International Journal of Orthopaedics Sciences

E-ISSN: 2395-1958
P-ISSN: 2706-6630
IJOS 2023; 9(1): 250-255

https://www.orthopaper.com
Received: 04-01-2023
Accepted: 06-02-2023

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Management of a rare case of displaced radial neck fracture and distal 1/3rd radius fracture of same side in 12 year old girl

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DOI: https://doi.org/10.22271/ortho.2023.v9.i1d.3305

Abstract
Introduction: Radial neck fractures make up approximately 5% of elbow fractures in children and patient is having along with distal 1/3rd radius fracture on same side.
Results: Rare case of patient with radial neck fracture and distal 1/3rd radius fracture and its functional and anatomical outcome using intramedullary nailing and percutaneous pinning has excellent results.
Conclusion: Closed reduction using Metaizeu procedure with kapandji and the percutaneous pinning results in excellent outcome.

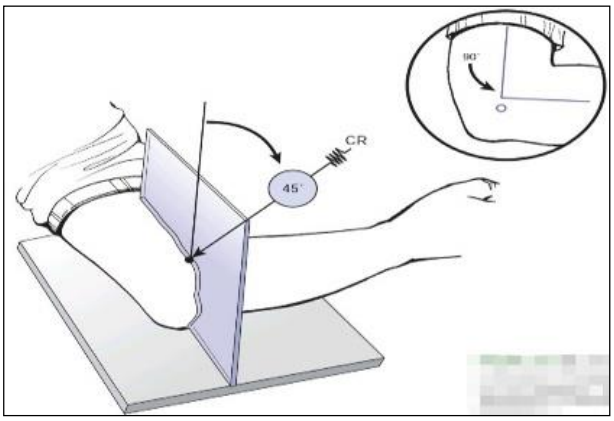
Keywords: Radial neck fracture, distal 1/3rd radius fracture, closed reduction

Introduction
Fractures of the radial neck account for slightly more than 1% of all children's fractures. Radial neck fractures make up approximately 5% of elbow fractures in children. Radial head fractures are uncommon, and when they occur usually are Salter-Harris type IV injuries. The median age at injury is 9 to 10 years in the pediatric population [1, 2, 3].

Mechanisms of injury for fractures of the proximal radius
Most fractures of the proximal radius occur at the neck. Fractures of the proximal radius most commonly occur after a fall on an outstretched arm with elbow extended and valgus stress at the elbow. The immature radial head is primarily cartilaginous and intra-articular radial head fractures in children and adolescents are rare. The cartilaginous head absorbs the force and transmits it to the weaker physis or metaphysis of the neck. These fractures characteristically produce an angular deformity of the head with the neck [3, 4, 5].

Signs and symptoms of fractures of the proximal radius
Following a fracture, palpation over the radial head or neck is painful. The pain is usually increased with forearm supination and pronation more so than with elbow flexion and extension. Displaced fractures frequently result in visible bruising or ecchymosis on the lateral aspect of the elbow with significant soft tissue swelling. Neurologic examination should in particular evaluate the PIN, which can be affected by fractures of the proximal radius. In young child, the primary complaint may be the wrist pain and pressure over proximal radius may accentuate this referred wrist pain [6].

Imaging
Displaced proximal radius fractures are usually easy to identify on standard anteroposterior (AP) and lateral radiographs. Some variants in the ossification process can resemble a fracture. Comparison views of the contralateral elbow are useful for evaluation of unusual ossification centers after an acute elbow injury.
One oblique view that is especially helpful is the radio-capitellar view suggested by Greenspan and Hall-Craggs. This view projects the radial head anterior to the coronoid process [5, 7, 8, 9].



Images 1: Radio-capitellar view [10]

Radio-capitellar view-center of x-ray beam is directed at 45 degrees to separate proximal radius and ulna on the radiograph.

Classification of fractures of the proximal radius
Chambers classification of proximal radial fracture
Chambers classified proximal radial fractures into three major groups based on the mechanism of injury and displacement of the radial head [11].

Group I: Primary displacement of the radial head.

