TECHNICAL NOTE

The Utility of Kapandji Technique in Closed Reduction and Percutaneous Pinning Of Completely Displaced Pediatric Supracondylar Fracture of Humerus: Technical Note

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Abstract

The standard treatment for displaced pediatric supracondylar fracture of humer us (PSCFH) is closed reduction and percutaneous pinning under image intensifier guidance. This technical note describes Kapandji intrafocal pinning technique (KIPT) for achieving optimal fracture reduction and stable fixation in Gartland Type III or IV extension type PSCFH. In KIPT, a K wire was introduced into the fracture site from the posterior aspect, fracture manipulation was done by levering with wire reducing the posterior displacement of the distal fragment and the wire was fixed to the anterior cortex of the proximal fragment. After this sagittal plane reduction and stabilization with intrafocal wire , coronal plane reduction could be carried out easily. This was followed by pinning of columns: all lateral or crossed (medial and lateral). In completely displaced extension type PSCFH, KIPT achieves ideal fracture reduction without vigorous manipulation in short surgical time and enables easy column pinning.

Level of evidence: II

Keywords: Intrafocal pinning, Kapandji leverage technique, Percutaneous pinning, Supracondylar fracture humerus

Introduction

Supracondylar fracture of humerus is the most common elbow fracture in children.[1] The recommended treatment for completely displaced pediatric supracondylar fracture of humerus (PSCFH) is closed reduction and percutaneous pinning under image intensifier (IMI) guidance.[2]

Achieving satisfactory reduction and optimal fixation are technically demanding in this fracture setting due to multiple reasons: peculiar fracture anatomy of the distal humerus changing from triangular shape to flat surface at the metaphyseal level, small size of the bone fragments, inherent fracture instability, comminution, moderate to severe local edema, delayed presentation , associated ipsilateral fractures, small size of the patient, difficult IMI positioning , difficulty in getting ideal IMI anteroposterior (AP) and lateral images while maintaining reduction for pinning and loss of reduction while pinning. The overall surgical time, anesthesia exposure time and radiation exposure time with IMI may increase with difficult reduction and fixation. Fixation and stability should be maintained throughout the fracture healing period, to avoid loss of fixation which can lead to malunion and cubitus varus deformity.

The Kapandji intrafocal pinning technique (KIPT) of fractures is an established method of treatment for both adult and pediatric distal radius fractures.[3,4] Several authors have employed the KIPT with individual variations in PSCFH and reported good outcomes.[5-7] However , this method is not popular among the orthopedic fraternity, probably due to the variations in the technique, lack of consensus with descriptions in supine, lateral and prone positions and the lack of documentation of the precise surgical technique. We too have found KIPT method highly successful and over the years, have standardized a protocol which is simple in concept and technique. Here we describe in detail the surgical steps of our KIPT technique.

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Surgical Technique

The procedure was performed on a radiolucent table in supine position. Based on the age of the patient, the injured elbow was placed on the radiolucent table or image intensifier base or radiolucent side table.

1) After suitable anesthesia, prep and draping, the pre reduction fracture anatomy was verified with IMI views [Figure1a, b].

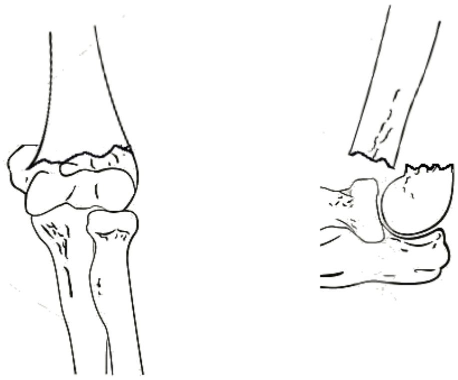

Figure 1a, b. Antero-posterior and lateral view of a typical completely displaced pediatric supracondylar fracture of humerus

2) Gentle traction and counter traction were given with shoulder in 45-70^0 abduction, elbow in neutral extension and forearm in supination. The forearm was brought in line with the arm, the anteroposterior (AP) view of the elbow was checked. The distal fragment was manipulated and positioned in line with the centre of the proximal fragment [Figure 2a].

