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Functional outcomes of Percutaneous Kirschner Wire Pinning in Paediatric Distal Radius Physeal Fracture (Salter Harris Type 2)

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ABSTRACT

Paediatric distal radius physeal Fracture are the most common injuries in childhood with no clear treatment guidelines. The initial fracture displacement of more than 50%, children close to skeletal maturity, and failed closed reductions are the indicators for surgical intervention. The purpose of this study is to evaluate the outcome following percutaneous K-wire fixation in displaced paediatric distal radius physeal fracture. A total of 24 patients (14 male and 10 female) were enrolled in the study under the age of 14 years (mean age: 11±4 years) with displaced physeal injuries with or without ulnar fractures were managed by percutaneous Kirschner wire fixation. The clinical and radiological evaluations were done following fixation with an average follow-up of 4.5 months. Palmer tilt of the radius was equal in 95.8% of the patient; no difference exceeding 10° was seen. The Mayo wrist score at the end of 6 months was 91 (range 85-93). Patient-reported outcomes and wrist motion were almost normal with no or minimal pain at the injury site. So, we recommend K-wire pinning is an easy, safe, effective and affordable procedure and prevents the chance of secondary displacement.

INTRODUCTION

Forearm fractures involving either one or both bones are the commonest injuries in the paediatric population among which distal radius fractures are more common (75-84%) [1]. Such injuries involve physis which is of significant value as distal radius physis comprises 70% of longitudinal growth of radius. Salter Harris II (SH II) injuries are the most common form of physeal injuries which involves the slippage of a triangular fragment of a meta physeal segment called Thurston-Holland fragment[2]. Despite common occurrences, the treatment guidelines are not clearly defined. Most authors recommend nonsurgical methods such as close reduction and casting[3], while some prefer operative intervention with K-wire fixation for children close to skeletal maturity, significant fracture displacement and failed close reduction[4]. Substantial evidence suggests better functional outcome is seen without intervention in patients with younger age, distal the fracture and lesser the angulations[5-6]. Nonsurgical intervention for displaced fractures is the mainstay of treatment but still has a chance of red is placement (25-39%)[7]. However the use of percutaneous K-wire has shown a decreased rate of red is placement following fixation[8-9]. Pin track infections, growth arrest, pin migrations, and neurovascular injuries are some potential complications following K-wire fixation[10].

The aim of this study is to analyze the outcome of pinning in SH II injuries clinically and radiologically and examine the incidence of pinrelated complications and red is placement following fixation. This study also helps to make a treatment guideline for the management of displaced SH II distal radius physeal injuries.

MATERIALS AND METHODS

This prospective study was conducted in our hospital from april 2022 to may 2023 for a period of 1 year. 24 children under the age of 14 years with displaced SH II physeal injuries were treated with percutaneous k wire fixation. Informed consent was taken and was obtained during regular follow-up. Inclusion criteria for operative management were Grade III and Grade IV fractures as per Mani[11]. Open fractures, associated with dislocations, previous injuries on the same site, and Grade I and II as per Mani[11] and pathological fractures were excluded.

Surgical Technique: All patients were anaesthetised with ultrasound-guided brachial plexus block with or without sedation as per compliance of child. The child was kept in a supine position and reduction was done under an image intensifier. After maintaining reduction a single or double smooth k-wire of size 1.5 mm for small children and 1.8 mm for larger ones was inserted percutaneously. Two lateral K-wires were kept in 20 patients and in 4 patients only 1 K-wire was kept. Postoperatively a long arm cast was applied. Cast along with K-wire was removed as a daycare procedure after 3-5 weeks. Then, active wrist and finger exercises were started. Follow up were done on 4 weeks, 3 months and 6 months. Fracture union and any displacement were noted with a plain radiograph. The pain was assessed with the Visual Analogue Scale (VAS) and function was assessed by the Mayo wrist score. Active wrist movements were measured by goniometer on 6-month follow-up and compared with the contralateral side. t-test was evaluated for independent variables and comparisons were done by chi-square test.

RESULTS AND DISCUSSIONS

Twenty-four children were enrolled in the study were of the age groups ranging from 6 years to 14 years with

Fig. 1: Pre Op x ray post op x ray

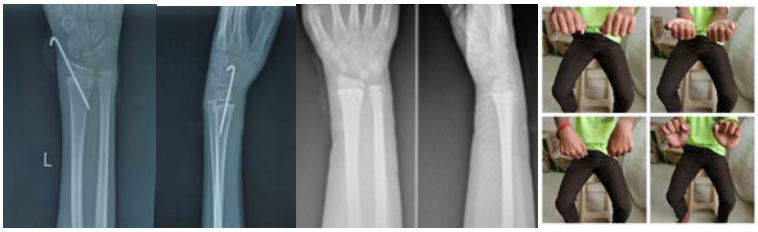

Fig. 2: 1 month follow up 3 month follow up 6 month follow up

Fig. 3: Pre Op x ray post op x ray

Fig. 4: 1 month follow up 6 month follow up

Table 1 Severity of translation

Grading of fractures	Grade 3	Grade 4	Total
Male	5(20.8%)	9(37.5%)	14(58.3%)
Female	6(25%)	4(16.7%)	10(41.7%)
Total	11(45.8%)	13(54.2%)	24(100%)

