

To Study Functional and Radiological Results of Percutaneous K Wire Aided Metaizeau Technique in the Treatment of Displaced Radial Neck Fractures in Children

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Abstract

Aim and Objectives: The purpose of this prospective study is to evaluate the efficiency and determine the radiological and functional results of closed reduction followed by fixation using percutaneous K-wire with the Metaizeau technique under fluoroscopic guidance.

Materials and Methods: This study was conducted at Department of Orthopaedics, SMS Medical College and Hospital, Jaipur. Selected patients were operated, nail was removed at 6 weeks and a follow up for 6 months was done post operatively. The patients functional results were evaluated.

Results: According to the Tibone-Stoltz functional evaluation classification, out of 22 patients 16 were evaluated as excellent (72.73%), 4 were evaluated as good (18.18%) and 2 were evaluated as fair (9.09%).

Conclusion: We considered that the closed K-wire aided Metaizeau technique can be used as an effective method in the treatment of Judet stage 3 and 4 displaced radial neck fractures in children.

Keywords: K-Wire; Metaizeau Technique; Tibone-Stoltz Functional Evaluation; Radial Neck Fractures; Children

Introduction

1% of all childhood fractures are radial neck fractures [1]. Since the radial neck injuries can account for up to 5% of elbow injuries, they make up 1% of all fractures in children [2]. They come fourth in place behind the external condyle fractures, supracondylar fractures and trochlear fractures. The most common kind of radial neck fracture is the metaphyseal fracture which is followed by the epiphyseal separation fracture (Salter-Harris II). All ages are affected with a peak frequency between the ages of 9 and 10 [3,4].

The radial head and neck has an unstable blood supply due to its unusual vascular structure. The Articular cartilage covers the radial head and vessels enter at the level of periosteal attachment. When there is an injury or an open manipulation, they are harmed. Stiffness, malunion, osteonecrosis and nerve damage are certain examples of complications [5].

This injury frequently occurs as a result of landing on an open, extended hand. Valgus stress may cause ulnar epicondylar avulsion fractures, ulnar capsule and collateral ligament ruptures, and olecranon and ulna fractures among other concomitant injuries [6].

A developing bone with an intra-articular fracture is the radial neck in youngsters. Its evolutionary risk may be the cause of severe anatomical and functional consequences caused by the emergence of a malunion or growth abnormalities caused by an attack on the growth cartilage, necessitating a particular course of therapy.

There are various procedures to treat these fractures, including percutaneous reduction and intramedullary fixation, reduction and casting, closed reduction and intramedullary fixation, and open reduction. Although fractures with significant displacement and angulation (Judet Types 3 and 4) necessitate surgery, the majority of radial neck fractures with no displacement or angulation less than 30 degrees (Judet Types 1 and 2), numerous surgical approaches including open reduction with or without internal fixation and percutaneous joystick reduction with Kirschner wires used to treat these type of fractures in children. However, the stabilization by elastic stable intramedullary pinning approach, first introduced by Metaizeau in 1980 and later developed in 1993, significantly improved the surgical outcomes [7,8].

A pin is inserted into the medullary canal of the radius and advanced proximally until it reaches the inferior part of the epiphysis, raising the epiphysis, according to the elastic stable intramedullary nailing (ESIN) technique that was first developed by Metaizeau. Extra capsular intramedullary reduction and fixation is possible with this approach, allowing for closed reduction and minimally invasive internal fixation while safeguarding soft tissue attachments. The procedure has had outstanding results, but there are a number of potential side effects, including damage to the proximal epiphysis, extensor pollicis longus, and superficial radial nerve at the site of the pin insertion.

Objective of the Study

This study's objectives are to assess the efficiency and determine the radiological and functional outcomes of close reduction followed by fixation that uses percutaneous K-wire and the Metaizeau technique under fluoroscopic guidance.

Materials and Methods

This study was conducted at the Department of Orthopaedics, SMS Medical College and Hospital, Jaipur.

Inclusion criteria:

1. All patients with radial neck fractures (Judet type 3 and 4).
2. Age group 5 - 13 years.
3. Attendants who will give informed consent and willing for surgery.

Exclusion criteria:

1. Compound fractures.
2. Fractures with preexisting neurological deficit.
3. Children with a history of previous trauma around the elbow.
4. Patients who are unfit for anesthesia and surgery.
5. Loss of follow-up before 6 months.

Method

This was a hospital based interventional study (prospective). All patients within 5 - 13 years age group with radial neck fracture undergoing attending department of orthopaedic as IPD patients were included in study after taking informed written consent.

Selected patients underwent detailed history and routine investigation. They were operated; nail was removed at 6 weeks and followed up for 6 months post operatively. Patients functional results were evaluated. All collected data was analyzed and results were interpreted by Ursei radiological classification and Tibone and Stoltz functional classification.

