

Pediatric displaced radial neck fractures: retrospective results of a modified Metaizeau technique

Nitin Bither · Parmanand Gupta · Nipun Jindal

Received: 19 January 2014 / Accepted: 26 March 2014 / Published online: 12 April 2014
© Springer-Verlag France 2014

Abstract Treatment of displaced radial neck fractures is challenging and controversial, as the risk of unsatisfactory outcome increases after operative as well non-operative treatment. Between 2004 and 2012, we treated 14 children with type IV fracture of radial neck with mean angulation of 72.8°, using the modified Metaizeau technique. The average follow-up was 39 months. Heterotrophic ossification and transient posterior interosseous nerve palsy were the only complication seen in two patients who had to undergo open reduction. We feel that the inability to achieve closed reduction can be attributed to loss of periosteal hinge. We obtained 100 % excellent clinical outcome and 79 % excellent radiological outcome at final follow-up. The modified closed intramedullary pin reduction technique proved to be minimal invasive technique for displaced radial neck fractures by allowing stable anatomic reconstruction while avoiding all the complications of classical Metaizeau technique.

Keywords Displaced radial neck fractures · Metaizeau · Pediatric

Introduction

A vast majority of undisplaced or minimally displaced radial neck fractures can be treated non-operatively with good outcome [1]. Angulations of up to even 30° are expected to remodel, more so in younger children. Severely displaced or angulated fractures, fractures in children with age more than 10 years, increase the risk of unsatisfactory outcomes after non-operative management [2–4]. Even after open reduction in displaced fragment, the results are cited as fair or poor [5]. Transcapitellar pinning across the elbow has been associated with high incidence of pin breakage and nerve injury [6]. Closed extracapsular reduction by Metaizeau technique followed by intramedullary pinning avoids both these adverse conditions, becoming the logical choice in this subset of radial neck fractures [7, 8]. We did a retrospective study to analyze the outcome of intramedullary pinning by modified Metaizeau technique in severely displaced radial neck fractures.

Materials and methods

Fourteen children presenting with Judet type IV radial neck fracture to our institute between 2004 and 2012 were included in the study. Cases with previous elbow injury, closed physis were excluded.

The operative technique used was intramedullary pinning according to Metaizeau [7] with modifications. A 1.2–2.0-mm K-wire was bent at one end with its sharp end cut and was introduced into the medullary canal through a 3.2-mm drill hole made 4 cm proximal to the distal physis and then hammered upward until its tip reached the epiphyseal plate, to create a tract (Fig. 1a, b). This is as compared to original Metaizeau technique where the point

N. Bither
Bither Hospital, Near New Flyover, Sirhind,
Punjab 140406, India

P. Gupta · N. Jindal
Department of Orthopaedics, Government Medical College
Hospital, Chandigarh, India

P. Gupta (✉)
House No 1157, Sector 32B, Chandigarh, India
e-mail: drpgupta123@gmail.com

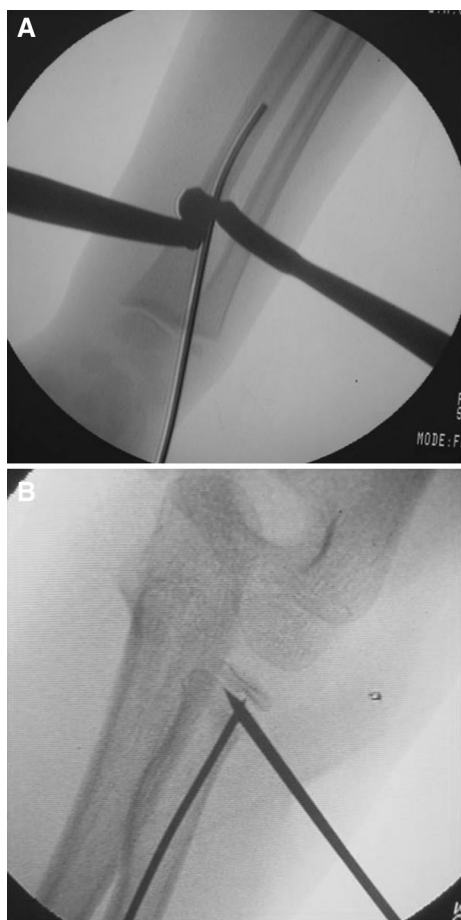


Fig. 1 **a** Intraoperative photograph showing the technique of introducing the K-wire and making of tract. **b** Intraoperative photograph showing the technique of introducing the K-wire and method of reduction used