I. Valgus fractures
- **Type A:** Salter-harris type I and II injuries of the proximal radial physis.
- **Type B:** Salter-harris type IV injuries of the proximal radial physis.
- **Type C:** Fractures involving only the proximal radial metaphysis.

II. Fractures associated with elbow dislocation
- **Type D:** Reduction injuries.
- **Type E:** Dislocation injuries.

Group II: Primary displacement of the radial neck.
A. Angular injuries (Monteggia type iii variant).
B. Torsional injuries.

Group III: Stress Injuries
A. Osteochondritis dissecans or osteochondrosis of the radial head.
B. Physeal injuries with neck angulation.

O'Brien classification [12]
In 1965, O'Brien also classified radial neck fractures based on angulation. They further suggested treatment based on the degree of angulation.
- **Type I:** <30 degrees angulation-immobilization.
- **Type II:** 30-60 degrees angulation-closed reduction.
- **Type III:** >60 degrees angulation-open reduction.

Judet classification of radial neck fractures [13]
Type I: Non-displaced.
Type II: <30-Degree Angulation.
Type III: 30–60-Degree Angulation.
Type IVA: 60–80-Degree Angulation.
Type IVB: >80-Degree Angulation.
Type V: Epiphyseal Separation.

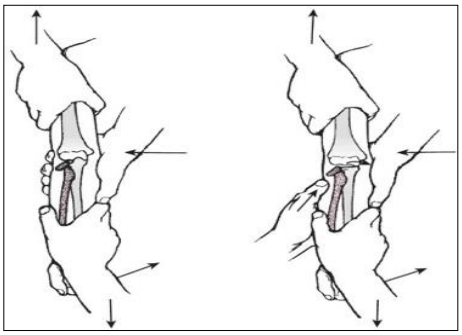
Most authors agree that less than 30-degree angulation should be treated with casting. There are diverging opinions as to how best to treat fractures angulated beyond 30 degrees. Many authors recommend attempting closed reduction for fractures angulated beyond 30 degrees. Regarding acceptable reduction following closed reduction, there is also a wide variance of reported outcomes. Salter and Harris found less than 15 degrees to be the optimal residual angle, whereas Metaizeau *et al*. suggested less than 20 degrees and Herring and Ho proposed less than 30 degrees to be acceptable limits. On the other hand. D'Souza *et al*. found excellent remodeling in fractures angulated up to 45-degrees. Regardless of classification scheme or proposed acceptable additional factors should be considered when choosing management of radial neck fractures, including amount of translation/ displacement, age of the patient, and time elapsed since injury [14, 15, 16, 17].

Management
Non-operative treatment
Indications
- <2 mm displacement of the radial head or neck.
- <30-45-degree angulation of the radial neck (<30 degrees age greater than 10, <45 degrees age less than 10).
- Full forearm pronation and supination.

Relative contraindications
- Open fracture.
- Incongruent elbow joint.

Closed reduction techniques
Patterson described a reduction technique for the radial neck in 1934.

Patterson's manipulative technique [18]
Left: An assistant grabs the arm proximally with one hand placed medially against the distal humerus. The surgeon applies distal traction with the forearm supinated and pulls the forearm into varus. Right: Digital pressure applied directly over the tilted radial head completes the reduction. (IMAGE A)



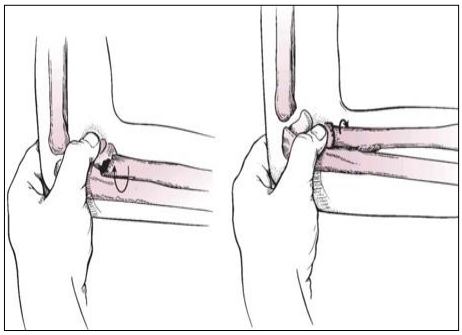
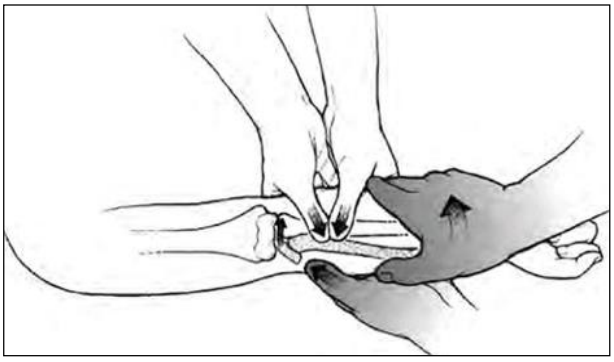


