Pediatric Floating Elbow: Case Report and Review of the Literature

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ABSTRACT: Floating elbow is defined as concomitant fracture of ipsilateral humerus and forearm. It is an uncommon injury with high potential to develop elevated forearm compartment pressures with potentially devastating neurological sequel. Several treatments have been reported. Although conservative treatment has been considered in the English literature, percutaneous or minimally invasive fixations is a goal when it is possible, soft tissue and growth plate preservation is crucial for fracture healing, mobility and bone growth.

KEYWORDS: Elbow, floating elbow, pediatric trauma, children, fracture.

Case Report

A 5 years-old child fell down from a bench and a consequent blunt trauma with elbow flexion.

He was admitted at our Trauma Center sent from other peripheric hospital, having sustained a right closed floating elbow.

Physical examination showed closed injuries, a severe pain of arm and forearm, a markedly ecchymosis at the antecubital fossa and functional limitation.

The arm and forearm compartments were soft and he was not neurovascular compromised. X-ray highlighted metaphyseal oblique fracture with residual contact (according to Gartland classification type III and AO/OTA classification 13-M/3.1) and ipsilateral ulnar and radial midshaft (AO/OTA 22-D) (Figure 1).

The elbow showed anterior dislocation. Accurate preoperative planning was performed. Complete pre-anesthetic check-up and parental informed consent for publication were obtained.

The surgery was performed twelve hours after the trauma under general anaesthesia without tourniquet.

The patient was placed in a supine position in the radiolucent table.

Antibiotic prophylaxis with cafazolin was administered prior to incision.

The first step was to reduce under image intensifier of the forearm fracture.

After successful reduction, we determined, firstly, the entry point of the elastic nail for the radius.

The entry point was performed 1 cm proximal to the distal radial physis.

After skin incision and gently dissection of the soft tissues, the radial elastic nail was inserted into the distal medullary canal of the radius in a retrograde method.
The nail was moderately moved forward along its curvature until its distal end enters the medullary canal of the proximal fragment. The ulnar elastic nail was introduced in an antegrade method through a skin incision made 1 cm distal to the olecranon apophysis. Once the forearm fracture was stabilized, the management of the supracondylar fracture was relatively straightforward. Fixation of the epiphysiolysis with metaphyseal wedge was achieved using two percutaneous 1.6 mm kirschner wires in a 45° divergent pattern. To identify the entry point, the lateral epicondyle was identified under fluoroscopic control.

The first K-wire was inserted perpendicular to the fracture line within the lateral column and moved proximally through the fracture site to engage the opposite cortex. The second K-wire was inserted from the lateral side into the lateral column at an angle of 45° divergent to the first wire. After insertion of the two wires, stability of the fixation was estimated by applying varus and valgus stress and by putting the limb into maximum flexion and extension movements. The K-wires were left protruding from the skin for easy removal. At the end of the intervention, the limb was immobilized for three weeks in an above-elbow noncircumferential plaster cast and a radiograph control was performed (Figure 2).

Figure 2. Early postoperative AP (Figure 2a) and lateral (Figure 2b) radiographs of right arm and forearm.

The patient's postoperative course was unremarkable. The K-wires were removed at three weeks. The plain radiographs showed stable reduction, adequate healing without any angular deformity on the elbow and forearm. A gradual and progressive mobilization of the elbow was advised. The elastic nails were removed at six months. We followed the child for two years after the trauma and at the last follow-up the patient was pain-free and has full range of motion, pronation and supination were complete, and had excellent clinical function with complete return to his preinjury occupation (Figure 3).

Discussion
Floating elbow is an unusual injury within paediatric traumatology and many aspects of the complications associated with this type of fracture and treatment options still need to be clarified. Usually associated with high energy trauma, may result in often poor functional and clinical

Figure 3. Plain AP (Figure 3a) and lateral (Figure 3b) radiographs at the final follow-up 2 years postoperatively. The photographs showing active flexion (Figure 3c) and extension (Figure 3d) motion of the right elbow in comparison with the contralateral limb.
results for the intra-articular extension of the injury and burdened with major complications [6,8,10].

