Case Report | Journal of Orthopaedic Case Reports 2024 October:14(10):Page 163-168

# Monteggia Equivalent Variant Type 1 in an Adult, its Management and Functional Outcome with Literature Review

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**Learning Point of the Article:**

Monteggia variants in adults remain an enigma because of its rarity, different injury mechanisms compared to children, various complex combinations of the injured structures, and the different management procedures, thus emphasizing the importance of early recognition of such fracture patterns with an appropriate classification, a stable anatomical reduction with osteosynthesis of the radial head–neck complex and restoration of the radio-capitellar joint congruity in giving the best functional outcome.


## Abstract

**Introduction:** In 1814, Giovanni Battista Monteggia first described the fracture pattern which was further characterized by Luis Bado in 1967. Bado also coined the term Monteggia equivalent which includes a spectrum of complex fracture patterns and dislocations of the proximal ulna and radius. Monteggia equivalent lesions in adults are rare with different injury mechanisms compared to children, and thus having different management procedures.

**Case Report:** We report a Type 1 Monteggia equivalent variant in a 31-year-old female who presented with a proximal ulnar fracture along with an ipsilateral radial neck fracture extending into the radial head. A fracture pattern that has not been reported much in literature as per our observations and we suggest should be considered a Monteggia equivalent Type 1b. Osteosynthesis of the ulna and proximal radius was done and at 1-year follow-up, complete radiological union with near-native function was achieved.

**Conclusion:** Early recognition of such complex fracture patterns and a reconstruction of the proximal radius wherever possible gives a better outcome than arthroplasty or excision as per literature.


**Keywords:** Monteggia fractures, Monteggia equivalent, Monteggia variants in adults, radial neck fractures.

## Introduction

Monteggia fracture, named after Giovanni Battista Monteggia, is a fracture of the proximal third of the ulna with anterior dislocation of the radial head from both, the proximal radioulnar and radio-capitellar joints, described in the nineteenth century [1]. Jose Luis Bado later described this fracture pattern well and classified it into mainly four parts according to the direction of the radial head dislocation. Apart from four types, Bado also coined the term "Monteggia equivalent lesion/variant" [2]. He classified a group of lesions that shared a similar mechanism yet presented heterogeneous manifestations with those of Monteggia lesions. The appellation "Monteggia equivalent lesion/variant" includes a wide spectrum of not-so-well-defined complex fracture patterns and dislocations of the proximal ulna and radius [2]. The concept of Monteggia equivalent lesion/variant has been expanded in the literature over the decades with various sporadic case reports. This injury pattern is relatively rare and even rarer in adults [3]. In this paper, we not only report a rare case of Type 1 Monteggia equivalent variant in

Access this article online

Website: www.jocr.co.in

DOI: https://doi.org/10.13107/jocr.2024.v14.i10.4848

*Author's Photo Gallery*


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Submitted: 01/07/2024; Review: 10/08/2024; Accepted: September 2024; Published: October 2024

DOI: https://doi.org/10.13107/jocr.2024.v14.i10.4848

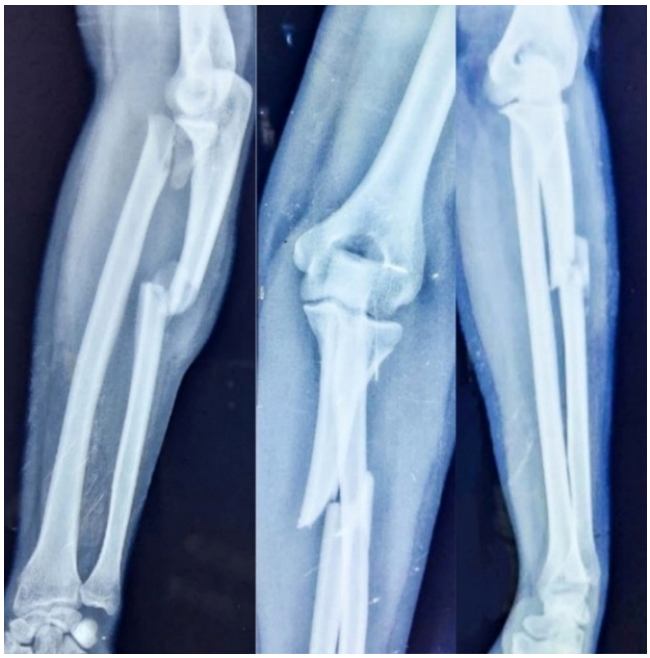

**Figure 1:** Radiographs show a multifragmentary proximal diaphyseal ulna fracture along with an ipsilateral radial neck fracture extending into the head.

