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Case Report

Completely displaced pediatric radial neck fracture treated by a combination of Métaizeau method and percutaneous reduction with the blunt-end of a k-wire: a case report and review of literature

Mohammad A. Ikram, FRCS.[1], Abdul R.Ahmad, MS (Ortho).[2], Fazrina A. Sani, MS (Ortho).[2], Velummylum B. Premdas, MBBS.[2]

[1]Department of Orthopedics, International Medical University, IMU Clinical Campus Seremban, [2]Department of Orthopedics, Hospital Tuanku Jaafar, Ministry of Health Malaysia, Seremban, Negeri Sembilan, Malaysia

***Corresponding author:**
Dr. Mohammad A. Ikram, Department of Orthopedics, International Medical University, IMU Clinical Campus Seremban, 70300 Seremban, Negeri Sembilan, Malaysia.

mohammadarshad@imu.edu.my

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ABSTRACT

Management of a completely displaced radial neck fracture is always challenging. A closed method is preferred as higher morbidity is reported in the literature pertaining to open reduction. Métaizeau's method with retrograde intramedullary pinning of the radius is a popular closed method and the current treatment of choice. In cases, where closed reduction is not achievable, the combination of percutaneous manipulation of the displaced radial head increases closed reduction probabilities. We are presenting two cases of a completely displaced fracture of the radial neck treated by a combination of the Métaizeau method and percutaneous push method using a blunt end of the K-wire, which provided anatomical reduction. Our results confirmed that the supplementation of the percutaneous maneuver is a good option when the Métaizeau method alone cannot achieve satisfactory reduction.

Keywords: Children, Closed reduction, Fracture radial neck, Intramedullary fixation, Leverage method

INTRODUCTION

Radial neck fracture in children is an uncommon injury, where the outcome of its treatment is dependent not only on the method but also on the timing of surgery. Various closed reduction methods are mentioned in the literature including the push and lever methods using either Kirschner wires (K-wire) or Steinmann pins or intramedullary nails. Métaizeau's retrograde intramedullary pinning, also known as the Métaizeau method, is widely used due to its excellent outcome and minimal complications.[1] Since the first description of percutaneous leverage reduction by Feray in 1969, it is becoming popular in combination with the Métaizeau method in recent literature.[2-4]

We are reporting two cases of a completely displaced radial neck fracture, treated with a combination of the Métaizeau method and percutaneous reduction with the blunt-end of a K-wire. We also reviewed the literature on the combination Metaizeau method and percutaneous manipulation of the completely displaced radial head.

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CASE REPORT

The first case was a 12-year-old boy who attended the emergency room with a history of a fall and sustaining trauma to the left elbow 10 days before the presentation. Examination revealed swelling of the elbow and forearm without any neurovascular injury. A radiograph and a computerized tomography showed a completely displaced fractured radial neck and an un-displaced fractured olecranon process [Figure 1]. We used a size 2.5 mm titanium elastic nail system (TENS) with 10° angle at the tip which was introduced into the medullary cavity of the radius by Métaizeau method. Since the fracture was 10 days old; using digital pressure failed to reduce the fracture. Hence, we used the blunt end of size 2 mm K-wire to push the head in the cephalic direction [Figure 2a-d]. Once we moved the displaced head, we continued to progress the TENS and rotated it 180°. We removed the K-wire and under fluoroscopy, continued advancing the TENS until it reached the inside of the head [Figure 2e and f]. The distal end of TENS was left outside the skin to make the removal easy [Figure 2g]. Immobilization was achieved with an above elbow plaster cast with his forearm in the neutral position. The cast and TENS were removed after 4 weeks in the clinic without anaesthesia followed by mobilization of the elbow [Figure 2 h].

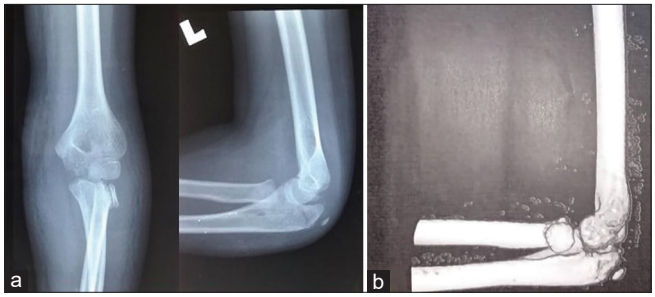

Figure 1: (a) Preoperative anteroposterior and lateral radiograph of the left elbow showing completely displaced radial neck fracture. (b) Preoperative computed tomography scan of the left elbow showing the position of the displaced radial head.

