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Pediatric Olecranon Fractures Associated With Radial Neck Fractures: Review and Report of Two Cases

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Abstract

Introduction: The debate regarding the description on classification and nomenclature of the injury which includes olecranon fracture associated with radial neck fractures in children is ongoing. We report two pediatric cases that could not be classified in a Monteggia-equivalents system and were treated with open reduction and k-wire fixation. The aim of this study was to perform a systematic review regarding pediatric radial neck fractures associated with olecranon fractures and presentation of two pediatric cases of olecranon fractures associated with radial neck fractures with radiocapitellar dislocation.
Case Presentation: Two boys, aged 7 and 12, came to two separate clinics on the same day after initial injury. On physical examination, the patients' elbow range of motion was limited and painful. Their upper extremities were intact. Radiographs revealed the radial neck fracture with prominent anterolateral radiocapitellar dislocation of radial head-associated with non-displaced olecranon fracture. Radial neck fracture was reduced easily by pushing posteromedially manually with the finger and secured with two K-wires .The olecranon fracture was visualized and confirmed that it was non-displaced and secured with two k-wires in the first case and one k-wire in the second case. After 2 months of follow-up, both patients had no pain in their elbow and a full functionality with a full range of motion of the elbow. The posterior intraosseous nerve functions were normal.
Conclusions: The fracture of olecranon if it does not extend into the metaphyseal region; it could not fascilitate diastasis of the proximal radioulnar joint and radial head dislocation. So this type of fracture must not be addressed as a Monteggia-fracture dislocation. The description of radioulnar diastasis must be included when this type of injury is to be classified.

Keywords: Pediatric Elbow Fractures, Monteggia Fracture Dislocation in Children, Monteggia Equivalents in Children, Nomenclature, Olecranon Process

1. Introduction

Proximal radial head dislocation with concomitant fracture ulna was first described by Monteggia in 1814 (1). Monteggia fracture dislocations were first classified by Bado (2) in 1967 and widened by other authors and named equivalent lesions (Box 1) (3-5).

Bado (2) described three equivalents (all type I) over a period of time. Various other type 1 Monteggia equivalents have been described, which includes pulled elbow syndrome, isolated radial neck fracture ,fracture ulnar diaphysis with anterior dislocation of radial head and olecranon fracture and ulna diaphyseal fracture with ipsilateral supracondylar extension fracture (Box 2) (6).

Type I lesions with anterior dislocation of radial head and concomitant anterior angulation of ulnar diaphyseal fracture- are the most common Monteggia fracture dislocations in pediatric populations (3, 10-16). Olney and Menelaus (15) concluded that type I equivalent lesions involving the proximal radius accounted for 14% of acute Monteggia lesions, suggesting that equivalent lesions may be more common than previously thought (4, 17-19).

Several authors (2, 12, 15, 16, 19-25) have described anterior or lateral dislocation of the radial head with fracture of the olecranon as a Monteggia-equivalent. We report two pediatric cases that could not be classified in a Monteggia-equivalents and treated with open reduction and k-wire fixation. The aim of this study was to systematic review the presentation of two pediatric cases of olecranon fractures associated with radial neck fractures with radiocapitellar dislocation.

2. Case Presentation

Two boys, aged 7 and 12, came to two separate clinics the same day and one day after initial injury. On physical examination, the patients' elbow range of motion was lim-

Box 1. Bados' Original Classification of Monteggia Fracture Dislocations

Monteggia Fracture Dislocations
Type I
Fracture of the middle or upper third of the ulna with anterior dislocation of the radial head and characteristically anterior angulation of the ulna.
Type II
A similar ulnar fracture generally posteriorly angulated with posterior dislocation of the radial head and often a fracture of the radial head.
Type III
A fracture of the ulna just distal to the coronoid process with lateral dislocation of the radial head.
Type IV
Fracture of the upper or middle third of the ulna, anterior dislocation of the radial head and fracture of the upper third of the radius below the bicipital tuberosity.

