Paediatric Radial Neck Fracture Fixation by Metaizeau Technique - Surgical Technique and Outcome

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ABSTRACT

BACKGROUND

Radial neck fractures in children are serious injuries with frequent sequelae when the tilt exceeds 60 degrees. Conservative treatment is often inadequate in such cases and open reduction may produce iatrogenic complications. Displaced radial neck fractures in the paediatric population can be treated with retrograde intramedullary nailing of the radius (the Metaizeau technique). This method allows early post-operative movement and thus has high functional outcome. The purpose of this case series was to evaluate the functional outcome of Metaizeau technique.

METHODS

This is a prospective study in which follow-up of 9 cases with radial neck fracture treated with Metaizeau technique was done. Clinical and radiological evaluation was done at 2 weeks, 4 weeks, 6 weeks and 6 months. Active range of motion of flexion and extension at elbow and forearm rotation was noted at 6 weeks along with pain score and Mayo Elbow Performance Score (MEPS). Radiological assessment was also done at 6 weeks regarding union.

RESULTS

8 out of 9 cases had radiological union at 6 weeks. 1 case was lost to follow-up. Excellent result was obtained in all 8 cases. Range of flexion-extension, supination-pronation were identical in all 8 cases. 1 case developed pressure bursitis at entry site.

CONCLUSIONS

Metaizeau technique for radial neck fracture fixation is simple, safe, soft tissue sparing, minimally invasive technique giving excellent functional and cosmetic results with minimal complication.

KEYWORDS

Metaizeau Technique, Retrograde Intramedullary Nailing, Radial Neck Fracture, MEPS

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BACKGROUND

Radial neck fracture in children accounts for 5 - 8.5 % of total elbow injury.[1] They are usually the result of a fall onto an extended and supinated forearm, which leads to the radial neck fracture and leads to angulation of the radial head. 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.[2,3,4] The immature radial head is primarily cartilaginous and intra-articular radial head fractures in children and adolescents are rare. The radial head is entirely articular cartilage and the primary blood supply comes from the metaphysis. This may predispose the radial head to avascular necrosis and non-union with significant displacement. The cartilaginous head absorbs the force and transmits it to the weaker physis or metaphysis of the neck.[4] These fractures characteristically produce an angular deformity of the head with the neck. Radial neck fractures in children are serious injuries with frequent sequelae when the tilt exceeds 60 degrees. Conservative treatment is often inadequate in such cases and open reduction may produce iatrogenic complications. Displaced radial neck fractures in the paediatric population can be treated with retrograde intramedullary nailing of the radius (the Metaizeau technique). The direction of angulation depends on whether the forearm is in a supinated, neutral, or pronated position at the time of the fall. Vostal showed that in neutral, the pressure is concentrated on the lateral portion of the head and neck. In supination, the pressure is concentrated anteriorly and in pronation it is concentrated. The prognosis depends on the degree of displacement, the age of the patient, associated elbow injury and the method of treatment. Less than 30 degree of angulation, which is Judet II, generally acceptable.[5,6,7] Poor results are generally associated with more degree of angulations and displacement. Restoration of radial neck angulation and displacement is essential to restore the normal biomechanics and stability of the elbow. Most of the minimally displaced radial neck fractures are treated conservatively with early initiation of physical therapy.[8] Conservative treatment might result in secondary displacement, malunion and cubitus valgus, whereas open reduction and internal fixation (ORIF) is associated with non-union, implant-related complications, reduced range of motion (ROM), posterior interosseous nerve palsy, heterotopic bone formation and avascular necrosis of the radial head. The standard procedure accepted for isolated radial neck in paediatric age group is centro medullary pinning (Metaizeau technique). The purpose of this case series was to evaluate the functional outcome of Metaizeau technique.

Injuries Associated with Radial Neck Fracture

Proximal radius fractures can occur concomitantly with distal humerus, ulna, radial shaft, or distal radius fractures.[2,9,10] Fractures in combination with ulnar fractures often are part of the Monteggia fracture. Presence of associated fractures portends a poor prognosis for patients with proximal radius fractures with higher rates of persistent stiffness and pain compared to those with isolated proximal radius fractures.[11] Proximal radius fractures can also occur during traumatic elbow dislocations. The posterior interosseous nerve (PIN) wraps around the proximal radius and occasionally can be injured in association with proximal radius fractures. More typically, however, the nerve is at risk during percutaneous manipulation or open reduction of proximal radius fractures.

Signs and Symptoms

Following a fracture, palpation over the radial head or neck is painful. The pain is usually increased with forearm rotation than with elbow flexion and extension. Displaced fractures frequently result in visible bruising on the lateral aspect of the elbow with soft tissue swelling. Neurologic examination should in particular evaluate the PIN (test for wrist, digital and thumb extension). Occasionally in a young child, the primary complaint may be wrist pain, and pressure over the proximal radius may accentuate this referred wrist pain.[12] The wrist pain may be secondary to radial shortening and subsequent distal radioulnar joint dysfunction. This reinforces the principle of obtaining radiographs of both ends of a fractured long bone and complete examination of the entire affected extremity.

Imaging

Displaced proximal radius fractures are usually easy to identify on standard anteroposterior (AP) and lateral radiographs.[13] Some variants in the ossification process can resemble a fracture. Most of these involve the radial head, although a step-off can also develop as a normal variant of the metaphysis. There may be a persistence of the secondary ossification center of the epiphysis. Comparison views of the contralateral elbow are useful for evaluation of unusual ossification centers after an acute elbow injury. If the elbow cannot be extended because of pain, special views are necessary to see the AP alignment of the proximal forearm and distal humerus. A regular AP view with the elbow flexed may not show the fracture because of obliquity of the beam and overlap of proximal forearm and distal humerus bones. One view is taken with the beam perpendicular to the distal humerus, and the other with the beam perpendicular to the proximal radius. The perpendicular views show the proximal radial physis in clear profile.