of entry is 2 cm proximal to the distal radial physis [9]. The wire was removed and a sharp K-wire with slightly bent anterior tip was introduced in the same track till it reached the fracture site. We primarily used percutaneous K-wire assistance to achieve reduction, and then intramedullary K-wire was pushed across the physis. Fine tuning of the reduction in the radial head to anatomic position by rotating the wire by appropriate degrees around its axis was not required in any of our patients. Cases where closed reduction assisted with K-wire joystick method was not achieved in two attempts, attempt to reposition the head fragment that was done by levering the head onto the shaft fragment like a ‘tyre maneuver’, which if unsuccessful in two attempts was subjected to open reduction; the method of fixation remained same. One severely displaced type IV b (125°) fracture neck radius and one type IV a fracture required open reduction, as closed radial head reposition could not be achieved. Postoperative immobilization in an above elbow back slab was given for 3 weeks. K-wires were removed after the fracture had consolidated.

The evaluation of clinical results was performed using Mayo elbow performance score [10]. Initial radiographs and radiographs after K-wire removal were examined for residual angulation and translation, peri-articular ossification, avascular necrosis of radial head, enlargement of radial head and premature physal closure. Radiographic results were graded as excellent, if the reduction was anatomic, good, if a simple shift or inclination not exceeding 20° persisted, fair, if the tilt was between 20° and 40° and poor, if it was beyond 40°.

Results

There were nine girls and five boys, age range 5–13 years, with average age of 9 years. Left-sided involvement was seen in 9 (64.3 %) and right sided in 5 (35.7 %) patients. All children had type IV Judet fracture with mean angulation of 72.8° (range 60–125), 3 type IV B and 11 type IV A (Fig. 2a, b). There was associated ipsilateral elbow dislocation in one child which resulted in Salter–Harris epiphyseal separation type I of the proximal radius. Follow-up period ranged from 6–80 months with a mean follow-up of 39 months. In all patients, postoperative course was uneventful. The K-wire was removed after radiological consolidation (10–16 weeks, average 12 weeks).

Based on Mayo elbow performance score, all elbows had excellent outcome with mean score of 98.2 (95–100). Final radiographic analysis showed 11 (78.6 %) excellent and 03 (21.4 %) good results. Two patients, one type IV B and other type IV A had translation had to undergo open reduction. At final follow-up of both these patients, clinical outcome was excellent (MES-95) with good radiological outcome, inspite of evidence of heterotopic ossification in one patient and transient radial nerve palsy in the other. There was no patient with avascular necrosis or enlargement of radial head at final follow-up. No patient at final follow-up had a growth arrest and the carrying angle was equal to the uninjured side (Fig. 3a–c).

Discussion

Management of displaced radial neck fractures in pediatric patients remains controversial. A plethora of surgeries have been described ranging from percutaneous pinning, transcapitellar pinning, intramedullary pinning and the modes (open or closed) and methods (joystick/leverage/rotational force of intramedullary bent wires) of reduction. Open reduction has been recommended conventionally for failed closed manipulation in displaced radial neck fractures. However, since worse outcomes following open reduction have been encountered, it is desirable to reserve it for

Fig. 2 **a** AP and lateral radiographs of patient with type IV A fracture neck radius. **b** AP and lateral radiographs of patient with type IV B fracture neck radius, resulting from ipsilateral elbow dislocation (reduced in this radiograph)



fractures where possible functional problems secondary to deformity may outweigh the risk of disturbing the blood supply [11]. In consensus, close reduction yield better functional results than open reduction; in severely angulated fractures, closed reduction alone has unpredictable results ranging from inability to achieve complete reduction or even loss of reduction inside the plaster [12, 13]. Percutaneous Kirschner-wire manipulation and fixation although enables satisfactory reduction but does not guarantee adequate stability when used alone for fixation [3, 14]. Moreover, repeated manipulations and leverage may cause further injury to the fractured fragment.