However, a retrospective review of 150 supracondylar fracture with ipsilateral forearm fractures found no cases of compartment syndrome, suggesting that the high incidence of compartment syndrome with this fracture pattern might be overestimated [11].

Time to carry out the surgery, type of treatment and the choice of fixation are still controversial topics [6,8,10,12,13].

Malheiros et al. [8] and Blumberg et al. [9] have described the largest number of this kind of injury so far.

Both authors agree that supracondyl fractures such as Gartland III and IV should be surgically treated. In the series presented by Blumberg et al. closed reduction with placement of percutaneous Kirschner wires is performed.

In the series presented by Malheiros open reduction of the supracondylar fracture of the humerus was performed on 13 patients (41,93%), and this gave rise to three cases of skewed consolidation (in varus).

On the other hand, there are greater differences regarding the treatment of the associated fracture of the forearm, mainly related to the pattern of fracture involving this skeletal segment.

The commonest pattern among the forearm bone injuries consisted of fracturing of the distal radius alone usually treated with a closed reduction without the use of percutaneous fixation.

In this case-report fractures are located distal humeral and forearm shaft; these fracture patterns are slightly less common than literature data, in which distal radius fracture is more frequent [6,8-10,12,13].

Several fracture stabilization strategies are described in literature.

We chose to perform a closed reduction and percutaneous fixation in order to restore anatomical reduction e minimally invasive fixation.

Distal humerus was stabilized with lateral epicondyles divergent k-wires which guarantee optimal stabilization and minimal growth plate and soft tissue damage.

Forearm shaft stabilization was obtained by intramedullary elastic nails to consent optimal rotational, axial and length alignment.

Elastic nails entry point was far enough from distal and proximal physis.

Several treatments are described to stabilize supracondylar metaphyseal fracture, nonetheless the most advised and safest one is lateral percutaneous pinning.

The best fixation treatment for child forearm shaft fracture is still controversial, our experience suggests elastic intramedullary nailing in order to obtain optimal stabilization, minimal soft tissue damage, physis sparing, reduction maintenance and early mobilization [14,15].

However, surgical forearm fracture treatment is not mandatory, several authors reported optimal functional outcomes through conservative treatment of the forearm shaft fracture [6,8,9].

About the fixation sequence Templeton et al. [16] suggest firstly distal humerus fixation.

However, we planned as first surgical time to perform closed reduction and ulnar anterograde and radial retrograde elastic intramedullary fixation and consequently, after closed reduction, to fix percutaneously distal humerus as second surgical time.

Obtaining forearm shaft fracture stabilization is essential to perform distal humerus closed reduction manoeuvre, which is based on elbow hyperextension and prono-supination in this case and to reduce forearm soft tissue damage during elbow reduction [12,13].

Cubitus varus deformity is high frequent in this injury, therefore careful anatomical reduction should be performed by experienced surgeon and post-operative follow-up as well [2,17].

The timing of surgery remains a topic of debate.

A very logical approach is that early surgery obtains better results; however, most studies fail to show a significant difference between early and delayed surgical treatment for supracondylar humeral fractures when the rates of perioperative complications and converting to the open surgical technique are taken into account [18,19] but reduction became technically more difficult as timing of surgery increased and the probability of switching to open surgery increased every 5h beginning 15h after injury [20].

Regarding the low incidence of compartmental syndrome reported by many studies [8,9,11,16], these findings may be explained by other factors, in addition to the injury pattern itself, involved in to the development of elevated compartment pressures, such as the use of a circumferential cast and the amount of postoperative elbow flexion [21].
Conclusion

In conclusion, multiple fracture patterns and several surgical treatments are described.

Therefore, surgeon should choose the best fixation options considering fracture pattern stabilization.

We suggest to fix both fractures and to stabilize first forearm shaft as forearm manipulation is necessary to reduce distal humerus.

Percutaneous or minimally invasive fixations is a goal when it is possible, soft tissue and growth plate preservation is crucial for fracture healing, mobility and bone growth.

Conflict of interests

None to declare.

References


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