Image A: Patterson's manipulative technique **Image B:** Israeli (Kaufma

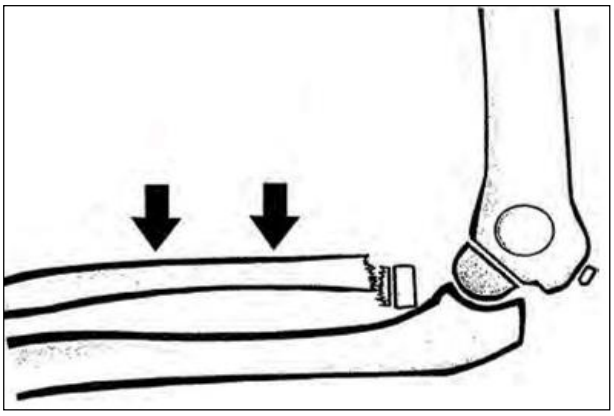
Israeli (Kaufman) [19]: With the elbow flexed to 90 degrees and the forearm supinated, the forearm is then pronated while direct pressure is applied to the radial head. (Images B)

Neher and Torch Technique [20]: An assistant uses both thumbs to place a laterally directed force on the proximal radial shaft while the surgeon applies a varus stress to the elbow. Simultaneously, the surgeon uses his other thumb to apply a reduction force directly to the radial head. (Images C)



Images C: Neher and Torch Technique

Monson technique [21]: After adequate sedation or anesthesia the elbow is flexed to 90 degrees and forearm fully supinated. The proximal radial fragment should be stabilized in place by the annular ligament. A directly applied force to the radial shaft is applied to reduce the shaft to the head. (Images D)



Images D: Monson technique

Regardless of the technique chosen alignment should be assessed by fluoroscopy. Radial neck angulation should be reduced to less than 45 degrees in children under 10 years of age and less than 30 degrees in children greater than 10 years of age. The radio-capitellar joint should be congruent.

Esmarch bandage [11]: While holding a varus stress to the elbow, an Esmarch bandage is applied distal-to-proximal over the forearm. This technique may be enough to reduce the radial neck alone or may be combined with other described maneuvers. At the very one should always check images of the fracture after use of the Esmarch bandage and prior to open reduction.

Operative treatment

Indications-Surgical treatment is indicated in situations where acceptable alignment cannot be achieved with closed means, or if there is persistent elbow instability or restricted range of motion after closed treatment.

Operative treatment should be considered when displacement remains over 2 mm, angulation is greater than 45 degrees (age < 10) or greater than 30 degrees (age < 10) and for open injuries. Nerve palsy is generally not an indication for surgery because most will recover function over time.

Preoperative planning

Checklist

- **OR table:** Standard with radiolucent hand table.
- **Position/positioning aids:** Turn table 90 degrees, bring patient to edge of table toward hand table. Secure head with blanket/towel and tape. Safety strap over torso.
- **Fluoroscopy location:** In line with affected extremity, perpendicular to or table.
- **Equipment:** Smooth Kirschner wires.
- **Tourniquet (sterile/non-sterile):** Nonsterile tourniquet.
- Esmarch bandage.

Kapandji: With the forearm held in pronation to protect the posterior interosseous nerve, a K-wire is percutaneously introduced from the posterior and distal aspect of the forearm. The radial head is then directly leveraged into place [22, 23].