Although several authors have reported excellent results with pinning of grade-III and grade-IV fractures, but indications for reduction (angulation $>30^\circ$ and $>35^\circ$) were different from our study group involving only type IV [13, 15]. Percutaneous reduction and pinning yielded excellent results in series by Biyani et al. [16]; however, they still concluded that this technique may, however, not be suitable for radial neck fractures with major translocation. Although the technique of Metaizeau is well described and published by

various authors, we differ from them by primarily using a joystick manipulation in all the cases, evaluating only type IV fractures and with a different point of entry from earlier described technique [17]. Open reduction was required in two patients; both the patients had complications, 1 had heterotrophic ossification and the other had a transient nerve palsy of the posterior interosseous nerve. We believe that inability to achieve close reduction in these two patients was due to loss of intact periosteal hinge; even leverage maneuver could not achieve reduction.

We believe the above modifications to the well-described Metaizeau technique have some significant advantages. Firstly, shifting the entry portal proximally prevents iatrogenic injury to the superficial radial nerve which has been reported earlier in series of cases treated by Metaizeau technique, [9] but was not encountered in any of our cases. Secondly, the use of a smaller diameter Kirschner-wire in our technique prevents the crushing of the soft cancellous bone of the head of radius that might be associated with the Metaizeau technique with a intramedullary elastic nail [11]. Thirdly, the use of joystick manipulation allows more

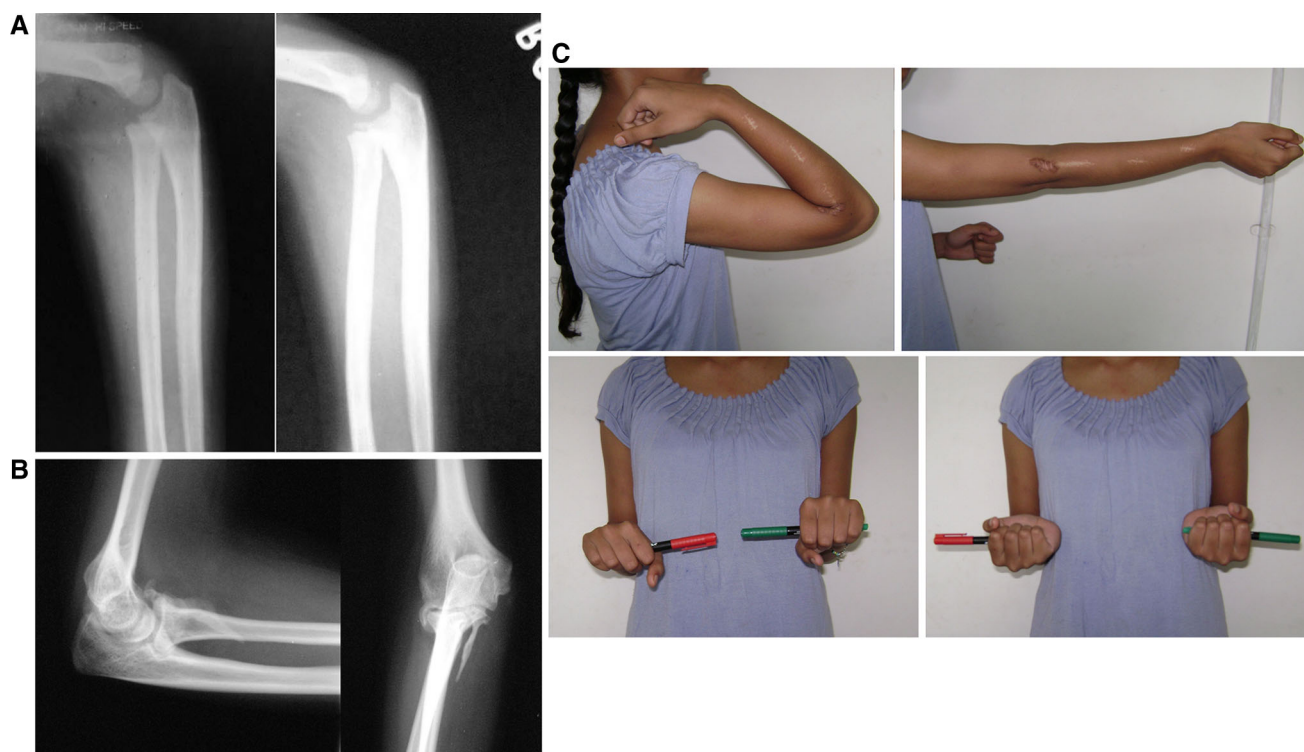


Fig. 3 **a** AP and lateral radiographs of patient with type IV A fracture neck radius at final follow-up. **b** AP and lateral radiographs of patient with type IV B fracture neck radius, requiring open reduction at final