Box 2. Classification of Monteggia-Equivalents

Monteggia Equivalents
Type I
Fracture of the ulnar diaphysis with fracture of radial neck
Fracture of ulnar diaphysis with anterior dislocation of radial head and an olecranon fracture.
Fracture of proximal ulna with fracture of the radial neck both-bone proximal third fractures with the radial fracture more proximal than the unlar fracture.
Pulled elbow syndrome
Isolated radial neck fracture
Isolated anterior dislocation of radial head (with plastic deformation of ulna).
Fracture of ulnar diaphysis (at proximal and middle third junction) with displaced extension type supracondylar fracture of humerus, Arora et al. (6)
Type II
Posterior elbow dislocation, Penrose (7) (1951).
Type III
Oblique fracture of the ulna with varus malalignment and an ipsilateral displaced fracture lateral condyle humerus, Ravessoud (8) (1985)
Type IV
Monteggia fracture dislocation along with an ipsilateral distal humerus and distal radius fracture, Arazi et al. (9) (1999)
Type V
Intermittent and habitual dislocation of the radiocapitellar joint and proximal radioulnar joint, Dormans and Rang (10) (1990)

ited and painful. Their upper extremities were neurovascularly intact. Radiographs revealed the radial neck fracture with prominent anterolateral radiocapitellar dislocation of radial head-associated with non-displaced olecranon fracture (Figure 1).

Radiographs obtained one day after the surgery confirmed anatomic reduction of the radial head (Figure 2). Differential diagnosis included isolated fracture of olecranon and isolated fracture of the radial neck. Those were all ruled out with imaging studies including X-rays.

No closed reduction was attempted. A decision was made to perform open reduction k-wire fixation radial neck and olecranon fractures. The Boyd's approach was performed. We noted to keep the forearm in pronation to protect the posterior intraosseous branch of the radial nerve during the operation. The space between the anterior border of the anconeous and Ext. Carpi ulnaris was opened to expose the radiocapitellar joint, radial neck and fractured side of olecranon. Radial neck fracture was reduced easily by pushing posteromedially with finger pressure and secured with two K-wires .The olecranon fracture was visualized and confirmed that it was non-displaced and secured with two k-wires in first case and one k-wire in the second case. Next reduction was confirmed with fluoroscopy and above elbow splint was applied with forearm neutral and elbow maintained in 90 degrees of flexion.

Figure 1. Pre-Operative Radiographic Appearence. Arrows show lateral displacement of radial head and non-displaced fractured olecranon in anteroposterior and lateral view. Notice that proximal radio-ular diastasis did not exist in both cases.

After 2 months of follow-up, patients had no pain in their elbow and full functionality with a full range of motion of the elbow. Posterior interosseous nerve functions were normal.

3. Discussion

A systematic search of the PubMed database was performed. The following research criteria were applied: 1) papers written in English, 2) papers examining Monteggia fracture in children, 3) cases involving radial neck fractures/dislocations with olecranon fractures, 4) papers examining Monteggia-equivalent lesions. Of 263 articles, only 30 fulfilled the inclusion criteria. Other papers involved adult cases and other issues. In this article we emphasize the controversy about the classification and nomenclature of these types of injuries. We utilized a mind map to explain to readers the debate on nomenclature and classification of this type of injury.

Despite what Bado stated earlier (2), there were no equivalents of type II, type III or type IV Monteggia, but various researches have described other equivalents on the ba-

