

## CASE REPORT

## Adhesions as an Uncommon Complication of K-Wiring in Paediatric Phalangeal Fractures

NANCHAPPAN S, PARMINDER GS, NUR AZUATUL AK, TAN JA, AHMAD SUPARNO B, JAMARI S, SHALIMAR A

*Hand and Microsurgery Unit, Department of Orthopaedics and Traumatology, Faculty of Medicine, Universiti Kebangsaan Malaysia Medical Centre, Jalan Yaacob Latif, Bandar Tun Razak, 56000 Cheras, Kuala Lumpur, Malaysia.*

### ABSTRAK

Fraktur tangan di kalangan kumpulan pediatrik adalah masalah yang kerap berlaku di mana rawatan secepat mungkin adalah penting untuk fungsi yang baik. Namun demikian ramai yang berpendapat rawatan fraktur hanya tertumpu kepada tulang tanpa penglibatan tisu-tisu sekeliling. Prosedur menyucuk wayar Kirschner atau lebih dikenali "K-wiring" kadang-kadang agak rumit terutamanya jika terlalu banyak kali percubaan dilakukan sehingga boleh menyebabkan kecederaan otot tendon fleksor dan ekstensor dan seterusnya tisu melekat atau "adhesions". Kami ingin menonjolkan kemungkinan berlaku komplikasi tisu melekat ini yang kami rasai kurang dilaporkan kerana ramai orang yang bersangka K-wiring ini adalah prosedur yang mudah. Kes yang dibentangkan adalah seorang budak lelaki berumur 9 tahun yang mengalami fraktur proksimal falanks (Salter Harris jenis 2) di jari telunjuk tangan kirinya. Fraktur ini bergerak dan lari agak banyak dan terpaksa dirawat dengan menyucuk K-wiring. Tetapi dia pula mengalami komplikasi otot tendon fleksor digitorum profundus (FDP) dan fleksor digitorum superficialis (FDS) yang melekat dengan teruk. Dia langsung tidak boleh membengkok sendi proksimal dan distal phalangeal joint. Kami terpaksa membuat dua kali pembedahan meleraikan otot tendon yang melekat serta membuat puli A2 untuk mengembalikan pergerakan jarinya. Meletak wayar Kirschner ke dalam tulang jari tidak semestinya kaedah pembedahan tulang yang mudah kerana ia boleh membabitkan tisu lembut yang boleh melekat.

*Kata kunci: falanks, fraktur, K-wiring, lekatan tisu, otot tendon fleksor, proksimal*

**Address for correspondence and reprint requests:** Assoc. Prof. Dr. Shalimar Abdullah. Hand and Microsurgery Unit, Department of Orthopaedics and Traumatology, Faculty of Medicine, Universiti Kebangsaan Malaysia Medical Centre, Jalan Yaacob Latif, Bandar Tun Razak, 56000 Cheras, Kuala Lumpur, Malaysia. Tel: +603-9145 6005 Email: kelapa44@yahoo.com

## ABSTRACT

Paediatric hand fractures are common and prompt management is mandatory to achieve a good functional outcome. However many fail to realize that treating a fracture does not only involve bones but the soft tissues, as well. K-wiring itself can be difficult with multiple attempts inadvertently injuring the flexor or extensor tendons and resulting in adhesions. We highlight this possible complication of K-wiring which we believe is under reported due to the perception that K-wiring is a simple procedure. We present a case of a 9-year-old child, who sustained a closed displaced fracture of the base of the proximal phalanx (Salter Harris type 2) of the left index finger. He underwent percutaneous K-wiring but was complicated with severe adhesions of the flexor digitorum profundus (FDP) and flexor digitorum superficialis tendons (FDS). He was unable to flex the proximal and distal interphalangeal joints of the affected finger. We subsequently performed tendon adhesiolysis twice together with A2 pulley reconstruction, to restore movement of the finger. K-wiring of the fingers are not just simple bony procedures but also involve soft tissue components which can be prone to adhesions.