Surgical technique: The procedure was carried out under general anesthesia in supine position without a tourniquet. A 1 inch vertical skin incision is made 1 - 2 cm proximal and radial to the distal radius epiphyseal line under fluoroscopic guidance. Avoiding the sensory branch of the radial nerve allows access to the cortex. Using a 3.2 mm drill, the lateral cortex was punctured. The intramedullary canal width and the patient's age are taken into consideration while choosing an elastic nail between 1.5 and 2 mm. Under fluoroscopic guidance, the TENS nail's blunt tip bends by about 30 degrees before being advanced to the radial head from the hole made on the distal radius. A 1.8 mm or 2.0 mm K-wire was then percutaneously inserted parallel to the fracture line to reduce the radial head angulation under fluoroscopy after making a 0.5 cm skin incision on the proximal forearm. The percutaneous K-wire is used to reduce the radial head fracture. The intramedullary-advanced TENS nail was moved near to the fracture line to distract the line. The curved TENS nail was rotated 180 degrees in order to obtain a proper reduction. Postoperative, an above elbow plaster was put on for three weeks. An exercise and finger movement was advised at home. After 6 weeks, when the fracture unites clinically and radiographically, the intramedullary nail is removed.

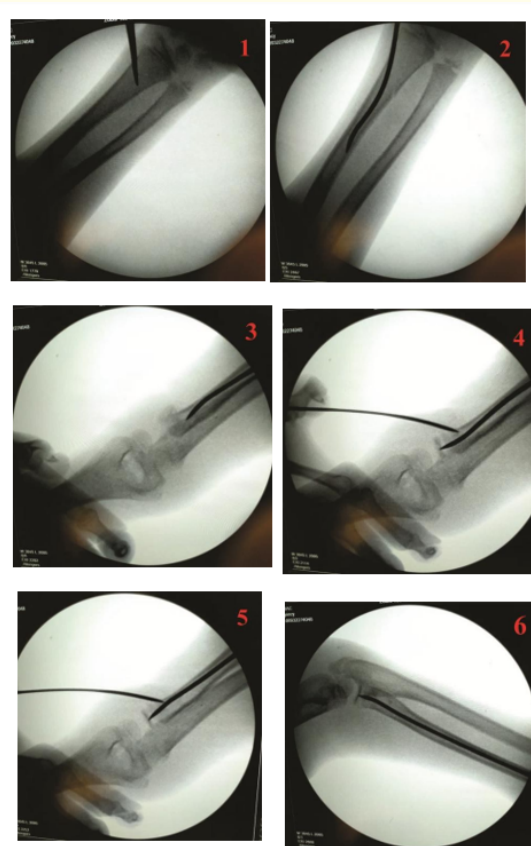


Figure 1: Operative stages: (1) Nail entry, (2) Nail advanced in canal, (3) Nail advanced just distal to neck of radius, (4) Reduction maneuver with aid of K-wire, (5) Nail rotated 1800 and advanced into the proximal fragment, (6) Final reduction.

Observation and Result

The patients in the study are in the age group ranging from 5 - 13 years with a mean of 8.77 years. Maximum 8 patients are in 5 - 7 years and 8 - 10 years age group (36.36% each). Minimum 6 patients are in the age group of 11 - 13 years (27.27%).

In the study of total 22 patients there are 10 males (45.45%) and 12 females (54.55%).

Out of the total 22 patients, 10 patients (45.45%) had injury to the right side whereas 12 patients (54.55%) had injury to the left side.

Out of 22 patients 17 patients (77.27%) presented with simple fall whereas 5 patients (22.73) presented with fall from height.

Out of total 22 patients 7 patients were classified under judet type 3 with radial head angulation between 30° - 60° (31.82%), 13 patients were classified under judet type 4 A with radial head angulation between 60° - 80° (59.09%) and 2 patients were classified as judet type 4B with radial head angulation more than 80° (9.09%). The mean radial head angulation was 64.9°.

Of the total 22 patients 17 patients (77.27%) had anatomical reduction postoperatively while 5 patients (22.73%) were left with 10° angulation at fracture site postoperatively.

Out of the 22 patients 16 patients (72.73%) did not have any change in carrying angle compared to the opposite limb. 1 patient (4.55%) had 8° valgus whereas 3 patients (13.64%) had 10° valgus and 2 (9.09%) patients had 12° valgus.

Discussion

Although a proper reduction is possible with open reduction and internal fixation, numerous studies have revealed that the risk of complications is higher than with open reduction. Elbow stiffness happens more frequently, which has an adverse effect on functional outcomes. Due to this, open reduction was not employed during the surgical procedures for this study.