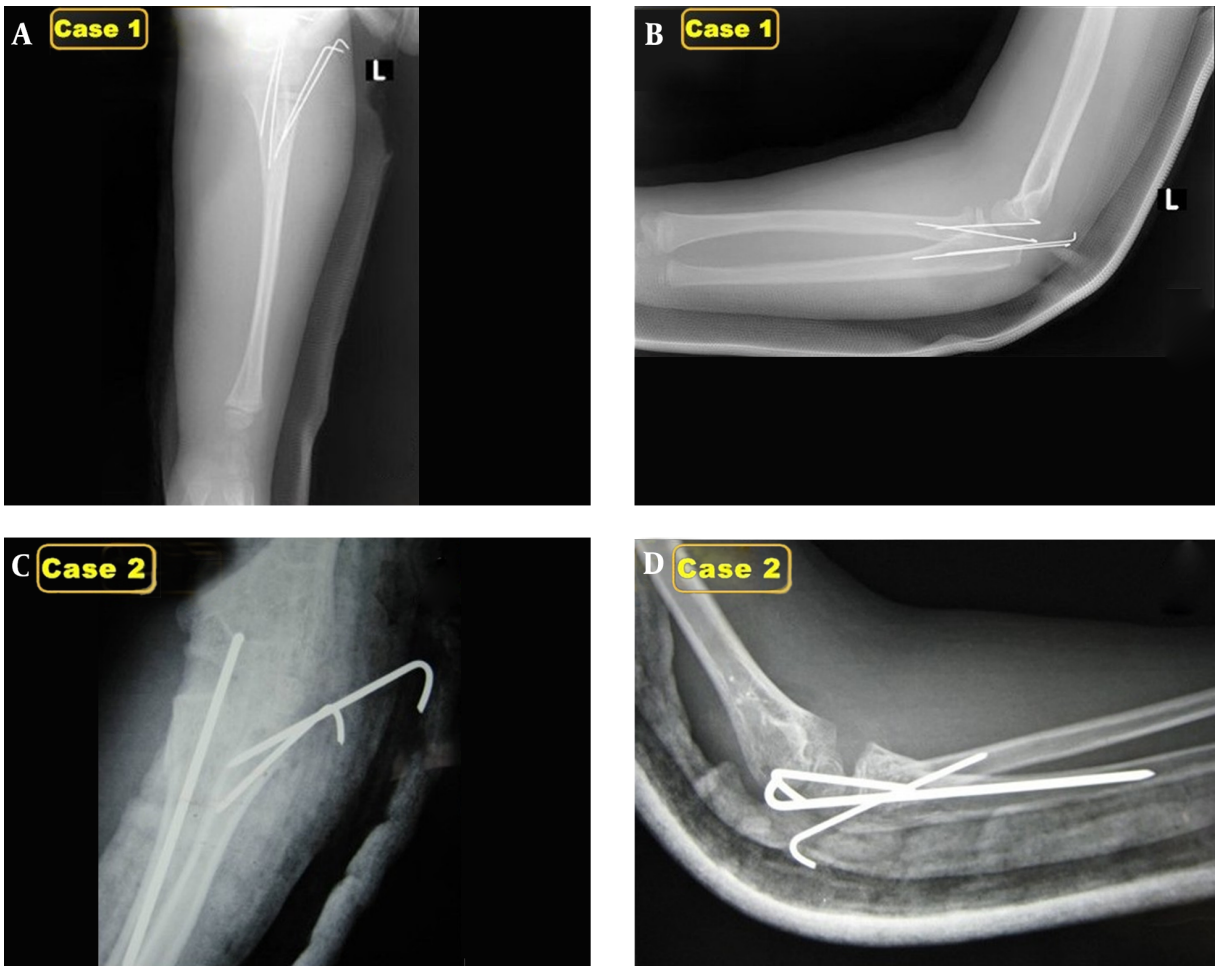

Figure 2. Notice Post-Operative Anatomic Reduction and Fixation With K-Wires in Case 1 and Case 2

sis of fracture characteristics (Box 2) (7-10).

The debate about the description on classification and nomenclature of the injury which includes olecranon fracture associated with radial neck fractures in children is still ongoing. Tibone et al. (18) reported a series (33 patients) which includes radial head and neck fractures. In this study only 6 of them ongoing associated with olecranon fractures (Figure 3).

In the article of Dormans and Rang (10), the definition of Monteggia fracture is "fracture of the shaft of the ulna with dislocation of radial head and diastasis of the proximal radioulnar joint".

Also the definition of Monteggia taken from Bados' study (1967) (2) included "traumatic lesion having common dislocation of a radio-humeral-ulnar joint, associated with a fracture of the ulna at various levels".

If the ulnar fracture extends into the olecranon, there may not be true dissociation between the radial head and the ulna. This fact led to debate about proper classification of this injury (12, 14, 15, 20, 22, 26, 27).

According to Bruce et al. (28) (1974) involvement of the olecranon meant that the injury was not a true Monteggia-fracture dislocation. Bruce et al. emphasized that "usually with fracture dislocations in which the olecranon process is fractured the radial head dislocates only from the capitellum and the proximal radio-ulnar joint is not disrupted. In the Monteggia fractures, however, the proximal radio-ulnar joint is always disrupted or dislocated and the articular surface is almost always grossly intact. Several authors make no distinction between these two different injuries, but a distinction is necessary because the injuries may have different sequelae" (Figure 3).

Unlike Bruce et al. (28), Wiley et al. (12) included the combination of radial head dislocation with olecranon