The postoperative clinical evaluation was performed by Mayo Elbow Performance Score (MEPS)[5] and radiological assessment was done according to Métaizeau score.[1]

At 1-year follow-up, the patient showed excellent clinical and radiological results on MEPS and Metaizeau score, respectively [Figure 3].

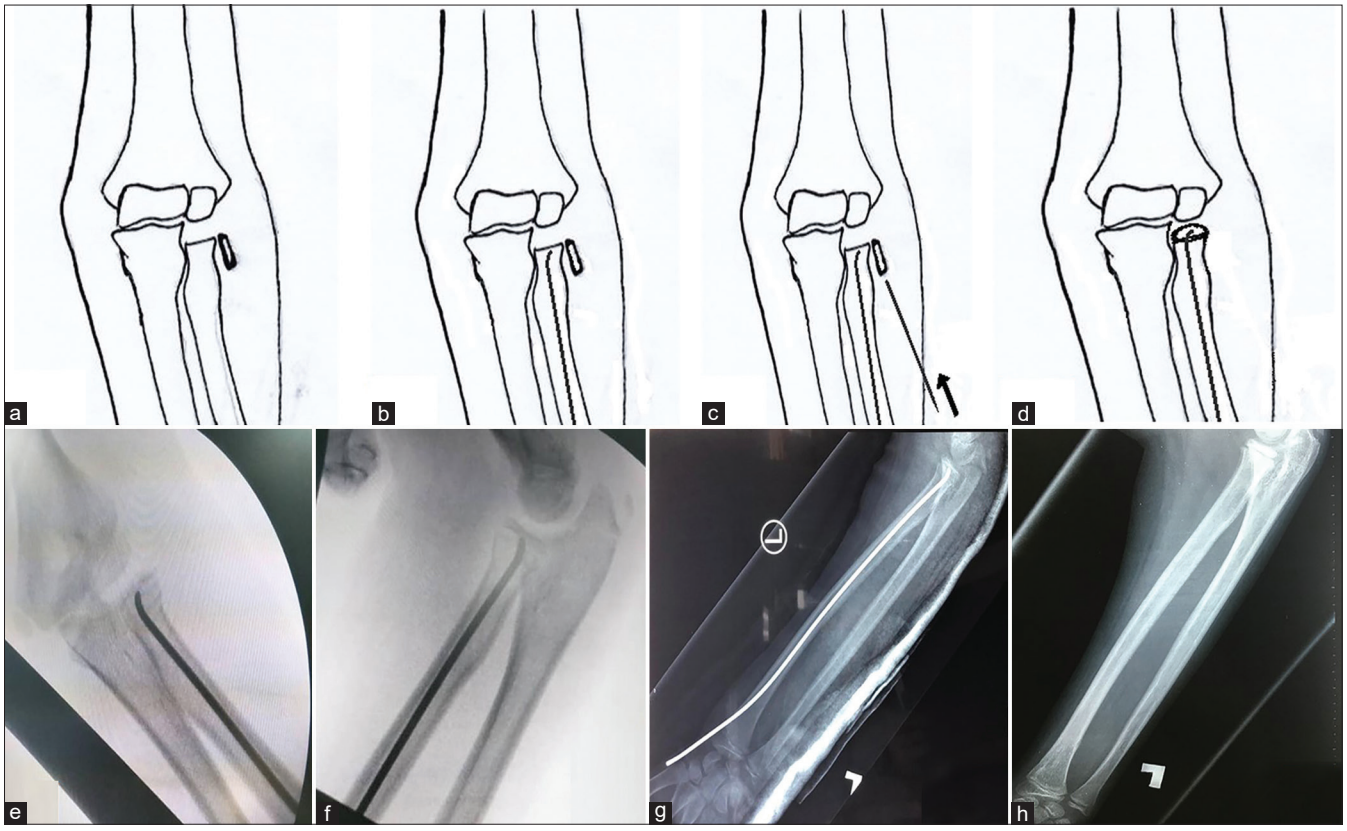

Figure 2: (a-d) Schematic illustration of percutaneous push method. (e and f) Intraoperative radiographs showing anatomical reduction with titanium elastic nail system inside the radial head. (g) Postoperative radiograph showing the position of titanium elastic nail system (h) Radiograph after removal of the titanium elastic nail system.

