CLINCAL CASE

LATERAL HUMERAL CONDYLAR FRACTURE IN A PAEDIATRIC MONTEGGIA TYPE III EQUIVALENT

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Abstract

Monteggia fracture dislocations can be classic or equivalents. Equivalents, also known as Monteggia like lesions, are very rare especially type III and IV, which have been added to the literature after Luis Bado presented the original classification system of Monteggia fracture dislocations. Type III equivalent is classically defined as a proximal ulna fracture associated with a fracture of the lateral condyle of the humerus. In the literature only seven such cases have been reported so far. Here we present two such cases where one eight-year-old boy had a complex type of injury with a shear type fracture of the lateral humeral condyle and other a seven-year-old boy who had a plastic deformity of the ulna with an avulsion type fracture of the lateral humeral condyle. We also try to describe a novel mechanism of injury, known as, "Barzulla circle", for the classical as well as equivalent type III Monteggia fracture dislocations.

Keywords*: Monteggia, lateral condyle, Monteggia equivalent, Barzulla circle*

Introduction

Monteggia fracture dislocation is classically defined as a fracture of the proximal ulna with associated radial head dislocation and are rare injuries, accounting for 0.4% of the forearm injuries in the pediatric population [1],[2]. Monteggia Equivalents are the unusual lesions which resemble Monteggia fracture dislocations in the bio-mechanism and are extremely rare with literature confined to case reports and small series. Type III Monteggia Equivalent lesion includes an ulnar shaft fracture with an associated lateral condyle fracture of the humerus [3],[4]. Occasionally the ulnar fracture in children may be a simple subtle plastic deformation which can be easily missed [5]. Here we present two cases of this rare injury, one with a complex fracture configuration of the ulna and other with a simple plastic deformation of ulna and we also review the international literature for reported cases of such injuries.

Case presentation

Case 1

An eight-year-old boy was referred to our center from peripheral hospital with history of fall of a heavy object (troller of a tractor) over right upper extremity. On examination there was a large laceration (10×4 cm) over postero-medial aspect of proximal forearm with exposure of the underlying bony fragments. Deformity of the forearm was evident. Radial artery pulsations were present and all the three nerves were clinically intact. Without correcting the

deformity, a radiograph (AP and lateral view) of forearm, elbow and wrist was ordered after which deformity was corrected by gentle traction and an above elbow splint was applied. Radiographs revealed a comminuted fracture of the proximal ulnar shaft with a varus angulation and lateral dislocation of the radial head. In addition, radiograph revealed a fracture involving lateral condyle of the distal humerus and the fractured condylar fragment was displaced laterally along with the radial head (Figure 1A). A diagnosis of compound type IIIB (Gustilo-Anderson) Monteggia fracture dislocation with an ipsilateral lateral humeral condylar fracture (Monteggia Equivalent type III) was made.

The patient was shifted to emergency operating room after all the baseline investigations. Under general anesthesia, the wound was thoroughly irrigated, followed by debridement. Entry point was made through tip of olecranon and a square nail was inserted into the medullary canal of the ulna. The fragments of ulnar shaft were assembled without any soft tissue dissection and secured over the rush nail with a cerclage stainless steel wire to maintain the alignment and the length of the ulna. The lateral condyle was exposed by Kocher's approach. Capitellum had a fracture in coronal plane, which extended proximally through the antero-lateral part of the lateral ephyseal growth plate and the metaphysis (Figure 1B). The fractured condylar mass was reduced and fixed with a cortical screw and two K-wires. Wounds were closed and above elbow slab was applied in 90o of flexion. Postoperative radiograph showed maintenance of the ulnar length and restoration of radio-capitellar alignment (Figure 1C). At two weeks follow up stitches were removed and above elbow slab was continued for three more weeks after which one K-wire, the tip of which was left over the skin surface and the slab were removed and range of motion exercises were started. At six weeks follow up, ulna did not show any radiological signs of union (Figure 1D). The square nail impingement prevented full extension at elbow and it was removed along with the humeral K-wire under local anesthesia at 3 months, when the radiological union was complete (Figure 1E). At the final follow up of six months, the patient had solid bony union of the ulna and the lateral condylar fracture with 15º to 125º flexion extension arc and supination and pronation of 80º and 65º respectively at the elbow (Figure 1F).