Keywords: adhesions, flexor tendon, fracture, percutaneous K-wire, phalanx, proximal

## INTRODUCTION

The most common type of fracture of the proximal phalanx is the Salter Harris type 2, also known as a juxta epiphyseal fracture (Nogueira et al. 1999). It is a fracture involving most of the growth plate and extending towards the metaphysis (Peter & Seth 2009). The management of the fracture depends on the degree of displacement and stability. It can be treated conservatively by closed manual reduction and immobilization. In few cases, closed manual reduction and K-wiring are done. K-wiring itself can be difficult with multiple attempts inadvertently injuring the flexor or extensor tendons and resulting in adhesions. We highlight this possible

complication of K-wiring which we believe is under reported due to the perception that K-wiring is a simple, uncomplicated procedure.



Figure 1: Radiograph of the left hand showing a displaced and angulated fracture of the base of the proximal phalanx of the left index finger (Salter Harris Type 2) (yellow arrow)



Figure 2: Post operative radiograph showing percutaneous cross K-wires, following closed manual reduction.

### CASE REPORT

A 9-year-old boy fell off his bicycle and sustained a closed displaced fracture of the base of the proximal phalanx of his left index finger (Figure 1). He underwent closed reduction and percutaneous K-wiring to fix the fracture (Figure 2). Intra-operatively there was no documented difficulty in reduction or instability. The K-wire was removed after 3 weeks and physiotherapy commenced with tendon gliding exercises.

A month later, the child had full passive range of motion at both the proximal interphalangeal joint (PIP) and the distal interphalangeal joint (DIPJ). However, he was still unable to flex the PIPJ actively at all but able to flex the DIPJ from 0 to 30 degrees. Ultrasound showed minimal movement between the FDS and FDP tendons and are most likely due to adhesions. At three months post-operative, we proceeded to a second surgery. We found severe adhesions between both flexor digitorum

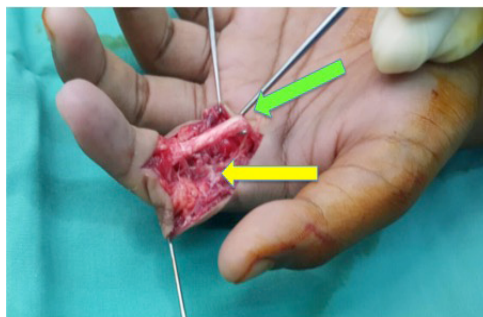


Figure 3: Intra-operative picture showing bowstringing (green arrow) of both flexor tendons due to absence of the A2 pulley with severe adhesions (yellow arrow) in the surrounding area.

superficialis (FDS) tendons and flexor digitorum profundus (FDP) tendons and also at the A1 and A2 pulley systems. The FDP appeared to also be adherent to new callus formation. We performed adhesiolysis followed by aggressive physiotherapy. The range of movement improved slightly with proximal and distal interphalangeal joint flexion from 0-30°.

Unfortunately, three weeks later, there was an episode of wound infection and the patient underwent a third surgery of incision and drainage where 3 ml of pus was drained.

One month after the third surgery, the active motion at the PIPJ had now



Figure 4: After adhesiolysis was done, we performed an A2 pulley reconstruction (yellow arrow) using a part of the extensor retinaculum.

decreased to 0-20° and at the DIPJ from 0-10°. Four months after the third surgery, active motion was even more limited at both PIPJ and DIPJ at 0-5°, only.

With such a poor range of motion, we proceeded to a fourth surgery and re-exploration of the finger was done (Figure 3) and we noted severe adhesions. The A2 pulley was absent and the flexor tendons were bowstringing across the joints. A repeat adhesiolysis was performed together with reconstruction of the A2 pulley using a small portion of the extensor retinaculum (Figure 4). Immediate physiotherapy was commenced to prevent further adhesions.

Initially a month after the last surgery, he had no active motion at the PIPJ but at the DIPJ, he had 0-15°. But at 6 months post surgery, active motion at the PIPJ remained zero and active motion at the DIPJ had decreased to only 0-5°. However, at all times, the proximal and distal interphalangeal joints remained supple with full passive range of movement of both joints.

## DISCUSSION

The proximal phalanx fracture is a common fracture in children with Type II Salter Harris as the most common fracture pattern (Nogueira et al. 1999). However, few authors have suggested that the fracture line may be entirely metaphyseal, 1 to 2 mm distal to the physis, hence the more appropriate termed is juxtaepiphyseal fractures (Peter & Seth 2009; Rodriguez-Vega et al. 2012).