The second case was a 7-year-old boy who attended the emergency room within a few hours of the accident. He presented pain and swelling of the elbow and the forearm following a fall from a beach buggy. Examination revealed obvious deformity and swelling of the elbow and forearm without any neurovascular injury. A radiograph showed a completely displaced fractured radial neck with ipsilateral fractures of the radius and ulna shafts [Figure 4]. Both fractures of the radius were treated with one intra-medullary K-wire of 2 mm size [Figure 5]. Anatomical reduction of the radial neck fracture was achieved by a similar maneuver of pushing with the blunt-end of the K-wire. A one-third tubular plate was used for fixation of the ulnar shaft fracture. The intramedullary wire was removed at 8 weeks. The follow-up at 6 months showed complete union with normal shape and the position of the radial head. There was mild malunion of ulna noted but it did not affect the function as the MEPS was excellent.

DISCUSSION

The management of completely displaced radial neck fractures in children is often demanding and needs an experienced surgeon. Anatomical reduction of the radial neck is essential as a minimal malalignment can result in an unfavorable outcome.[3] Closed methods are considered the treatment of choice as the open reduction of these fractures is associated with high morbidity.[2,3,6] The intramedullary fixation as described by Metaizeau has a great advantage of anatomical reduction without affecting the blood supply of the radial head.[5]

In the Métaizeau method, a K-wire is contoured and bent at the tip at an angle of 30° which is then introduced into the medullary cavity through the distal radial metaphysis.[1]

The incision was made laterally proximal to the growth plate and protecting the superficial branch of the radial nerve. The K-wire was gradually passed into the shaft by a

Figure 3: (a) Radiograph anteroposterior and lateral at 1-year follow-up showing anatomical position of the radial head. (b) Clinical photograph showing the full range of motion with the normal function of the radial nerve like the uninjured side.

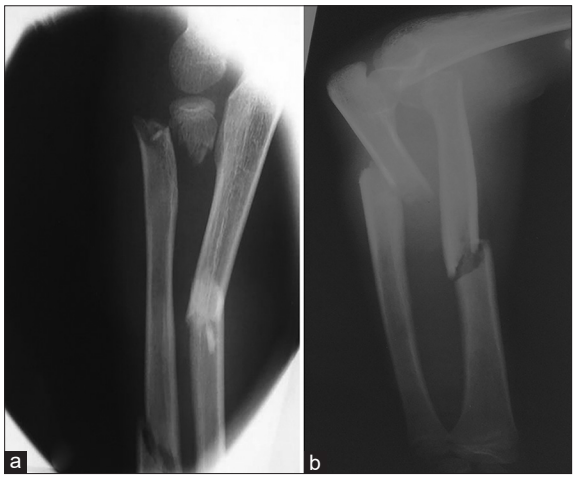

Figure 4: (a and b) AP and lateral radiograph of the forearm showing completely displaced fracture radial neck with ipsilateral fracture shaft of ulna and radius.

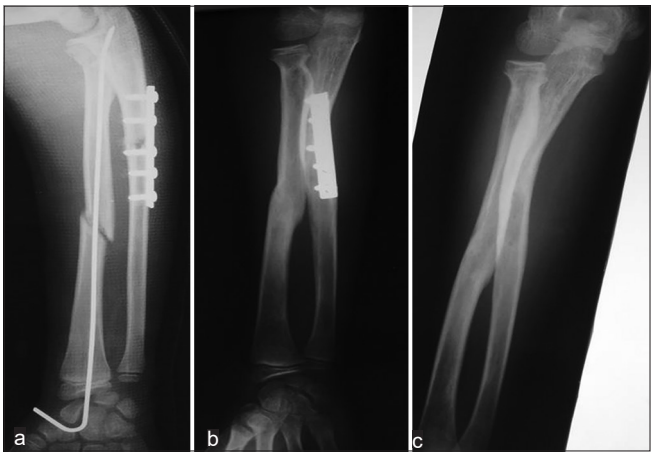

Figure 5: (a) Postoperative radiograph showing fixation of all fractures. (b) Eight weeks postoperative following removal of the K-wire. (c) Six months postoperative following removal of the plate showing sound union of all fractures, with well-located radial head.

