractures are often reported to have an inferior outcome such as significant stiffness^{9,10}. Close reduction alone has high failure rate up to 40% of the times, mainly in fractures angulated $\geq 36^\circ$, and that half of fractures displaced $\geq 65\%$ will require open reduction¹¹. It is recommended to have surgery when fracture angulation $>45^\circ$ for children <10 years old and for angulation $\geq 30^\circ$ (O'Brien II or _Judet III) for children 10 years of age or older¹². Surgery is also recommended if there is still 2mm displacement or in the presence of translation (uncovered metaphyseal fracture surface) exceeding 3-4 mm¹³. Surgery is also considered in the presence of associated injuries which can occur in 37 to 46% of patients and may include elbow fracture or dislocation or nerve damage¹¹. The Metaizeau technique of closed intramedullary pinning of displaced radial neck fractures was introduced in 1980 by a group led by Jean Paul Metaizeau, aiming to address the limitations in managing radial neck fractures through open reduction¹⁴. This study aims to evaluate the results of Metaizeau technique in the management of

displaced radial neck fracture in children

Patients and methods:

This case series included patients <16 years who presented with displaced radial neck fractures and managed at Erbil Teaching Hospital and West Emergency Hospital in Erbil, Kurdistan region-Iraq between July 2018 and September 2019. Children were included if presented with open growth plate of proximal radius at injury time which would be managed by the Metaizeau centromedullary nail technique of closed manipulation and intramedullary pinning. Patients were excluded if had combined fracture of the head and neck radius, elbow dislocation, open fracture, and previous injuries that affect wrist or forearm movement. Type I and II fracture were excluded from the study. Parents/guardians of the children included in the study were briefed regarding the risks and benefits of the procedure, and an informed consent were obtained to undergo the operation. Principles of the Metaizeau technique were followed¹⁴. After routine sterilization and draping, closed reduction was attempted by thumb pressure over the radial head while applying longitudinal traction and varus stress on the extended elbow. Sometimes reduction was obtained by digital pressure in

treated at Kurdistan region of Iraq.

an anterior to posterior direction with the elbow flexed and forearm gradually pronated. Extremely forcible manipulation to achieve ideal reduction was avoided. Care was taken to avoid injury to the deep branch of the radial nerve. A 2-cm longitudinal skin incision was made on the dorsoradial aspect of the mid-radius. The cortex of the radius dorsal to the pronator muscle insertion was exposed. One slanting hole was made with a 2.5-mm drill bit that increased gradually to 4.5 mm provided that the diameter of the drill hole is less than the width of bone at the level of drilling. In patients with small-size bones, two drill holes at two different levels were made with 2.5-mm drill bit to avoid stress riser effect. A drill sleeve was used to protect the soft tissues. At first, the drill bit was directed perpendicular to the bone and then obliquely at an angle of 45–60° with care to avoid penetration of the far cortex. Through these holes, two 1.5–2.5 mm flexible wires were inserted manually retrograde into the medullary canal over a T-handled drill chuck. The tips of the wires were prebent by pliers and advanced into the radial head using gentle taps of a small mallet.

Reduction was helped and maintained by rotation of the wire around its longitudinal axis through 180°, so that the bended tip guided the head to its reduced position. After obtaining an accepted position, the second wire was pushed into the head with care to avoid penetration of the articular surface. This will combat torsional and shearing forces along the fracture. A third K-wire was used to add stability to the fixation construct in three patients. The use of a high-resolution image intensifier with magnification facility was helpful to ascertain the proper reduction and accurate placement of the wires. The distal end of the wires was bent and buried in the subcutaneous tissues. After surgery, a long-arm posterior plaster splint with the forearm in a neutral position was applied for 3–4 weeks. In patients with associated posterior elbow fracture dislocation, external splint was continued for 3 weeks more till soft tissue healed. During the period of immobilization, patients were instructed to move fingers and clench their fists over a soft ball to allow axial compression through the fracture by the muscles crossing the elbow joint. After removal of the splint, assisted active range-of-motion exercises of the elbow and forearm were gradually