These growth plate injuries are

generally simple to be reduced and are stable following reduction (Nogueira et al. 1999). The method of reduction is by counter force applied to the digit using a pencil as a lever at the web space (Peter & Seth 2009). Acceptable reduction is when there is no lateral or rotation angulation. Immobilization is performed by placing a buddy splint and plaster of paris slab in intrinsic plus position. Growth arrest is rare and most often, there is no problem in remodelling because of proximity of the physis and multiplanar movements of metacarpal phalangeal joint (Nogueira et al. 1999). A long-term follow-up in a 5-year-old boy showed that a 90° rotated epiphysis in a Salter-Harris Type IV fracture in the proximal phalanx of the thumb reduced by K-wiring resulted in a narrower thumb with no loss of length after 10 years (Al-Qattan 2017).

Complications post-K-wiring are not uncommon. Hsu et al. (2011) reported on insertion of 408 K-wires in 189 patients and categorized complications into infection, pin loosening, pin migration, skin overgrowth, nonunion, malunion and fracture across the pin track. This is similar to Stahl & Schwartz (2001) who performed 590 K-wire fixation on 236 patients reporting 15.2% complications of osteomyelitis, tendon rupture, nerve lesion, pin tract infection, pin loosening and migration. They attributed the cause of complication to inexperienced surgeons and poor patient compliance. Both papers do not mention adhesions as a complication.

In the event of a difficult reduction, multiple attempt of closed reduction

may lead to further swelling and more soft tissue entrapment between the fracture site. Soft tissue entrapment can be the cause of difficult reduction. Hence, open reduction is recommended to clear the soft tissue, and achieve anatomical reduction by augmenting with a cross K-wire. It is important to achieve anatomical reduction to ensure proper gliding of the tendons in the finger (Rodriguez-Vega et al. 2012)

The most common soft tissue injured are the flexor tendons especially the flexor digitorum profundus (Pandey et al. 2008). This is due to the proximity of the tendon towards the bone. In some cases, tendon entrapment will remain unnoticed and will present late as tendon dysfunction. Hence, a high index of suspicion is required when dealing with these fractures. There are few reports of displaced irreducible phalangeal growth plate fractures in children due to different anatomic structure such as extensor hood-periosteal, fibrous tissue infolding, lumbricals and interosseous tendons (Peter et al. 2009). Suspicion of soft tissue entrapment at the fracture site can be diagnosed by ultrasound (Pandey et al. 2008).

For flexor tendon adhesions after phalangeal fractures, only the total passive range of motion before tenolysis was significant in affecting the results of tenolysis. The fracture type, the time to mobilization and time between injury and tenolysis had no effect (Yamazaki et al. 2008). There is mention of extensor tendon adherence and joint contracture as a common complication following phalangeal

fractures (Creighton & Steichen 1994).

Multiple attempts of K-wire placement, can also cause injury to the soft tissue especially flexor tendons. The K wire can cause tendons to be entangled or punctured due to the penetrating injury. Although this is rare but such cases have been reported (Sharma et al. 2007). We believe that this is under reported due to the perception that K-wiring is a simple procedure. This can be prevented by making a small incision, and ensuring the wire is appropriately placed on the bone prior to entry. The recommended size of the wire is 0.8mm or 1mm to prevent insult to the soft tissue yet with adequate stability and reduction of phalanges.

All of the articles mentioned above generalized the phalangeal fractures as one category. A more detailed study confined phalangeal fractures to only the proximal third region (Faruqi et al. 2012) dividing patients into those receiving extra-articular cross K-wiring or transarticular wiring. The PIPJ was notably affected with half of their patients losing on average 27° of flexion at the joint. Nearly a third had a fixed flexion contracture greater than 15° at the PIPJ. This poor outcome appears to be reflected in our patient who has no active motion at all at the PIPJ but full passive motion. This is better than a fixed flexion contracture. A recent cadaveric study showed that K-wires placed away from the extensor tendon has less tethering effect than those placed through or adjacent to the extensor tendon (Sela et al. 2016). However, there is still much debate as to whether there is a significant

difference between periarticular or transarticular wire placement (Logters et al. 2017).