Table 2 Radial inclination and palmer tilt as compared with the contralateral side

Angulations	Radial inclination		Palmer tilt	
	male	female	male	female
equal	12	8	13	10
<10 degree	1	2	1	0
>10 degree	0	0	0	0

Table 3 Pattern of fracture

Pattern of fracture	Grade 3	Grade 4	total
Dorso-volar angulations			
Dorsal angulations	11	10	21
Volar angulations	2	1	3
Radio ulnar angulations			
Radial angulations	11	9	20
Ulnar angulations	0	1	1
Neutral angulations	3	0	3
Ulna styloid fracture			
No fracture	10	8	18
Fracture	1	5	6

a mean age of 11±4 years. The ratio of male to female was 7:5 with the involvement of the dominant hand in 62.5%. There were 13 patients with age<10 years and the remaining 11 patients were of greater than 10 years of age. The median time of injury to the surgery was of 23 hours (8-48 hr).

There were no injuries with neurovascular complications or triangular fibrocartilage complex (TFCC) on MRI. Six patients had ipsilateral ulna styloid fractures. The mean duration of immobilisation was 4 weeks [Range 3-6 weeks]. 45.8 % of patients were of G III and 54.2 % were of G IV as per Mani *et al* classification (Table 1) and displacements with grading were illustrated in (Table 3). The mean follow-up was 4.5 months (3-6 months). Five patients developed pin tract infection and 2 patients had pin migration. All patients achieved radiological union with no postoperative DRUJ instability. The Palmar tilt of the radius was equal in 95.8% of the patients; no difference exceeding 10° was seen. Radial inclination and palmar tilt are cited in (Table 2). There was no significant displacement in form of radial inclination and palmar tilt with a P-value >0.05. There was no significant impact on the functional outcomes of age, sex, side of injury, delay in treatment and postoperative complications. The median visual analog score was 0 [0-2] after 3 months. The range of motion compared to the contralateral wrist is 98% flexion, 90% extension, 80% radial deviation and 87% ulnar deviation. The Mayo wrist score at the end of 6 months was 91 [range 85-93].

Distal radius physeal injury can be treated conservatively but the chance of red is placement and malunion is always troublesome. In older children, initial fracture displacement of more than 50% of the diameter of bone, angulations greater than 20° and failure to achieve perfect reduction were some risk factors[12]. The question always arises during surgery whether we need anatomical reduction or shall we accept suboptimal reduction hoping that remodelling potential is good enough in the child. In the treatment of childhood fractures like supracondylar fracture of the humerus, both radius and ulna fracture, lateral condyle fractures K-wire have been used for a long but their use in high-risk distal radius physeal injuries has not been so common although many studies had documented significant chance of red is placement in those fractures following conservative treatment along [11-13]. Our study sample was selected according to initial fracture displacement of greater than 50% and which subset of groups had a high chance of red is placement following cast immobilization alone[12]. In the study by Nietosvaara[4], the better outcomes were seen with anatomical reduction and percutaneous pinning in children with greater than 50% displacement and not >1 year of growth remaining. Zamzam[14] recommend the usage of K-wires in all displaced distal radius fractures regardless of reduction while others concluded their use when perfect reduction is not achieved[9-11-13]. In our study, we found the use of K-wire has no translation and none developed radial inclination and palmar tilt greater than 10°. According to Jerome JT, Mayo's wrist scoring following intrafocal K-wire for Salter-Harris II physeal injuries was 84 and no associated injuries to TFCC[15] which was comparable to our study. Pin track infections, migration, scars, neuropraxia and hypertrophic granulation tissue formations were some potential complications following K-wire fixation[9-16]. In our study 5 patients developed superficial pin tract infection and pin migration was seen in 2 patients. Infection Was settled after pin removal. Ulnar styloid fracture is commonly associated with distal radius fracture. In the study by Zimmermann et al, additional ulnar styloid fractures had no influence on the overall outcome and neither did they cause instability of the DRUJ, produce wrist pain, or limit the range of motion[12]. Similarly, in our study 6 patients had ulna styloid fracture but have no influence on the overall outcome.

CONCLUSION

For displaced paediatric distal radius SH II physeal injuries with a potential chance of red is placement additional support with K-wire following close reduction should be the procedure of choice. Percutaneous K-wire fixation is an easy, safe, effective, and affordable procedure that further prevents the chance of red is placement or needs secondary intervention.

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