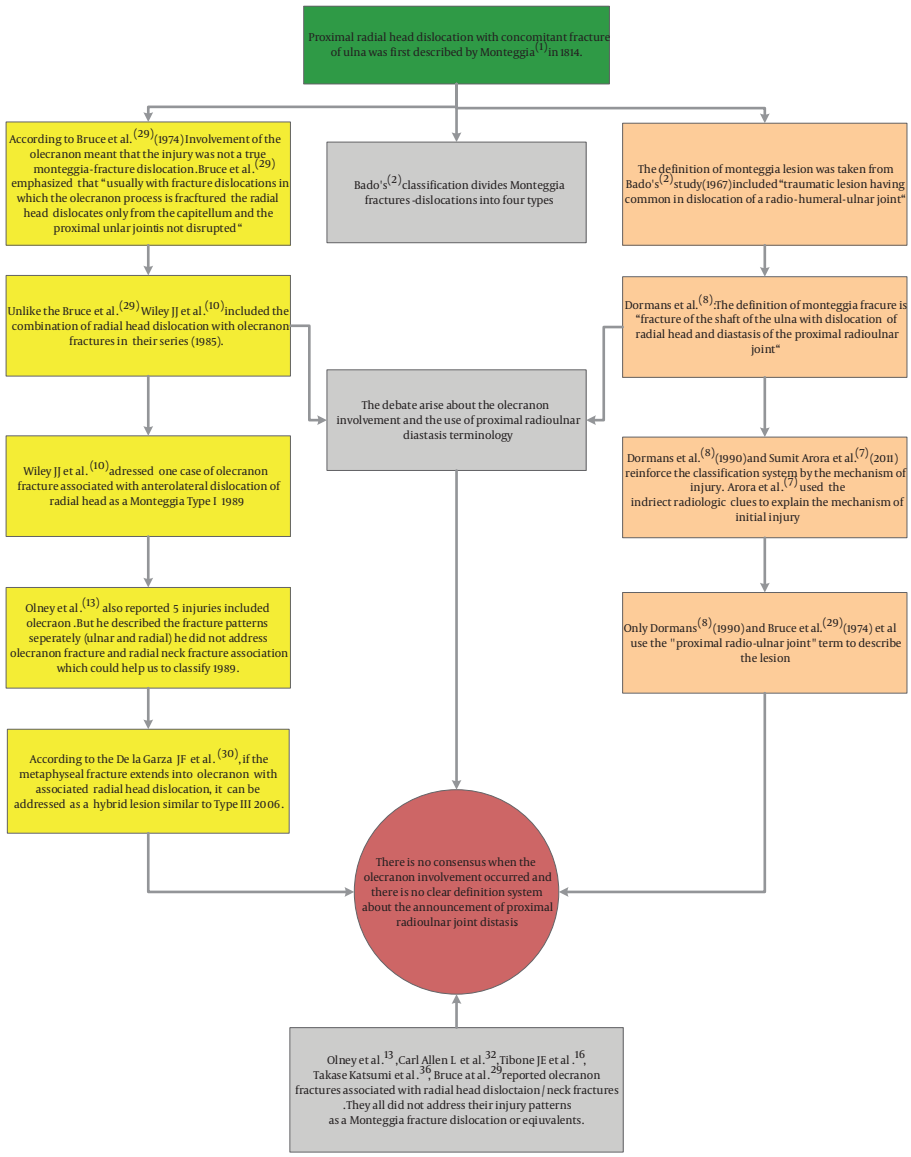

Figure 3. Mind map shows the development of debate about the olecranon fractures associated with radial head dislocation.

fractures in their series (Figure 3).

Wiley et al. (12) addressed one case of olecranon fracture associated with anterolateral dislocation of the radial head as a Monteggia type 1 (Figure 3).

Olney and Menelaus (15) also reported 5 injuries included olecranon. But he described the fracture patterns separately (ulnar and radial). He did not address olecranon fracture and radial neck fracture association which could help us classify it (Figure 3).

Wiley et al. (12) preferred to put Monteggia equivalent type IV fracture pattern into type I, II, III according to the direction dislocation of the radial head. He rejected about the existence of type IV (Figure 3).

According to the De la Garza et al. (29) if the metaphyseal fracture extends into olecranon with associated radial head dislocation, it can be addressed as a hybrid lesion similar to type III (Figure 3).

Mullick et al. (23) reported two cases (1977) radial head dislocation associated with fracture of the upper ulna he addressed both cases as a lateral Monteggia fracture and he

did not mention diastasis. In both cases roentgenograms, only one documented diastasis (Figure 3).

Later contributions to the literature include other variations and combinations of olecranon, ulnar diaphysis, radial neck, medial epicondyle, supracondylar fracture with or without radiocapitellar dislocations. These were all classified as an Monteggia type I equivalent or type I Monteggia equivalent variant (Table 1) (15, 17, 30-34).

As seen from the Table 1, Ruchelsman et al. (34) (diastasis existed), Olney and Menelaus (15) (focused on treatment results), Caterini (30) reported olecranon fractures associated with radial head dislocation. Carl and Ain (31) reported olecranon and medial epicondyle fracture associated with radial neck fracture. In our cases, olecranon fracture was not associated with proximal radio-ulnar diastasis but radial neck fracture with the radiocapitellar dislocation of radial head existed (Table 1).