The average age of our study was 8.77 years which was comparable to the one by Cevik N., *et al.* [9] (who had an average age of 9.75 years) and Trabelsi A., *et al.* [10] (which had a mean age of 9 years). Additional elbow injuries were discovered to be associated with a worse outcome in the patients with radial neck fractures in the study by Falciglia., *et al.* which involved a total of 24 open reductions for radial neck fractures with an average follow-up of 7.1 years. Only 1% of all pediatric fractures in children and about 5% of elbow fractures in children involve the radial neck. The series that most closely matches our patients' average age is this one. According to the research, a fall onto an outstretched hand with the elbow extended or slightly flexed and a valgus force being delivered to the elbow joint are the most common causes of radial neck fracture in infants.

In our study there were 12 females and 10 males which is different from Cevik N., *et al.* [10] where there were 16 males and 4 females. In Al-Aubaidi Z., *et al.* [15] 12 patients were female and 4 were male which is comparable.

In our study the mean radial head angulation was 64.9° whereas in the study done by Cevik N., *et al.* [10] mean radial head angulation was 52.4°. There is debate over how much angulation should be corrected surgically versus how much of a displaced radial neck fracture can be treated conservatively. The majority of authors believe that angulations greater than 30° for children younger than 10 and greater than 15° at the end of growth require reduction and surgical treatment. Although the surgeon determines the course of action, it is evident that younger patients have a greater chance of remodeling. Al-Aubaidi., *et al.* used surgical reduction and fixation in patients who had radial neck fractures with an angulation over 30°, with excellent results. In contrast, Locke., *et al.* reported that radial neck fractures with an angulation up to 50° in children under the age of 10 had good results with conservative treatment.

In our study out of 22 patients 7 patients were classified as Judet type 3 (31.82%), 13 patients as Judet type 4A (59.09%) and 2 patients as Judet type 4(9.09%). The treatment of Judet Type 3 radial neck fractures remains controversial in the literature [11]. For Judet Type 4 radial neck fractures, surgical treatment is recommended [12].

In our study out of 22 patients anatomical reduction was achieved in 17 patients (77.27%) whereas 5 patients (22.73%) had 10° residual angulation. In study done by Cevik N., *et al.* [10] out of 20 patients anatomical reduction was achieved in 17 patients (85%), 10° angulation was left in 2 patients (10%) and 8° angulation was left in 1 patient (5%).

In our study out of 22 patients 3 patients had occasional pain (13.64%), 2 patients had heterotopic ossification (9.09%) and 1 patient had AVN of radial head (4.55%). Although these complications did not affect the functionality of elbow joint. Sandmann., *et al.* [13] using the Métaizeau technique to treat radial neck fractures in adults reported injury to the superficial radial nerve in 14% of their patients. Yallapragada., *et al.* [14] in 2018 in their report on 21 patients observed that 66% of their patients had prominent metalwork at the nail entry point which caused pain.

The functional evaluation was done by Tibone-Stoltz functional evaluation classification. According to it out of 22 patients 16 were classified as excellent (72.73%), 4 were good (18.18%) and 2 were fair. Cevik N., *et al.* [10] used the same classification system. Out of 20 patients 16 were excellent (80%), 3 were good (15%) and 1 was fair (5%). The result of both the studies are comparable.

The radiological evaluation was done by Ursei radiological classification system. In our study out of 22 patients 17 were excellent (77.27%) and 5 were good (22.73%). Cevik N., *et al.* [10] used the same classification system in which out of 20 patients 17 were excellent (85%) and 3 were good (15%). The result of both the studies are comparable.

In the postoperative evaluation using the Ursei classification for radiological evaluation, 19 of the 25 patients who underwent the open reduction technique (76%) had excellent results and 6 patients (24%) had good results. Of the 22 patients who underwent percutaneous reduction using K-wire with the Metaizeau technique, 20 (90.9%) had excellent results and 2 (9.09%) had good results [15].

In published studies, D'Souza., *et al.* who used closed or percutaneous reduction on 99% of their patients reported excellent and good results. Similarly, in another study, 94% of patients treated with percutaneous reduction had positive results, and it was found that this procedure works efficiently for these types of fractures.

The small sample size and lack of comparability with other treatment modalities are two drawbacks of our study. We think that in order to establish treatment strategies for pediatric radial neck fractures, additional comparison studies with a considerably bigger sample size are necessary.

Conclusion

Based on the findings of this study and the relevant literature, it is advised that children with displaced radial neck fractures who need surgical treatment undergo the K wire assisted Metaizeau procedure. It is simple to use, does the least amount of injury to soft tissue, and produces good results. Therefore, we believe that Judet stages 3 and 4 displaced radial neck fractures in children can be successfully treated using the closed K-wire aided Metaizeau technique.

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