Wallace: A blunt-tipped instrument such as a Joker or a hemostat is inserted on the dorsal subcutaneous border of the ulna at the level of the bicipital tuberosity. This is then used to push and reduce the radial shaft back toward the radial head [3]. Intramedullary reduction and fixation of proximal radius fractures was described by METAIZEAU in 1980. After selection of an appropriate-sized implant (K-wire or titanium flexible nail) the distal 3 to 4 mm of the implant should be bent sharply about 40 degrees. Either a dorsal or radial approach can be utilized at the entry site of the distal radius. The implant should be impacted into the epiphysis to achieve maximal fixation prior to reduction attempts with the implant. Once advanced appropriately, the nail should be rotated 90 to 180 degrees as needed to reduce the proximal fragment. The forearm should be held by the assistant to prevent the radial shaft from rotating with the implant [15].

Postoperative care

Immobilization should only be for symptomatic relief from surgical trauma and soft tissue healing. Generally 1 to 2 weeks is sufficient in patients with open reduction internal fixation or intramedullary fixation. Longer immobilization of 2 to 3 weeks may be required for some patients treated with no reduction or closed reduction to achieve enough symptom relief to allow for mobilization. Collar and cuff, posterior splint, and long-arm cast are all appropriate methods of immobilization. Range of motion should be allowed and encouraged when acute fracture pain has resolved and surgical scar has healed.

Pitfall: PIN injury, Radio-capitellar subluxation, Failure to engage proximal fragment with intramedullary implant, Mechanical block to forearm rotation [24].

Complications after radial neck fracture

Complications of treatment include loss of motion, which is most common in pronation and supination rather than flexion and extension. Malunion and nonunion can occur [24].

Case report

History

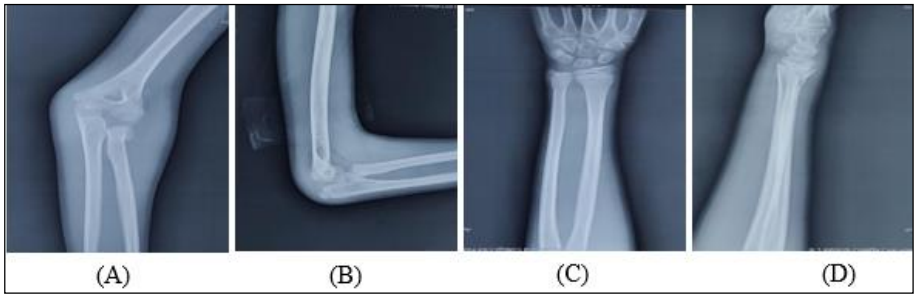
A 12-year female present with complaint of pain swelling left elbow and wrist with deformity and restricted movements over

elbow and wrist A/h/o injury due to all down from height (10ft approximately) over her left hand while playing at home.

On physical examination
Swelling, tender, crepitations, deformity abnormal movements present at elbow (Radial Neck facture) and distal forearm Radial aspect (distal 1/3rd radius fracture).

Distal examination-distal pulse and movements present.

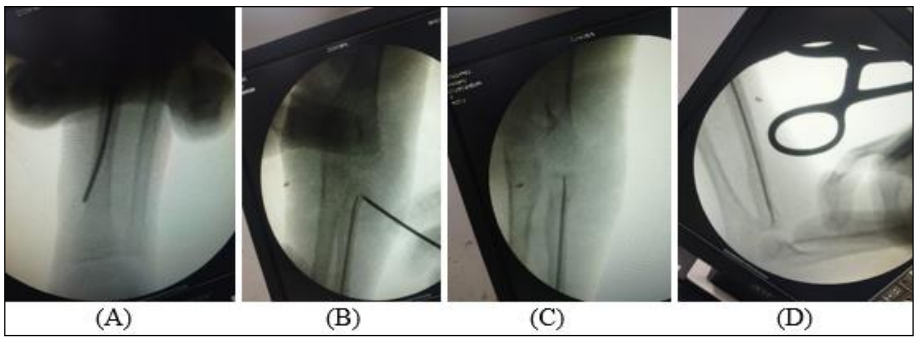
X-ray
Radiography shows radial neck fracture and distal 1/3rd radius fracture same left side.
(Judet type IV-B classification more than 80 degree).