follow-up. Note the heterotrophic ossification. **c** Clinical photograph of the same patient showing range of motion at elbow

precise reduction. Reduction in Metaizeau technique relies only on the arc of rotation of the bent wire which might be sufficient to reduce Judet type III fractures but may be unable to fully reduce type IV fractures.

We recommend these modifications in the classical Metaizeau technique in Judet's type IV fractures of neck radius. Failure to achieve closed reduction may occur in cases where lateral periosteal hinge is broken and these cases usually require open reduction. The presence of a periosteal hinge as a marker of success of closed reduction needs to be further evaluated in a larger series.

Conflict of interest The authors declare that they have no conflict of interest.

Ethical standard The study has been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments.

References

- D'souza S, Vaishya R, Klenerman L (1993) Management of radial neck fractures in children: a retrospective analysis of one hundred patients. *J Pediatr Orthop* 13:232–238
- Tibone JE, Stoltz M (1981) Fractures of the radial head and neck in children. *J Bone Joint Surg (Am)* 63(1):100–106
- Rodriguez Merchan EC (1994) Percutaneous reduction of displaced radial neck fractures in children. *J Trauma* 37(5):812–814
- Waters PM, Stewart SL (2001) Radial neck fracture nonunion in children. *J Pediatr Orthop* 21:570–576
- Radomisl TE, Rosen AL (1998) Controversies regarding radial neck fractures in children. *Clin Orthop* 353:30–39
- Fowles JV, Kasab MT (1986) Observations concerning radial neck fractures in children. *J Pediatr Orthop* 6:51–53
- Metaizeau JP, Lascombes P, Lemelle JL, Finlayson D, Prevot J (1993) Reduction and fixation of displaced radial neck fractures by closed intramedullary pinning. *J Pediatr Orthop* 13:355–360
- Metaizeau JP (2005) Reduction and osteosynthesis of radial neck fractures in children by centromedullary pinning. *Injury* 36(S):75–77
- Endele S, Wirth T, Eberhardt O, Fernandez F (2010) The treatment of radial neck fractures in children according to Metaizeau. *J Pediatr Orthop B* 19:246–255
- Morrey BF, An KN, Chao EYS (1993) Functional evaluation of the elbow. In: Morrey BF (ed) *The elbow and its disorders*, 2nd edn. W. B. Saunders, Philadelphia, pp 86–89
- Prathapkumar RK, Garg KN, Bruce EC (2006) Elastic stable intramedullary nail fixation for severely displaced fractures of the neck of the radius in children. *J Bone Joint Surg [Br]* 88-B:358–361
- Wood SK (1969) Reversal of the radial head during reduction of fracture of the neck of the radius in children. *J Bone Joint Surg [Br]* 51:707–710
- Steele JA, Graham HK (1992) Angulated radial neck fractures in children. A prospective study of percutaneous reduction. *J Bone Joint Surg [Br]* 74-B:760–764
- Walcher F, Rose S, Mutschler W, Marzi I (2000) Minimally invasive technique for reduction and stabilization of radial head and radial neck fractures in children. *Eur J Trauma* 26:85–89

15. Bernstein SM, McKeever P, Bernstein L (1993) Percutaneous reduction of displaced radial neck fractures in children. *J Pediatr Orthop* 13:85–88
16. Biyani A, Mehara A, Bhan S (1994) Percutaneous pinning for radial neck fractures. *Injury* 25(169):71
17. Brandao FG, Soares BC, Teixeira ML, Boechat CL (2010) Displaced radial neck fractures in children: association of the Metaizeau and Bohler surgical techniques. *J Pediatr Orthop* 30:110–114