started guided by pain. The wires were removed after 4-6 months under local or general anesthesia in the operating room. All patients were followed up clinically and radiographically every month for the first four months, then every two months until end of study period. Radiological assessment of the fracture was done prior and during postoperative follow up using the JUDET classification system as illustrated in Table 1. Clinical assessment was done for pain, range of motion of elbow and forearm, grip strength, alignment and stability of the elbow, functional status, and the development of any complications. The degree of deficits in the maximum ranges of motion, valgus angle of the elbow, and grip strength were assessed at the final follow-up by taking the contralateral un-injured limb as a control. The Mayo elbow performance score was used for the final clinical functional evaluation (Table 2)¹⁵. Radiological assessment included the measurement of radial head angulation on anteroposterior and lateral radiographs of the elbow before surgery, next day after surgery, and at final follow-up. These measures were compared with that obtained from radiographs of normal extremity and the final postoperative radiographic outcome

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was evaluated according to the Me'taizeau classification (Table 3)¹⁴. The series of follow-up radiographs were also checked for alignment, fracture healing, loss of reduction, nonunion, avascular necrosis, periarticular ossification, proximal radioulnar synostosis, and degenerative arthrosis.

Table (1): Comparison of two, displacement-focused, classification of schemes for paediatric radial neck fractures based on degree of angulation.

O'Brien classification ⁶	Judet classification ⁵
I - <30°	I- Undisplaced
II- 30- 60°	II- <30°
III- >60°	III- 30-60°
	IV-a 60-80°
	IV-b >80°
	V Salter-Harris II

Table (2): Mayo elbow performance score ¹⁵

Parameters	Elbow	Points
Pain (45 points)	None	45
	Mild	30
	Moderate	15
	Severe	0
Range of motion (20 points)	Arc >100°	20
	Arc 50-100°	15
	Arc <50°	5
Stability (10 points)	Stable	10
	Moderately stable	5
	Grossly unstable	0
Function (25 points)	Able to comb hair	5
	Able to feed	5
	Able to perform hygiene	5
	Able to put on shirt	5
	Able to put on shoes	5

Score: excellent 90-100 points, good 75-89 points, fair 60-74, poor <60.

Table (3): The radiological assessment using Me´taizeau classification¹⁴

Results	Description (angulation in AP)
Excellent	Anatomic reduction
Good	<20°
Fair	20-40°
Poor	>40°

Results

There were 21 children included in this study, with a median age of nine years (ranged between 6-11 years), among which 11 (52%) cases were females. A summery of the cases are presented in table(4). According to Judet classification, 9 (43%) children had class IVb fracture while 8 (38%) had class IVa and only 4 (19%) cases had class III fracture. The median fracture angulation prior to the surgery was 75° (ranged between 50-85°). Postoperatively, the children had a median follow up time of

10 months, ranged between 7-12 months. By the end of the follow up period, 19 (90.5%) cases achieved excellent results according to the Metaizeau classification while the remaining two (9.5%) had good outcome with mild degree of angulation of 8° and 14° respectively. Other postoperative complication was noted in two cases (9.5%) who had postoperative asymptomatic enlargement of radial head. No postoperative bone necrosis, compartment syndrome or infection was reported.

Table (2): Summary of patients' demographics and the degree of fracture before and after surgery.