In a case of toe lengthening in brachymetatarsia, an axial K-wire was inserted into the phalanges of the fourth toe and a distraction type external fixator into the metatarsal for 5 months. A complication of non-union occurred but a further two axial K-wires facilitated union a month later. The patient mobilized well. There was no complications of adhesions. However, this may be unnoticeable in the foot compared to the hand (Norliyana et al. 2018).

Possibility of multiple K-wire entry injuring the flexor tendon, aggressive manipulation during the closed reduction and inadequate physiotherapy could have resulted in adhesions at the proximal phalanx pertaining to this case. Complications sustained by the child resulted in dysfunction of the finger in terms of grip strength and pincer grasp.

## CONCLUSION

Displaced proximal phalangeal fractures of the finger which are not easily reduced or are unstable requires a high index of suspicion of soft tissue interposition. Hence, open reduction and K-wiring is suggested. Additionally, we should restrain from multiple attempts of K-wiring to avoid soft tissue injury.

## REFERENCES

- Al-Qattan, M. 2017. Salter-Harris Type IV fracture of the proximal phalanx of the thumb with rotation of the epiphysis: Outcome 10 years following open reduction and K-wire fixation. *Int J Surg Case Rep* 31: 14-16.
- Creighton, J.J., Steichen, J.B. 1994. Complications in phalangeal and metacarpal fracture management. Results of extensor tenolysis. *Hand Clin* 10(1): 111-6.
- Faruqi, S., Stern, P.J., Kiefhaber, T.R. 2012. Percutaneous pinning of fractures in the proximal third of the proximal phalanx : complications and outcomes. *J Hand Surg Am* 37(7): 1342-8
- Hsu, L.P., Schwartz, E.G., Kalainov, D.M., Chen, F., Makowiec, R.L. 2011. Complications of K-wire fixation in procedures involving the hand and wrist. *J Hand Surg Am* 36(4): 610-6.
- Logters, T.T., Lee, H.H., Gehrmann, S., Windolf, J., Kaufmann, R.A. 2017. Proximal phalanx fracture management. *Hand* 13(4): 376-83.
- Nogueira, A., Alvarez, R., Iglesias, F. 1999. Irreducible phalangeal fracture in a child due to flexor tendon entrapment. *J Hand Surg Am* 24(5): 924-7.
- Norliyana, M., Mohd Yazid, B., Abdul Muhaimin, A. 2018. Bilateral brachymetatarsia: A rare case report. *Med & Health* 13(1): 279-85.
- Pandey, T., Al Kandari, S.R., Al Shammari, S.A. 2008. Sonographic diagnosis of the entrapment of the flexor digitorum profundus tendon complicating a fracture of the index finger. *J Clin Ultrasound* 36(6): 371-3.
- Peter, C., Seth, D. 2009. Paediatric Hand fractures. *Techniques in Orthopaedics* 24(3): 150-60.
- Rodríguez-Vega, V., Pretell-Mazzini, J., Marti-Ciruelos, R., Jorge-Mora, A., de la Mano, A.C. 2013. Simultaneous Juxta-epiphyseal Proximal Phalanx Fracture with Flexor Tendon Entrapment in a Child. A Case Report and Review of Literature. *J Pediatr Orthop B* 22(2): 148-52.
- Sela, Y., Peterson, C., Baratz, M.E. 2016. Tethering the extensor apparatus limits PIP flexion following K-wire placement for pinning extra-articular fractures at the base of the proximal phalanx. *Hand* 11(4): 433-7.
- Sharma, H., Taylor, G.R., Clarke, N.M. 2007. A review of K-wire related complications in emergency management of pediatrics upper extremity trauma. *Ann R. Coll Surg Engl* 89(3): 252-8.
- Stahl, S., Schwartz, O. 2001. Complications of K-wire fixation of fractures and dislocations in the hand and wrist. *Arch Orthop Trauma Surg* 121(9): 527-30.
- Yamazaki, H., Kato, H., Uchiyama, S., Ohmoto, H., Minami, A. 2008. Results of tenolysis for flexor tendon adhesion after phalangeal fractures. *J Hand Surg Eur Vol* 33(5): 557-60.

Received: 27 June 2018

Accepted: 28 Jan 2019