3) Maintaining traction, the arm was rotated externally with elbow at 90 degree flexion and the forearm was rested on the surface of the table. Proper lateral view of the fracture was obtained with maximal external rotation of the shoulder by an assistant and confirmed with IMI. The posterior displacement and superior displacement of the distal fragment remains at least partly unreduced at this stage [Figure 2b].

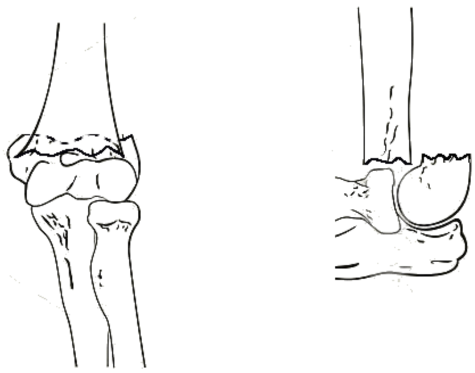

Figure 2a, b. AP and lateral views after simple longitudinal traction showing residual posterior and superior displacement

4) With the elbow in lateral position, under image intensifier control, a K wire was introduced by hand into the fracture site from the posterior aspect [Figure 3a]. The point of entry of the K wire should be 0.5 to 1cm distal to the fracture site on the posterior surface of the arm between the medial and lateral epicondyles corresponding to the center of the distal fragment. In smaller children, 1.5mm K wire was used and in bigger children 2mm K wire was used. The K wire was gradually advanced across the distal fragment into the fracture area of proximal fragment. The posterior cortex of the proximal fragment was levered out posteriorly with the hand held K wire reducing it to the posterior cortex of the distal fragment [Figure 3b, 3c]. Drill was attached to the K wire, and the wire was drilled through the anterior cortex stabilizing the fracture [Figure 3d]. The complete reduction of the posterior displacement of the fracture was confirmed with lateral view imaging. The K wire was bent, cut and the visible portion was side turned making it parallel to skin surface.

If the reduction in the lateral view was complete by simple traction maneuver, a 1.5 mm K wire was introduced obliquely into the fracture site and driven into the proximal fragment.

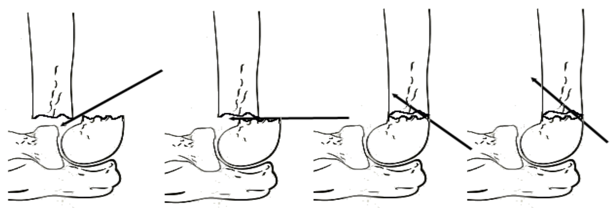

Figure 3 a-d. Intrafocal K wire introduction into the fracture site from the posterior aspect, leverage manipulation, reduction and fixation to anterior cortex of the proximal fragment

5) The arm was rotated to neutral at shoulder and the elbow was extended gently, AP view was checked. Most of the reduction in coronal plane was generally achieved with correct positioning of the single intrafocal posterior K wire [Figure 4a]. Mild medio-lateral manipulations were done to correct the residual translational or angular displacement in the AP view [Figure 4b].

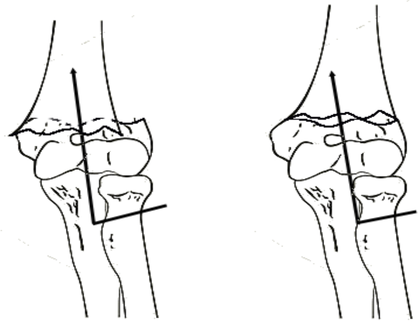

Figure 4 a, b. AP view after posterior intrafocal K wire fixation before and after medio - lateral final manipulation

6) Once reduction in the AP view was optimized, further pinning of the supracondylar columns was done in routine fashion. The pinning can be all lateral or crossed medial and lateral pinning [Figure 5a, b].