Figure 1 – Case 1. A) Pre-operative radiographs, B) Fixation of lateral condyle with K-wire, C) Post-operative radiographs, D) Radiographs at 6 weeks, E) Radiographs at 3 months, before square nail removal, showing union, F) Radiographs at final follow up of 6 months

Case 2

A seven-year-old boy reported to our accident and emergency department with a fall on outstretched right hand while jumping from a chair. On examination there was a swelling on outer aspect of elbow with tenderness along lateral epicondyle of the humerus and along the subcutaneous border of the ulna. The neuro-vascular examination of the extremity was unremarkable. Bi-planar radiological examination of the elbow and the forearm revealed a Milch Type I lateral condyle fracture of the humerus and a plastic deformation with a varus deformity of the ulna suggestive of Monteggia type III equivalent fracture dislocation (Figure 2A).

The patient was planned for closed correction of plastic deformity of ulna and long arm cast immobilization under general anesthesia. However, under fluoroscopy after correction of the ulnar deformity, the lateral condyle fracture was unstable when subjected to stress and the plan was changed to fix the lateral condyle by open reduction. The lateral condyle was approached by Kocher's approach and was reduced and fixed with two K-wires, the tips of which were cut above the skin surface. The extremity was immobilized in a long arm slab with elbow in 90º flexion.

Postoperative radiographs showed an anatomically reduced lateral condyle with well-maintained radio-capitellar alignment (Figure 2B). Stitches were removed at two weeks. At 5 weeks follow up the check radiographs revealed a healed lateral condyle fracture and evident bridging callus along lateral epi-condylar ridge and the ulnar deformity correction was well maintained (Figure 2C). The slab and the K-wires were removed and gentle range of motion exercises of the elbow were started and was advised to follow us after one week. However, the patient never turned back again for follow up for radiological and clinical evaluation.
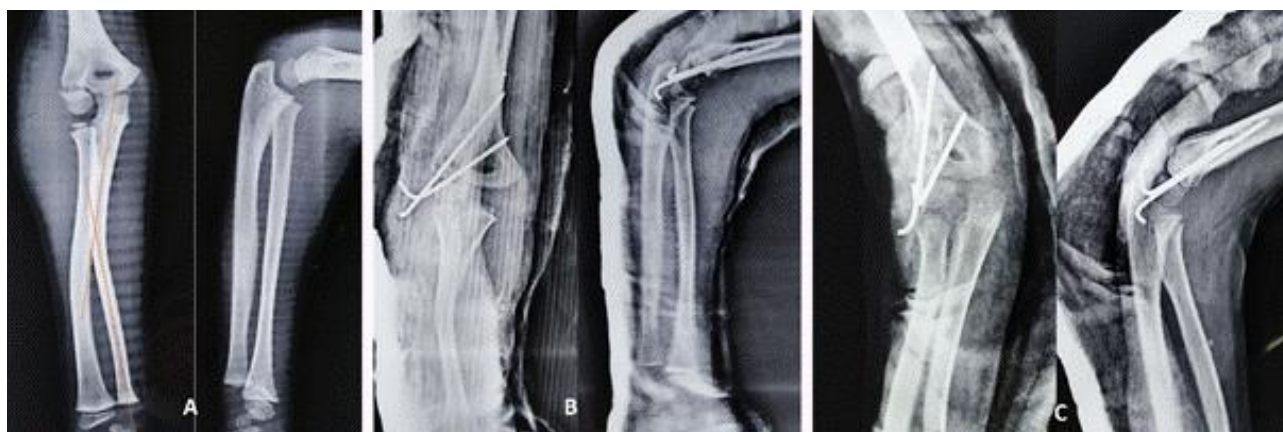

Figure 2 – Case 2. A) Pre-operative radiograph demonstrating plastic deformity of ulna with a lateral apex angulation and a fracture of the lateral condyle, B) Post-operative radiograph after correction of deformity of ulna and fixation of lateral condyle, C) Radiograph at 5 weeks showing union of lateral condyle with callus along lateral epicondylar ridge as well as well-maintained alignment of ulna