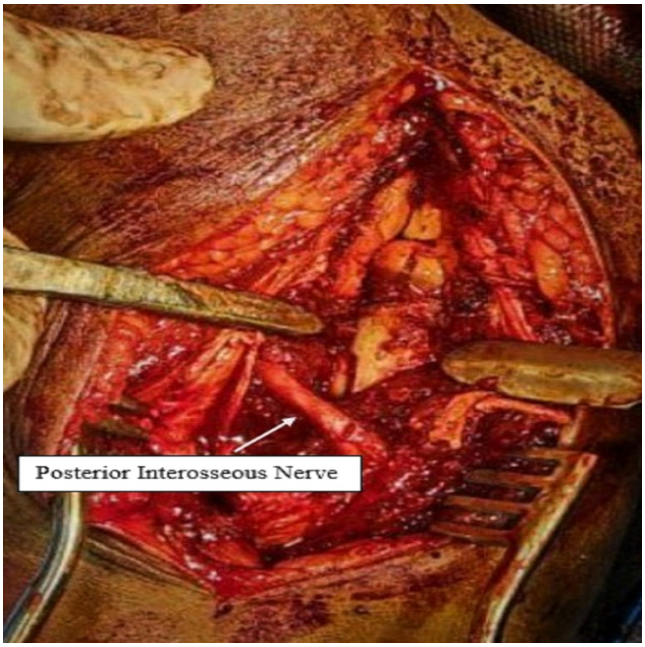


**Figure 2:** The posterior interosseous nerve lying on the substance of the supinator muscle.

an adult, with regard to its biomechanics and mode of injury along with its management and functional outcome but also review relevant literature to facilitate better understanding and additional awareness to orthopedists.

## Case Report

A 31-year-old female presented to our hospital emergency after an alleged road traffic accident, causing her to fall on her outstretched left hand. She had pain, swelling, deformity in her left forearm and was unable to move her left elbow. The patient had no other injury and upon evaluation, plain radiographs revealed a wedge multi-fragmentary fracture of the left proximal ulnar shaft along with an ipsilateral radial neck fracture extending into the radial head (Fig. 1).

This fracture pattern was similar to a Monteggia type 1 equivalent lesion as described by Bado. Now, Monteggia fractures are considered unstable and it requires surgical intervention [4]. After proper prognostic evaluation, appropriate literature review, and patient counseling, the patient was taken up for plate osteosynthesis for both, the proximal ulnar shaft fracture and the radial neck fracture. Under brachial anesthesia, the proximal ulna was addressed first by a direct approach; the fracture site was identified, freshened, proper anatomical reduction achieved, and fixed with a 9-hole dynamic compression plate using non-locking 3.5-mm cortical screws. For the radial head–neck fracture complex, the conventional Kaplan approach between the extensor digitorum communis and extensor carpi radialis brevis was used. The posterior interosseous nerve (PIN) was identified in the substance of the supinator muscle and retracted (Fig. 2).

Following the exposure, the proximal radial head–neck fragment was found to have a fracture and was actually a three-part fracture. This could have been predicted with a pre-operative computed tomographic scan of the elbow; however, due to logistic issues, it could not be done. The three-part fracture was converted into a two-part fracture by an interfragmentary screw fixation of the proximal neck fragment with the distal shaft (Fig. 3).

Finally, the radial head fragment was fixed with the parent construct using a 2.0 mm mini plate. Following fixation, intraoperative stability and the range of movement (ROM) of the elbow joint were checked and reconfirmed. The arc of supination and pronation was also restored. Post-surgery, the limb was immobilized in an above elbow splint in supination for a period of 3 weeks following which active assisted ROM exercises for elbow flexion extension and forearm supination and pronation were begun. Post-operative radiographs showed restoration of the ulnar length along with acceptable reconstruction of the proximal radius and reconstitution of the radio-capitellar joint (Fig. 4).