Patient No.	Age (years)	Gender	Judet Class.	Fracture angulation preop	Fracture angulation postop	Follow up (months)	Me-Taizeau class	Mayo elbow class.
1	11	Female	IVb	85°	0°	12	Excellent	Excellent
2	10	Male	IVb	79°	0°	12	Excellent	Excellent
3	8	Female	IVb	80°	0°	10	Excellent	Excellent
4	6	Male	III	57°	0°	9	Excellent	Excellent
5	9	Female	III	50°	0°	10	Excellent	Excellent
6	8	Male	IVa	70°	0°	12	Excellent	Excellent
7	9	Male	IVa	75°	0°	7	Excellent	Excellent
8	10	Female	IVa	70°	14°	12	Good	Good
9	11	Male	IVa	60°	0°	9	Excellent	Excellent
10	9	Female	IVb	80°	3°	11	Excellent	Excellent

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11	7	Female	IVb	80°	2°	7	Excellent	Excellent
12	11	Female	IVb	85°	0°	12	Excellent	Excellent
13	10	Male	IVb	79°	0°	12	Excellent	Excellent
14	8	Female	IVb	80°	0°	10	Excellent	Excellent
15	6	Male	III	57°	0°	9	Excellent	Excellent
16	9	Female	III	50°	0°	10	Excellent	Excellent
17	8	Male	IVa	70°	0°	12	Excellent	Excellent
18	9	Male	IVa	75°	0°	7	Excellent	Excellent
19	10	Female	IVa	60°	8°	12	Good	Excellent
20	11	Male	IVa	60°	0°	9	Excellent	Excellent
21	9	Female	IVb	80°	4°	11	Excellent	Excellent

Discussion

This was a study to evaluate the outcome of using Metaizeau technique in managing children with displaced radial neck fracture. To the best of our knowledge, there hasn't been a published study on the outcome of Metaizeau technique among children treated for radial neck fracture in Iraq and hence this was a topic of interest in this research. Distal radius fracture has been reported in 20.2% out of 6,493 fractures among children younger than 16 years admitted over 10 year period³. While this type of fracture is most commonly seen between 4-14 years of age, the average age of our patient was nine years, with the youngest case being six years within 3-6 months follow up¹⁶. Metaizeau technique has been shown to be an effective method for minimally invasive surgical management of paediatric radial neck fractures. Eberl et al studied the outcome of

old. This is similar to a most recent study of radial neck fracture managed with Metaizeau technique¹⁶. Most cases in this study had excellent outcome with one case of type IVa fracture which had a good outcome and residual angulation of 14° postoperatively. This outcome reflect the previous reports of the favourable outcome of Metaizeau technique in managing most cases of type III or IV fractures. The surgical outcome of this study is also better compared to a recent study by Yallapragada and Maripuri on 22 children in whom 90.5% of the cases had excellent or good outcome whereas the remaining had fair outcome this technique on 42 patients with dislocated fractures of radial neck. Excellent results and function restoration was obtained in 38 of the cases while open fracture reduction was required in four patients and two cases

developed necrosis of the radial head¹⁷. In this study, only one (4.8%) of the cases with radial neck fracture had an additional olecranon fracture with fracture of the coronoid process. This is less than what has been reported in a previous study which had elbow related fracture in 31% of their cases¹⁸. The most common associated fractures with radial neck fractures are fracture of olecranon, proximal ulna, medial or lateral epicondyle. Compartment syndrome and collateral ligament rupture has also been reported, the latter leading to elbow instability and although percutaneous K-wire manipulation could damage the proximal radial physis¹⁹, we did not come across such complication among our study cohort. Open reduction allows anatomical reduction, but there is higher risk of complications and worse outcome compared to close reduction and internal fixation¹⁸.

Conflicts of interest

The authors report no conflict of interest.

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Care should be made in performing Metaizeau technique the presence of associated elbow dislocation or instability as the latter case may compromise the ability of elbow joint to hold the radial head in position while the implant is driven into the proximal radius in a retrograde fashion. In such cases the increased operative time and soft-tissue injury associated with repeated attempts with this method may lead to or worsen compartment syndrome²⁰. As conclusion, the Metaizeau method is technically easy with a simple learning curve and is highly effective with excellent functional outcomes and that the rate of postoperative complications is rare compared to reported cases of radial neck fracture managed with open reduction and internal fixation. Limitation of this study may include the small sample size and the lack of comparison control group.

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