Discussions

After Giovanni Battista Monteggia described his unsatisfactory experience in 1814 with Monteggia fracture dislocation in his book, many researchers worked and published their results on this entity [6]. But it was not until 1967, when Jose Luis Bado thoroughly classified and explained the bio-mechanism of this rare injury. His classification was based on the direction of the radial head dislocation and the pattern of the forearm bones fracture. He classified this injury into four types (type I to type IV) and also added some other types of injuries which had similar mechanism, radiological presentation and treatment and he called them the "Monteggia equivalents" or "Monteggia like lesions" [7]. In his classification, equivalents existed for type I and type II Monteggia lesions only but subsequently researchers have added equivalents for type III and type IV as well [4],[8]. Type III and IV equivalent lesions are so rare that

literature is confined to only case reports. Eglseder WA et al. in their series on distribution of Monteggia fractures dislocations had 52 Monteggia equivalents and among these there was only one case of type III equivalent and two cases of type IV equivalents and the remaining were type I and II [9].

The mechanism of these injuries is complex and not properly understood but from time-to-time researchers have tried to work it out. In case of type III injuries, the elbow is fully extended so that the olecranon will be locked in the olecranon fossa of the humerus and a varus force applied will act on the ulna which may lead to a plastic deformity, greenstick fracture or a displaced fracture of the ulna. The energy liberated from fracture of ulna will traverse along the interosseous membrane and annular ligament, disrupting them. With persistent varus force and the fulcrum at the ulnar fracture, the radial head will be dislocated laterally [10],[11]. But we here propose a different mechanism of these type III lesions. We believe, once the ulna is fractured by the varus forces, the distal fragment, interosseous membrane attached to distal fragment of ulna and the radius act as a single unit and as the distal fragment of ulna goes into varus the intervening interosseous membrane will pull the distal radius along and at the same time fulcrum will act at ulna fracture which will force out the proximal radius laterally resulting in annular ligament tear and lateral dislocation of radial head and the injury may progress distally along interosseous membrane towards the ulnar fracture. So, the events take place in form of a circle we call as "Barzulla circle' after the name of our institute, with injury starting at the ulna fracture and ending at it again thus explaining the classical Monteggia type III mechanism (Figure 3). Occasionally the proximal radius may pull the lateral condyle resulting in a lateral condylar fracture and the injury may progress distally involving annular ligament and interosseous membrane which explains why some cases of type III Monteggia equivalent had a combination of lateral condyle fracture with radio-capitellar mal-alignment or dislocation [4],[12]-[15]. If annular ligament is strong the proximal radius may give away at the proximal physis or at the metaphysis resulting in lateral displacement of proximal radial metaphysis with radial epiphysis retained inside the annular ligament and such cases have also been labelled under type III Monteggia equivalent injuries in the literature (Figure 3) [16],[17]. The pattern of fracture that we see in our first case cannot be explained simply by this proposed mechanism alone. The lateral condylar fracture in this case is a shear fracture rather than an avulsion and it may have resulted by impaction of radial head against the capitellum as it got dislocated and the comminution of ulna can be explained only by crushing force and its varus angulation by adduction force. Our second case can well be explained by the said mechanism or by a simple varus stress force with elbow in extension as both Type III Monteggia and lateral condyle fracture have a similar mechanism [18].
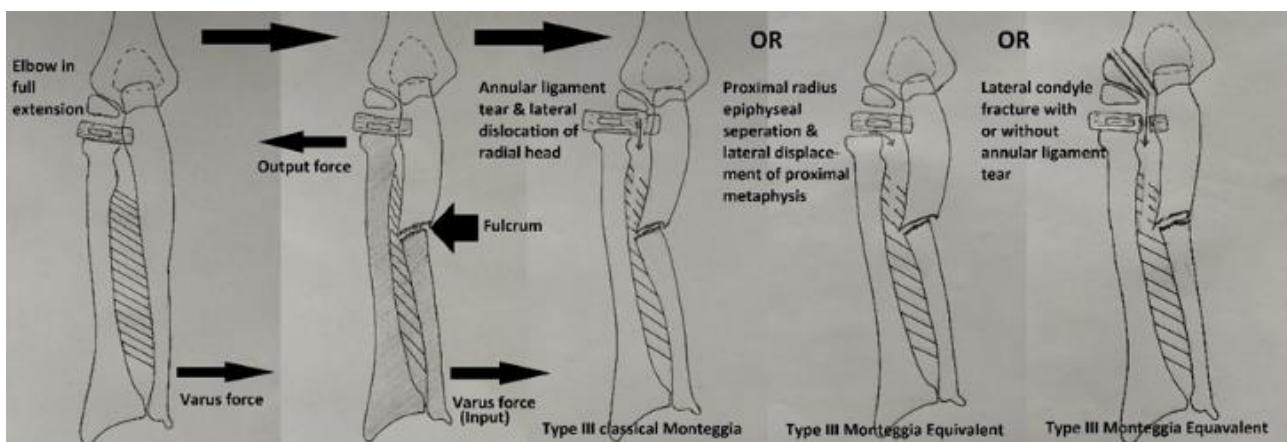