The patient was followed up at 3 weeks, 6 weeks, 12 weeks, 3 months, 6 months, and 1 year to assess the functional outcome.

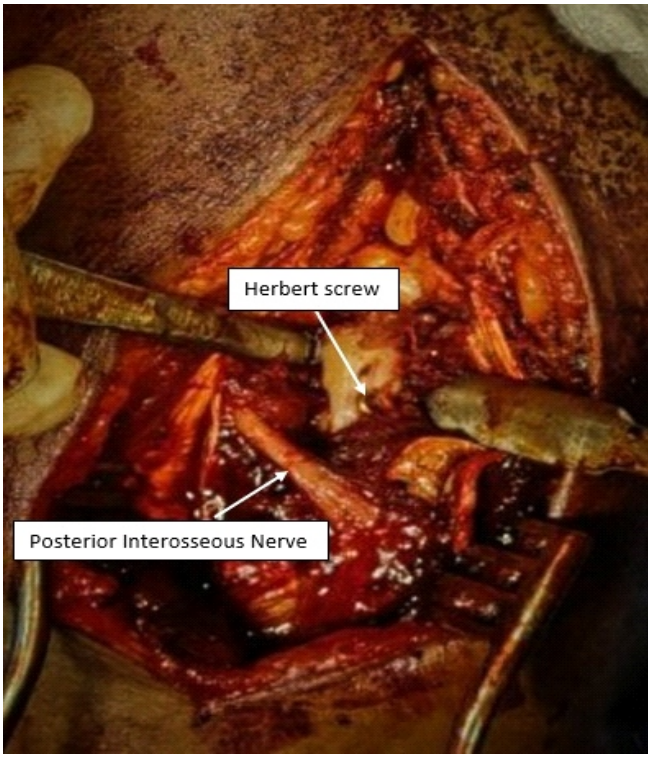


**Figure 3:** Intraoperative image shows the proximal neck fragment fixed to the shaft with a Herbert screw, converting a three-part fracture into a two-part fracture.

**Figure 4:** Immediate post-operative radiograph shows acceptable reduction.

At 3 weeks, stitches were removed and elbow range of motion exercises were commenced. The patient was advised against direct loading or heavy lifting for until 6-weeks duration postoperatively. The patient was gradually restored back to normal life activities with progressive overloading and was allowed unrestrained activities from 12 weeks onward. At 6-months follow-up, the patient regained near-native elbow flexion and extension and forearm supination with terminal restriction of pronation (Fig. 5 and 6).

Check radiographs showed signs of bone healing with a complete bony union at 1-year follow-up (Fig. 7).


**Figure 5 & 6:** Clinical images show near native functional outcome at 6-month follow-up.

## Discussion

Monteggia or Monteggia-like lesions are rare injuries and it poses a challenge to orthopedists in the treatment strategies. Giovanni Battista Monteggia, an Italian Surgical Pathologist, described the Monteggia fracture for the 1st time in 1814. He described it as a "traumatic lesion distinguished by a fracture of the proximal third of the ulna and an anterior dislocation of the proximal epiphysis of the radius" [1]. Monteggia fracture however is one of the rarer injuries among forearm fractures in adults [3].

In 1967, Bado in his seminal article classification mainly described four types of fracture patterns based on the direction of the radial head dislocation [2]. It was seen that the incidence of such fractures varied in adults compared to children. Type 2 injury with posterior dislocation of the radial head and fracture of the diaphysis of the ulna with posterior angulation accounts for almost 80% of the cases, being the most common type in adults. Type 1 accounts for 15% whereas Type

