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Review article

## Monteggia injuries

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### ABSTRACT

The Monteggia injury is defined as radial head dislocation with a fracture of the ulnar shaft. This combination should be sought routinely in patients with ulnar fractures, even when the displacement is small. The emergent management is simple, as reducing the ulnar fracture is usually sufficient to stabilise the radial head. Internal fixation of the ulna deserves to be widely used to fully stabilise the radial head. Irreducibility of the radial head at the acute stage may indicate an interposition, which requires open surgery on the joint. Radial head dislocation may occur even with minimal displacement of the ulnar fragment. Chronic Monteggia fractures are more challenging to treat and their outcomes are more variable. The radial head becomes irreducible after 2 to 3 weeks. When a simple surgical approach fails to ensure stable reduction, the most widely used method at present is open reduction of the radial head and proximal osteotomy of the ulnar shaft. Stability must be obtained intra-operatively. Without treatment, radial head dislocation may be well tolerated for several months or even years. In the long term, however, osteoarticular remodelling results in loss of joint congruence, pain and, eventually, osteoarthritis. Radiographs must therefore be obtained on an emergency basis and analysed with great care to avoid missing a Monteggia fracture.

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The Monteggia injury is defined as radial head dislocation combined with a fracture of the ulnar shaft. For many years, non-operative treatment was preferred at the acute stage. No surgical method seemed satisfactory in chronic Monteggia injuries. Starting in the 1970s, however, ulnar shaft osteotomy was described as ensuring effective stabilisation of the surgically reduced radial head in chronic cases [1–4]. Other reduction techniques were developed during the same time period, such as gradual lengthening in an external fixator [5].

The objective of this article is to discuss current issues raised by Monteggia injuries, based on a review of the literature. These issues include the time interval after which a Monteggia injury should be considered chronic, the place of ligament reconstruction in the treatment strategy and the most reliable first-line treatment technique.

### 1. Definition of the Monteggia injury

The Monteggia injury is defined as radial head dislocation combined with an ulnar shaft fracture. This rare combination accounts for less than 2% of all forearm fractures (in both adults and children).

It was first described in 1814 by Giovanni Battista Monteggia, who made a delayed diagnosis, 1 month after the injury, and emphasised the diagnostic challenges, with the ulnar fracture being readily detected but the radial head dislocation being easily missed at first [6].

Bronfen conducted a detailed anatomical analysis [7]. The displacement of the radial head usually causes a tear in the annular ligament. In some cases, however, this ligament remains intact, connected to the lateral collateral ligament and ulna and the radial head slips under it. The radial head is then often irreducible at the acute stage.

The most widely used classification was developed by Bado [8] and distinguishes four types based on the displacement of the radial head:

- Bado 1: anterior dislocation. This is the most common type (70%) [9] (Fig. 1). Three main mechanisms have been described:
  - indirect mechanism with hyper-pronation responsible for radial head dislocation, with transfer of the full load to the ulna, which fractures [10],
  - indirect mechanism with hyper-extension inducing reflex contraction of the biceps muscle responsible for radial head dislocation, which is followed by a fracture of the ulna [11],

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Fig. 1. Bado 1 Monteggia fracture (anterior dislocation).



Fig. 3. Bado 3 Monteggia fracture (lateral dislocation).



Fig. 2. Bado 2 Monteggia fracture (posterior dislocation).

- direct mechanism in which a blow to the posterior aspect of the ulna causes a posteriorly angulated ulnar fracture that pulls the radius out of the joint (nightstick injury) [12,13];
- Bado 2: posterior or postero-lateral-dislocation (6%) (Fig. 2). The ulna angulates posteriorly. The mechanism is believed to be indirect, involving a longitudinal force applied when the elbow is partly flexed, causing a break in the posterior ulnar cortex [14];
- Bado 3: lateral or antero-lateral dislocation (23%) (Fig. 3). The ulnar fracture is usually metaphyseal. The mechanism involves forced varus with the elbow extended [15]. The most common complication is injury to the posterior interosseous nerve;
- Bado 4: anterior dislocation with a fracture of the radius (1%). This type occurs chiefly in adults and is exceedingly rare in paediatric patients. The mechanism is unclear.

Several Monteggia-like injuries have been described, such as anterior radial head dislocation with a non-displaced or minimally displaced fracture of the olecranon [16]. Another example is ante-

rior radial head dislocation, which has been likened to a Bado 1 injury in which a plastic ulnar shaft fracture goes unnoticed [17].

Other classifications have been developed but are rarely used in the current literature [18–20].

Acute Monteggia injuries are now usually defined as those seen within 1 month after the trauma [21]. Beyond this interval, the injury is considered chronic. In acute cases, non-operative management can be expected to ensure reduction, without surgery on the humero-radial joint. After 3 months, an additional procedure on the bone is required. The optimal management between 1 and 3 months remains ill defined. Advanced chronic injuries are those seen beyond 1 year after the trauma and are treated in the same way as chronic injuries, although the risk of residual abnormalities is higher.

## 2. Reasons for, and consequences of, missing the diagnosis of Monteggia injury

In young children, fractures are often minimally displaced, considered non-serious and treated non-operatively by a cast without reduction. In the emergency setting, attention focuses on the ulnar fracture. Nevertheless, even minimally displaced ulnar lesions should be viewed with circumspection: in a study of children with initially missed Monteggia fractures, Delpont et al. found that the mean angular displacement of the ulna was only 5° [22].

The low frequency of Monteggia injuries translates into limited familiarity with their diagnosis among emergency physicians and radiologists. Consequently, a very high level of suspicion must be maintained. The surgeon must review the radiographs, even if they were interpreted as normal. Positioning should be assessed carefully and further radiographs obtained if appropriate, notably when the entire forearm is not visible. A lateral view of the elbow must be available.

After the acute phase, the radial head dislocation may remain asymptomatic for several weeks or months.

### 2.1. Short-term consequences of missing the diagnosis

Fibrosis develops rapidly within the ulnar notch, precluding radial head reduction by external manoeuvres after 3 weeks [23]. Motion range may be restricted, particularly during flexion when an

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