Dormans et al. (10) and Arora et al. (6) reinforced the classification system by the mechanism of injury. Arora et al. used the indriect radiologic clues to explain the mechanism of initial injury (6).

Only Dormans et al. (10) use the "proximal radio-ulnar joint" term to describe the lesion. We agree with Dormans because the using of proximal radio-ulnar joint term is mandatory to define the injury location. Ruchelsman et al. (34) presented one case which did not include proximal radio-ulnar joint dislocation but he addressed it just as a radial head dislocation. As in our case the proximal radio- ulnar dislocation did not exist. So we prefer use of the term "radial neck fracture with radial head anterolateral displacement." instead of the term "radial head dislocation". We think that future classification system, the position of proximal radio-ulnar joint position should be shown clearly and terminology of radial head dislocation must be used carefully. In addition, we think that the term radial head dislocation must be used if only proximal radio ulnar joint and radiocapitellar joints are dislocated together. Moreover, in our cases, an anterior displacement of the radial head with concomitant fractures of the radial neck and the olecranon apophysis without ulnar diaphyseal or metaphyseal involvement can be seen.

Also according to us in contrast with Wiley et al. (12) the fracture of olecranon if it does not extend of the metaphyseal region; it could not facilitate diastasis of proximal radioulnar joint and radial head dislocation. So this type of fractures must not be addressed as a Monteggia fracture dislocation. Olney and Menelaus (15), Ruchelman (34), Wiley et al. (12), Carl and Ain (31); reported the cases which includes olecranon fractures associated with radial neck fractures. But none of them used the terms of "diastasis and proximal radioulnar joint dislocation". On the other hand Carl and Ain (31) Tibone et al. (18) and Takase et al. (35) did not address their fracture patterns as Monteggia fracture dislocations or equivalents (Figure 3).

In the literature there were two trends one of them had tendency to classify such injuries like Monteggia-equivalents and the other had tendency to classify such injuries as radial neck fractures with olecranon fractures (separately). Here we report two pediatric cases that could not be classified in a Monteggia-equivalents and treated with open reduction and k-wire fixation cranon fracture. The proximal radioulnar diastasis did not exist in our two cases.

A fracture of the olecranon if it does not extend to the metaphyseal region; it could not facilitate diastasis of proximal radioulnar joint and radial head dislocation. So this type of fractures must not be addressed as a Monteggia fracture dislocation. The description of radioulnar diastasis must be included when this type of injuries trying to be classified.

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Footnote

Authors' Contribution: Kemal Gokkus, wrote the manuscript and is guarantor; Ahmet Turan Aydin, developed the original idea, performed supervision for his article; Kose Ozkan, contributed the surgery of the one case; Kemal Gokkus, study concept and design performed; Sagtas Ergin, contributed the radiologic analysis and literature review; Saylik Murat, abstracted and analyzed data and contributed the literature review.

Table 1. Latest Contributions: Type I Monteggia Equivalents/Type I Monteggia Equivalent/Variants

References	Latest Contrubitions Type I Montegia Equivalents/ Type I Monteggia Equivalent-Variants/ Seperately Defined Injuries							
	Radio-Capitellar Dislocation	Radial Neck Fracture	Involvement of Lateral or Medial Epicondyle or Supra-condylar Region	Ulnar Diaphyseal Plastic Deformation or Fracture	Olecranon Fracture	Radial Head Displace-ment	Proximal Radio-Ulnar Diastasis	Number of Cases
Kamali et al. (17) **(1974)**	-	+	-	+	-	+	-	1
Mullick (23) **(1977)**	+	-	+	+	+	-	+	2
Olney and Menelaus (15) **(1989)**	+	+	-	-	+	-	-	5
Carl et al. (31) **(1994)**	-	+	+ (Medial epicondyle)	-	+	-	-	1
Caterini et al. (30) **(2002)**	+	-	-	-	+	-	-	3
Faundez et al. (33)**(2003)**	-	+	-	+	-	+	+	1
David E. Ruchelsman et al. (34) **(2005)**	+	+	-	-	+	-	+	1
Kose et al. (32) **(2010)**	+	-	+ (Medial epicondyle)	+	-	-	+	1
Arora et al. (6)**(2011)**	-	-	+ (Supra-condylar fracture)	+	-	-	-	1
Current article	+	+	-	-	+	+	-	2

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