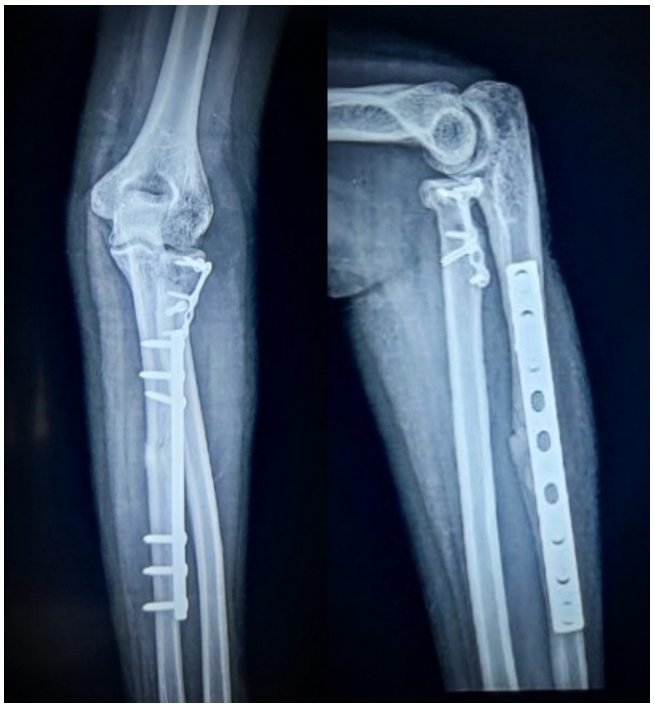

**Figure 7:** Radiographs at 1-year follow-up show complete bony union.

3 and 4 injuries have a combined 5% incidence [5].

The Bado Type 2 was further subclassified into subtypes by Jupiter et al. [6].

The term Monteggia equivalent' or Monteggia-like lesion' was also proposed by Bado in his article to accommodate and describe specific injuries having a similar mechanism of injury and treatment, however, with different radiological appearances. Five equivalent lesions were described in his classification and a further five subgroups of Type 1 equivalents were described, namely 1 a – anterior dislocation of the radial head without obvious ulna fracture; 1 b – fracture of the ulnar diaphysis with fracture of the neck of the radius; 1 c – fracture of the neck of the radius; 1 d – fracture of the ulnar diaphysis with fracture of the proximal third of the radius; 1 e – fracture of the ulnar diaphysis with anterior dislocation of the radial head and fracture of the olecranon [7]. Over the decades with increased sporadic case reports, Monteggia-like lesions expanded in the literature by different authors. Kamali described an injury as having a fracture of the radial neck with radial head displacement, along with a proximal third ulnar shaft fracture without involving the olecranon [8].

Various patterns of Monteggia equivalents were tabulated by Gundavda and Chinoy in 2015 [9] (Table 1).

Monteggia-like lesions in adults must be considered separately from that in children, as because they are not only much rarer in adults but also have a completely different mechanism of injury. Management of Monteggia-like lesions in adults is challenging and the functional outcome is uncertain due to various combinations of these injured structures, the complexity, and different management procedures [10].

Boyd and Boals in their study had observed that for Monteggia type injuries, an anatomical internal fixation of the ulna along with a radial head reduction yielded the best results [11]. In the literature, almost 44% of those fractures were diagnosed as Type 1 equivalent [12, 13]. Despite an aggressive approach and early surgery, his group of patients had poor results [11].

Monteggia fractures have high mal-union and non-union rates; 2–10% higher than average forearm fracture non-union rates [4]. Bruce et al. [14] reported similar results, however, Boyd and Boals [11] had a very low incidence of non-union, attributed mostly to their use of bone grafting in fracture cases wherever an anatomical apposition could not be obtained.

The assessment of the functional outcome of an elbow following a Monteggia lesion is difficult. According to Boyd and Boals' [11], a full ROM if regained is considered excellent; >75° of flexion-extension and >50% of normal pronation and supination is considered good; >50° of flexion-extension and >50% of normal pronation and supination is considered fair; and less than this ROM is poor. Reckling [13] used a different grading system where a good result was a loss of 10° motion, a fair result was a loss of >10° but <30°, and a poor result was a loss of >30° of motion. In our case, we also used the Mayo Elbow Performance Score (MEPS) to assess the elbow functional outcome. At 6-month follow-up the patient showed a good functional result with a MEPS 90.