Images A, B: Preop x-rays left elbow, **C, D:** Preop x-rays left wrist ap and lateral

Reduction
Radial neck fracture fixation done using
a) Closed reduction f/b.
b) Percutaneous pining f/b.
c) Intramedullary nailing.
a) Patterson maneuver f/b.
b) k-wire joy sticking done f/b.
c) Metaizeu technique done.
F/b distal 1/3 Rd radius fixed using 1*2 mm k-wire

Intraoperative IITV shoots Operated for radial Neck fracture and Distal 1/3rd Radius Fracture same side



Images A, B: Intraop postop x-rays left elbow, **C, D:** Preop x-rays left wrist AP and lateral)

Postoperative care
The arm is immobilized in a long arm cast for 2 to 3 weeks. The Kirschner wire is removed in 3rd to 4th weeks once callus is present on radiographs.
Followed by physiotherapy done for elbow and wrist passive active flexion and extension and Also supination and pronation at elbow.

At the end of 3rd week k-wire removed
By the end of 8th week patient had regained full range of movements and at 3 months patient has normal as before performance level.

Immediate post-op X-rays of elbow AP and lateral and wrist AP and lateral

Images A, B: Immediate post-op X-rays of elbow AP and lateral and C, D: Wrist AP and lateral

At 2 week follow-up postop x-rays and physiotherapy of upper-limb strengthing exercise is started.

At 3 months follow-up postop x-rays and clinical photos of operated upper-limb x-rays.

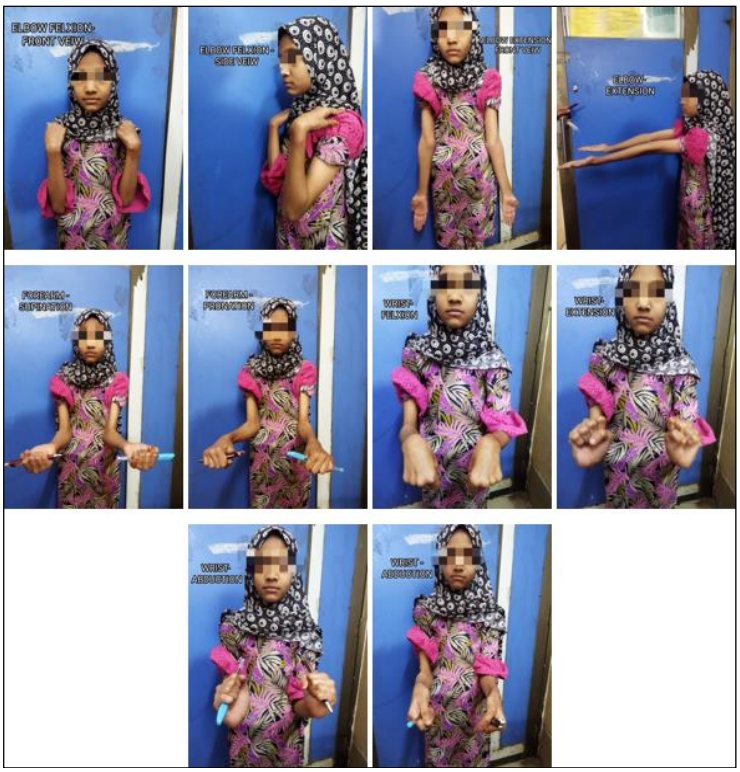
A) X-ray elbow AP and Lateral **(B) X-ray wrist with radius ulna AP and Lateral**

Conclusion

The technique of closed reduction for distal 1/3RD radius using k-wire and distal intramedullary nail fixation of the radial neck fractures in children described by Metaizeau in 1980 changed the prognosis of radius neck fracture in children and given better functional and anatomical results with no complications.

Early mobilization can be started

Clinical photos of 12 year old female patient at 3 month follow-up



Images: Clinical photos of 12 year old female patient at 3 month (18 weeks) follow-up

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How to Cite This Article
Jaydeep R, Pavak P, Anand T, Kapildev P, Sakshi M. Management of a rare case of displaced radial neck fracture and distal 1/3rd radius fracture of same side in 12 year old girl. International Journal of Orthopaedics Sciences 2023; 9(1): 250-255.