METHODS

It was a prospective study in which 9 cases of radial neck fracture, after proper consent were treated by Metaizeau technique at Burdwan Medical College from 2018 - 2019. Patients were followed up at 2 weeks, 4 weeks, 6 weeks, 10 weeks and 12 weeks. Long arm back slab was done after operation for 48 hours.

After 48 hours, slab was removed, dressing changed and active range of motion (AROM) exercise was advised and patients were discharged with single antibiotic coverage

(tablet amoxiclav). Patients were advised to do light activities like eating, grooming etc. Heavy work and playful activities were forbidden. Clinical assessment was done by degree of active range of motion and MEPS at 6 weeks. Radiological assessment for union was also done at 6 weeks.

Surgical Technique

Patient was positioned supine with arm abducted 90 degree and forearm placed on a radiolucent side-table. C-arm was positioned and pre-checked. All the patients were given brachial block. Under C-arm, radial head was tried to be reduced by Patterson manoeuvre. If it failed, then blunt tip K wire was used to hinge and reduce the head (Kapandji technique). Reduction was confirmed under C-arm.

2 mm titanium elastic nails (TENS) were used for this purpose. 1 cm long incision was placed on lateral aspect of forearm 2 cm proximal to radial styloid. Entry for TENS nail was taken using awl. TENS was introduced inside the radial medullary canal. Nail was advanced under C-arm till it gets engaged in proximal fragment. Then nail was rotated 180 degree and fracture was reduced and confirmed under fluoroscopy. The nail was then buried under skin and single suture was given at entry site. Long arm back slab was applied for 48 hours and then slab was removed, and dressing was changed, and patient was allowed for AROM exercise.

Post-Op Protocol

Patient was discharged with single antibiotic coverage (tablet amoxiclav)
And painkiller (aceclofenac-paracetamol combination)
Pt was followed up at 2 weeks for stitch off.
At 4 weeks X-ray was done to check for union.
At 6 weeks clinic-radiological assessment was done.
At 10 weeks removal of TENS was done.

RESULTS

A total of nine cases were included. Average age was 9 years (range = 6 yrs. - 12 yrs.). 1 patient was lost to follow-up. Functional outcome data was compiled at 6 weeks.

	Demography	N (%)
Gender (N = 9)	Male	5 (55.55 %)
	Female	4 (44.44 %)
Side (N = 9)	Right	4 (44.44 %)
	left	5 (55.55 %)
	Complication of entry site pressure necrosis (N = 9)	1 (11.1 %)

Table 1. Demography

Sl. No.	Flexion / Extension	Pronation / Supination	MEPS
1	0 - 130	70 / 90	85
2	0 - 120	80 / 70	80
3	10 - 130	80 / 80	75
4	0 - 130	70 / 80	85
5	0 - 130	70 / 80	80
6	10 - 130	90 / 80	80
7	10 - 120	90 / 80	80
8	0 - 120	80 / 70	85

Table 2. Functional Outcome

VAS Score	Cases
0	6
1 - 2	2

Table 3. VAS Score at 6 Weeks

Figure 1. Pre-Op X-Ray

Figure 2. Post-Op X-Ray (AP)

Figure 3. Post-Op X-Ray (Lateral)

Figure 4. X-Ray at 12 Weeks

DISCUSSION

The method of closed intramedullary pinning of displaced radial neck fractures described in this article was introduced by the French in 1980.[14] This group was led by Jean Paul Metaizeau. The prognosis for radial neck fractures was strongly dictated by 2 factors: severity of displacement and associated injuries to the elbow. Radial neck fracture is relatively a common paediatric fracture accounting for 5 - 10 % of all paediatric elbow fracture and 1 % of all paediatric fractures. Judet I and II (angulation < 30^0) can be well treated conservatively by long arm slab but Judet III and IV requires intervention.

Closed reduction and intramedullary pinning technique (Metaizeau technique) are considered as the treatment of choice.[15] The ORIF is associated with a higher rate of avascular necrosis,[16] proximal synostosis,[17] heterotopic ossifications,[18] infection, posterior interosseous nerve palsy and loss of range of motion (ROM).[19] There is no surgical scar near the elbow or disruption of internal milieu of the elbow leading to stiffness of the joint.

In this study, it is found that this technique is safe and effective in treating radial neck fracture in children. The fracture should be reduced within 7 days of injury. Later on, fracture reduction will not be possible because of fibrosis and fracture healing. In our study, average age was 9 years. Males were affected more than females and the common mode of injury was fall on outstretched hand.

All cases achieved radiological and clinical union by 6 weeks. All cases achieved comparable flexion-extension of elbow, supination-pronation of the forearm (as compared to healthy side). Average MEPS was 81.5 which was quite remarkable.

Only one patient developed entry site pressure necrosis by cut end of TENS nail. The other disadvantage of this technique was need of second surgery to remove TENS nail which we did at 10 weeks.

CONCLUSIONS

Results of Metaizeau technique in children was promising. Proper selection of patient and timing of surgery is important for success. Metaizeau technique is a minimally invasive technique with easy learning curve, minimal tissue damage, and reduced chance of elbow stiffness and osteonecrosis of radial head.

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