To achieve a good functional outcome of the elbow joint after a Monteggia fracture, the gold standard treatment is open reduction and internal fixation of the ulnar fracture followed by restoration of the radio-capitellar joint congruency. Konrad et al. [15] evaluated 11 adults with Monteggia fractures and Givon et al. [16] investigated 41 patients with Monteggia-like lesions, and both results were in agreement with the fact that an additional radial head fracture was associated with a poorer prognosis.

Monteggia equivalents with a fracture of the radial head and neck gave a better functional outcome with respect to the MEPS with osteosynthesis compared to a radial head replacement or an excision. For Monteggia-like lesions with a multifragmentary radial head fracture that is beyond the scope of reconstruction, a prosthetic replacement of the radial head even still gives a fair functional outcome compared to a radial head excision. Therefore, radial head excision should only be considered a salvage procedure to minimize operating time and

| Type | Pattern |
|---|---|
| Type 1 Monteggia equivalent | Isolated anterior dislocation of radial head |
| | Isolated radial neck fracture |
| | Pulled elbow syndrome |
| | Fracture of ulna diaphysis with fracture of radial neck |
| | Fracture of both bones in the forearm (wherein the radial fracture is above the junction of proximal and middle third) |
| | Fracture of ulnar diaphysis with anterior dislocation of the radial head and an olecranon |
| | Fracture of the ulnar diaphysis (at the proximal and middle third junction) with displaced extension type supracondylar of the humerus |
| Type 2 Monteggia equivalent | Posterior elbow dislocation in children |
| Type 3 Monteggia equivalent | Displaced fracture of lateral condyle of the humerus |
| Type 4 Monteggia equivalent | Distal humerus fracture with proximal third ulnar diaphysis fracture and distal radial metaphyseal fracture with anterior dislocation of the radial head. |

**Table 1: Various patterns of Montegia equivalents.**

contraindicated in acute situations [17-23].

The complications that commonly occur with Monteggia-like lesions are non-union and mal-union [4] as previously mentioned. Other complications can be acute compartment syndrome, elbow stiffness, heterotopic ossification, ulno-humeral osteoarthritis, and wound infection. PIN neuropathy is the most common cause of motor deficit occurring in up to 10% of Monteggia fractures [24].

As discussed earlier, not every Monteggia-like lesion falls into the established classification system. Based on the fracture characteristics, bio-mechanics, and mode of injury our case with a proximal ulnar shaft fracture with a radial neck fracture we suggest can be included in the Type 1 b Monteggia equivalent lesions. However, again the radial head was found separated from the radial neck fragment intraoperatively; and such a morphology has not been reported much in literature as per our observations.

## Conclusion

Monteggia equivalent lesions in adults with radial head and/or neck fractures are usually prone to complications owing to its severity and are associated with high rates of revisions following any intervention. Early recognition of the fracture pattern, correctly classifying the type of fracture, providing a stable anatomical reduction following the basic principles of Monteggia fracture reduction, and wherever possible, osteosynthesis of the radial head neck complex along with restoration of the radio-capitellar joint congruity gives the best functional outcome. The choice of treatment for radial head repositioning however depends on the fracture pattern.

### Clinical Message

Adult Monteggia equivalents are rare complex injuries which need reporting, to establish an appropriate classification for a better understanding of the fracture morphology and thus customizing a treatment algorithm for the osteosynthesis of the proximal radius whenever possible, as because the restored anatomic radiocapitellar joint congruity gives the best functional outcome compared to excision or arthroplasty.

**Declaration of patient consent:** The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given the consent for his/ her images and other clinical information to be reported in the journal. The patient understands that his/ her names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

**Conflict of interest:** Nil **Source of support:** None

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**Conflict of Interest:** Nil
**Source of Support:** Nil

**Consent:** The authors confirm that informed consent was obtained from the patient for publication of this case report

**How to Cite this Article**

Mukherjee S, Parkaviyan R, Banerjee K. Monteggia Equivalent Variant Type 1 in an Adult, its Management and Functional Outcome with Literature Review. Journal of Orthopaedic Case Reports 2024 October;14(10): 163-168.