T-handle under fluoroscopy with the tip pointed towards the displaced fragment. Once engaged, the K-wire was then rotated at 180° to reduce the head and neck fragments. In our first case, we used an intramedullary TENS instead of K-wire since we thought it provided more stability as compared to a K-wire. However, considering the size of TENS we bent it up to 10° as angle of 30° would make the entry difficult. However, the Métaizeau method alone was unable to achieve a reduction in this 10-day old fracture due to the delayed intervention. As Zhang *et al.*,[6] recommended using a percutaneous leverage method using K-wire, when closed reduction is not possible. Therefore, we utilized similar method to achieve the reduction but modified it using the blunt end and to perform push maneuver rather than piercing into the bone. We used the same maneuver in our second case and successfully reduced the fracture without any complication.

Recent literature [Table 1] reported excellent results of completely displaced fracture radial neck when treated by the Métaizeau method combined with the percutaneous leverage method. The results were evaluated clinically on Mayo elbow performance Index and radiologically by Metaizeau score.

Watkins *et al.*[2] treated eight cases of completely displaced radial neck fractures with a modified percutaneous leverage method, which involves manipulating the radial shaft below the fracture line by curved forceps through a small incision lateral to the subcutaneous ulnar border. Massetti *et al.*[3] and Hilgert *et al.*[7] performed percutaneous leverage by introducing the tip of a K-wire into the fracture site and used it as a lever for the reduction of the fracture. Qiao and Jiang,[4] along with Zhang *et al.*[6] and Wang *et al.*[8] inserted the tip of the K-wire into the displaced head and achieved the reduction by joystick maneuver. Du *et al.*[9] did the percutaneous reduction using two pins; one entering the head and the other at the fracture site. Bither *et al.*[10] achieved anatomical reduction by the leverage of the radial head through the sharp end of the K-wire inserted into the metaphysis. However, they had reported one transient radial nerve palsy and one heterotopic calcification. Repeated manipulations and leverage with the sharp end may cause injury to the fractured fragment.[9]

In our cases, we did not enter the head, fracture site, or interosseous space therefore we did not have any complication. Instead, we used the blunt end to push the displaced head in a cephalic direction to bring it in line with the shaft axis. This allowed the intramedullary TENS/K-wire progression into the head, which reduced the fracture instantly.

Table 1: Review of the literature of recent studies on Métaizeau method in combination with percutaneous leverage for displaced radial neck fractures.

Author	Study period	Number of patients	Surgical method	Follow-up	Outcome
Watkins *et al.*, 2020	2008-2016	8	Manipulation of shaft of radius distal to the fracture but proximal to the bicipital tuberosity by curved forceps through an opening	12 months	Excellent results on Mayo elbow performance score
Massetti *et al.*, 2020	2015-2019	21	Leverage of the radial head through the K wire inserted into the fracture site	20 months	19 had excellent results on Mayo elbow performance score
Du *et al.*, 2019	Not mentioned	16	Leverage of the radial head through the one K wire inserted into the fracture site and another needle into the head	19 months	12 patients excellent and 4 good
Qiao F, Jiang F, 2019	2011-2015	24	Leverage of the radial head through the K wire inserted into the head	33 months	23 excellent 1 good results on Mayo elbow performance score
Zhang *et al.*, 2016	2010-2013	30	Leverage of the radial head through the K wire inserted into the head	6 months	Excellent results in all patients
Bither *et al.*, 2014	2004-2012	14	Leverage of the radial head through the K wire inserted into metaphysis	39 months	One patient had transient Radial N palsy, one had heterotopic calcification. 12 had excellent results on Mayo elbow performance score
Wong *et al.*, 2013	2006-2008	23	Leverage of the radial head through the K wire inserted into the head	37 months	3-malunion, 2 hypertrophic head
Hilgert *et al.*, 2002	2002	1	Leverage of the radial head through the K wire inserted into the fracture site	16 weeks	Excellent results on Mayo elbow performance score

CONCLUSION

We recommend the Métaizeau method as the ideal treatment method for completely displaced radial neck fractures in children. However, if the reduction is not achievable, then the percutaneous reduction with the blunt-end of the K-wire could be used as a supportive approach.

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AUTHORS' CONTRIBUTIONS

MAI and ARA conceived and designed the study. FAS and VBP managed the case. All authors participated equally in writing the initial and final draft of the article and providing logistic support and literature reviews. All authors have critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript.

ETHICAL APPROVAL

The case report got the Ethical approval from the National Medical Research Registry, Malaysia with NMRR Number: KKM.NIHSEC.800 4/4/1 Jld. 66 (48) dated March 12, 2019.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient's parents have given their consent for the images and other clinical information to be reported in the journal. The parents understand that the patient's name and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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