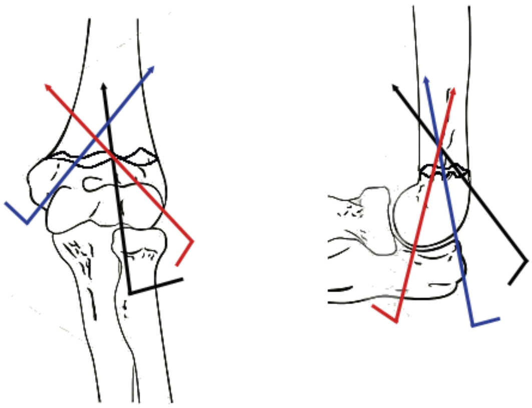

Figure 5 a, b. AP and lateral view after medial and lateral supracondylar column fixation

7) Sufficient purchase of the pins in both proximal and distal fragments was ensured. If necessary, the olecranon fossa was crossed with the pin, especially with all lateral pin configuration.

8) After satisfactory pinning, the K wires were bent just outside the skin and cut. Sterile gauze dressings were positioned between K wire and skin surface. A well-padded above elbow POP slab was given.

Discussion

The standard technique described in the literature to reduce a completely displaced PSCFH is by traction counter-traction with milking maneuver and then by the flexion reduction of the distal fragment.[8] the elbow is hyperflexed for stabilizing reduction and AP view imaging. This Jones view is difficult to interpret due to overlapping radius and humerus. Hyperflexion is not possible in patients with moderate to severe elbow edema. In many situations the applied force does not get transferred to the fracture site and the fracture remains unreduced. Repeated or improper manipulation can cause additional damage to an already traumatized joint and should be avoided. Several studies have advocated open reduction of PSCFH when closed reduction had failed. The overall rate of conversion from closed reduction to open reduction ranges from 3 to 46%.[9]

According to us, in PSCFH, the postero-superior displacement and antero-posterior tilting of distal fragment is the first element that needs initial proper reduction and stabilization. If this reduction or stabilization is suboptimal, any manipulation made to correct the medial/ lateral tilt and rotation will result in posterior displacement and complete loss of reduction in all planes. Therefore sagittal plane reduction and fixation should be achieved first followed by coronal plane reduction and fixation. The KIPT serves well to achieve the necessary sagittal plane reduction in this difficult fracture setting. With this technique, the necessary force is given at the necessary site without undue stretching of normal soft tissues that usually accompanies traction maneuver. The technique acts according to class I lever, where fracture site acts as "fulcrum", the surgeon provides the "effort" with K wire to move the "resistance/load" provided by the displaced proximal fragment.[4]

After sagittal plane reduction, the elbow can be moderately or fully extended for proper AP view without the fear of posterior displacement and loss of reduction. The posterior intrafocal K wire acts as an extension block and maintains the reduction in the sagittal plane, making reduction and fixation in the coronal plane easier. Even though the K wire holds the proximal fragment, the distal fragment is free without fixation for the correction of residual varus or valgus angulation or/ and translation. With good sagittal plane and coronal plane reductions, rotational plane reduction is automatically achieved. The medial and lateral column or all lateral pinning with placement of the wires in the desired angles could be performed satisfactorily without hurry with no fear of loss of reduction [Figure 6-10]. The surgical duration and image intensifier radiation exposure time could be potentially reduced with this method.

Since the posterior intrafocal wire was started at one angle, manipulated and rested at another angle, skin tenting could happen at the K wire entry site. To avoid this, the skin entry point of the wire should be 0.5 to 1.5 cm distal to fracture site. The wire should be first translated proximally in the subcutaneous plane before entering into the triceps tendon and the fracture site. While reverse skin tenting would be produced by this step, it would disappear once the intrafocal wire angulation got changed with fracture reduction.

The KIPT described here has got a small learning curve and could be performed in the convenient supine position in any operating room set up. For the beginners who are uncomfortable with the leverage technique, we recommend them to start with distal radius fractures which might be technically easier.