Figure 3 – Mechanism and sequence of events in type III Monteggia fracture dislocations (classical and equivalent). The injury starts as ulna fracture and may end by interosseous membrane tear up to the level of the ulna fracture (Barzulla circle)

Monteggia type III injury with associated lateral humeral condylar fracture is a very rare entity with only seven cases reported so far in the literature (Table I) [4],[12]-[15],[18]. There have been also other type III equivalents where there had been physeal separation at the proximal radius with radial metaphysis dislocating laterally [16],[17]. Some authors have mentioned type III Monteggia injuries with associated distal both bones forearm fracture or distal radial epiphyseal injury as Monteggia equivalents where as others have presented them as an associated injury to Monteggia fracture dislocation. These injuries are an association rather part of the Monteggia fracture dislocation as the two have different mechanism [16],[19]-[23].

Author (year)	Age in years (Sex)	MOT	Management		Additional procedures	Outcome
			Ulna	Lateral condyle		
Ravessoud FA (1985)[4]	13 (M)	RTA	ORIF with plate	ORIF with screws	Ulnar wound debridement	Full ROM
Park JH (1997)[12]	5 (F)	-	Non-operative (CR)	ORIF with K-wires	Trans-capitellar K-wire	Excellent
Guven M (2008)[13]	6 (F)	-	Non-operative	ORIF with K-wire	CR of radial head	Good
Guven M (2008)[13]	-	-	Debridement and K-wire	ORIF with K-wire	Reconstruction for skin defect	Poor (30° to 90° flexion)
Dattani R (2008)[14]	3 (M)	FFH	Non-operative (CR)	Non-operative	CR of radial head	Full ROM
Muzaffar N (2011)[18]	6 (F)	FFH	Non-operative	Non-operative	-	Uneventful
Bugeja M (2018)[15]	4 (F)	FFH	CR and K-wire fixation	ORIF with K-wires	CR of radial head	Full ROM
Present	8 (M)	Fall of heavy weight	Debridement; ORIF with square nail and cerclage	ORIF with screw and K-wires	-	Flexion (15-125°) Supination (75°) Pronation (65°)
Present	7 (M)	FFH	Non-operative (CR)	ORIF with K-wires	-	Lost in follow up

Table 1 – Reported cases (in the literature) of pediatric Monteggia Type III Equivalent injuries associated with lateral humeral condyle fracture (MOT: mode of trauma; FFH: fall from height; ORIF: open reduction and internal fixation; CR: closed reduction; ROM: range of motion)

Conclusion

From this review we conclude type III Monteggia equivalent is a very rare entity in pediatric population. Lateral humeral condylar fracture may be a part of this type of equivalent and all the pediatric age group patients with a humeral lateral condyle fracture should have a clinical and radiological screening of the forearm bones to rule out a subtle type of ulnar fracture which may be a simple plastic deformation that may go unnoticed.

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