Balakumar et al reported 18.2% loss of reduction in PSCFH treated with percutaneous pinning and concluded that pinning should be technically good enough to provide fracture stability.[10] Despite pinning, an incidence of 6.6% has been reported for cubitus varus deformity in the literature.[11] With the advocated method, the posterior intrafocal K wire maintains fracture reduction throughout the fracture healing period avoiding delayed loss of reduction and deformity. While crossed pinning is preferable for better stability, medial pinning has been associated with ulnar nerve injury. Various methods like minimal opening, maintaining elbow at 90 degrees while pinning and ultrasound guided pinning have been described to reduce ulnar nerve injury.[12] With the intrafocal wire, two lateral column wires can effectively prevent rotation, the medial column pinning can be avoided and the risk of iatrogenic ulnar nerve injury can be eliminated.

Figure 6. Lateral and AP radiographs showing completely displaced supracondylar fracture of humerus

Figure 7. AP and lateral image intensifier views of elbow after traction and counter-traction maneuver showing residual posterior displacement of distal fragment

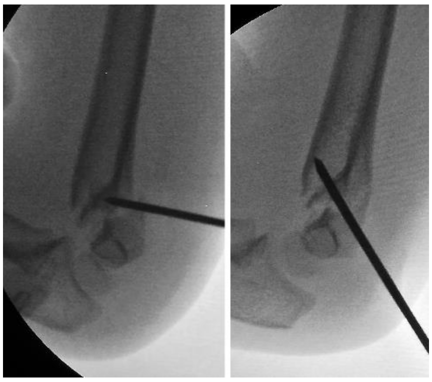

Figure 8. Fracture manipulation by posterior intrafocal wire

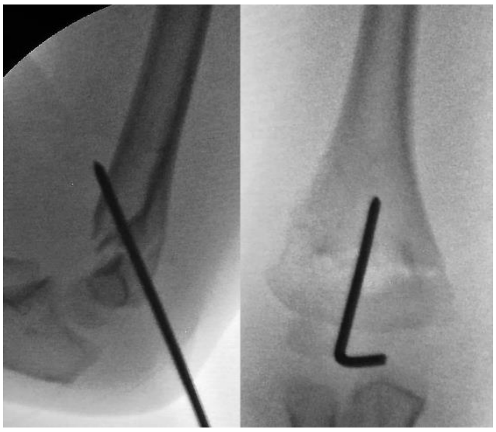

Figure 9. Fracture reduction and posterior intrafocal wire fixation

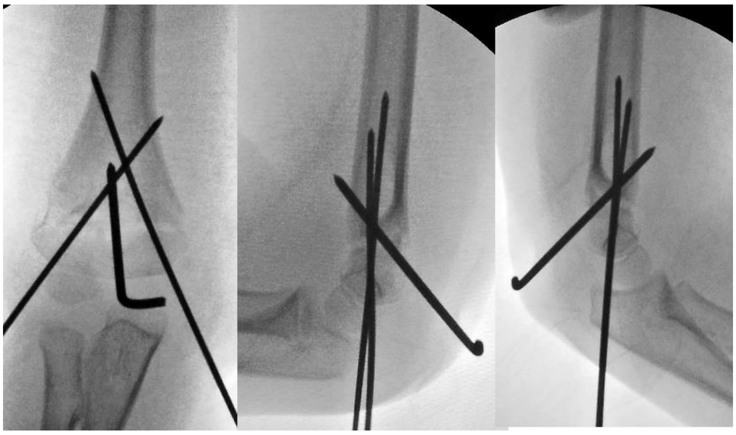

Figure 10. AP view, lateral views (shoulder external rotation and internal rotation) after medial and lateral column cross pinning

Conclusion

The Kapandji intrafocal pinning technique is a simple and efficient method in completely displaced extension type pediatric supracondylar fractures of humerus to achieve and maintain fracture reduction without vigorous manipulation and to subsequently perform column pinning in a short surgical time. The incidence of open reduction and loss of reduction with resultant cubitus varus could be potentially minimized with this technique.

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Authors Contribution: Bhava RJ. Satishkumar conceived and designed the analysis, collected the data, contributed data or analysis tools, performed the analysis, wrote the paper. Mallesh Mahadevappa and Frank Lester, contributed data or analysis tools, performed the analysis.

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