

Monteggia lesions: tips & tricks in acute management and 2-years follow-up

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SUMMARY

Objective. This report aims to offer a practical protocol and indications on the acute management of Monteggia lesions in the adult population.

Methods. We retrospectively analysed all patients with radius and ulna lesions treated over 5 years. Inclusion criteria were: patient with Monteggia injuries, age 18-100; exclusion criteria: Monteggia-like injury, paediatric patient. Acute management consists of immediate close reduction of the radial head dislocation. All patients received ORIF with 3.5 mm LCP applied to the dorsal surface of the proximal ulna in compression mode. Elbow stability was always evaluated under anaesthesia.

Results. Of a total of 3652 patients, 30 (0.82%) met inclusion criteria, and were classified as follow: 2 Bado I; 18 Bado II (4 2a; 4 2b; 7 2c; 3 2d); 6 Bado 3; 4 Bado 4. Heterotopic periarticular ossifications formed in 2 patients. At 24 months, the follow-up VAS score was 1 and the Mayo elbow performance score was 85.

Conclusions. The immediate management of radius head dislocation, preservation of the length of the radial column and a stable anatomic synthesis of the ulnar fracture are the key treatment principles in Monteggia lesions. To minimise the risk of arthrofibrosis and stiffness and promote bone healing, indomethacin, muscle relaxants and vitamin D are administered. It is important to inform the patient that *restitutio ad integrum* after this type of injury is almost impossible.

Key words: Monteggia fracture, forearm, elbow instability, radius, ulna

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Introduction

The fracture at any ulna segment associated with a radial head dislocation is recognised as a severe injury, known as Monteggia lesions, in honour of Italian surgeon Giovanni Battista Monteggia who first described the traumatic mechanism of this particular fracture and dislocation even before the advent of radiography¹. It represents 0.7% of all elbow fractures and dislocations in adult patients².

In 1967, Bado classified Monteggia fractures into four types based on the direction of dislocation of the radial head: type I, anterior dislocation and anterior angulation; type II, posterior dislocation and posterior angulation; type III, lateral dislocation and lateral angulation; and type IV, third proximal fracture of both bones and anterior dislocation of the radial head³. Subsequently, both Jupiter⁴ and Bado described other so-called "Monteggia-like injuries"⁵. They include: isolated (anterior) dislocation of the radial head; the bony fracture of proximal radius and

ulna with the radial fracture more proximal than the ulnar one; elbow dislocation associated with ulna fracture and possible radius fracture; the isolated radial neck fracture. Bado stated that these injuries, though less frequent, share the same traumatic mechanisms as classic Monteggia injuries⁵.

The low frequency of Monteggia lesions results in a limited familiarity with their diagnosis among emergency physicians and radiologists⁵; correct and rapid diagnosis and treatment of this type of lesion are essential to obtain satisfactory clinical results. Especially in children, diagnosis of Monteggia injury is more complex and may be underestimated, resulting in chronic injury and disabling sequelae⁶.

Traditionally, results after Monteggia fractures for adults and children were often summarised, although these are not comparable in fracture shape, accompanying injuries, treatment principles and prognosis⁶.

In the current case series, we report this kind of lesion occurring exclusively in the adult population to offer practical indications on acute management.

Materials and methods

We retrospectively analysed all patients with radius and ulna lesions treated at our Institution from January 2016 to December 2020. Inclusion criteria were: patient with Monteggia injury; age 18-100. Exclusion criteria were: Monteggia-like injury; paediatric patients.

Acute management consists of immediate close reduction of radial head dislocation and immobilisation of the elbow in a long-arm cast to maintain the reduction until surgical treatment. X-ray controls were performed to confirm radial head reduction and analyse a complete view of the forearm bones. A CT scan of the injured elbow to improve planning was always performed⁷ (Fig. 1).

The surgery was performed on average at 5 days after the trauma (2 to 15 days). In patients suffering from polytrauma, surgery was delayed and performed on average at 11 days after the trauma (8 to 15 days).

In our institution it is preferred to perform the surgery under general anaesthesia to immediately evaluate post-surgery limb function, allowing to diagnose any nerve injuries. Supine position and tourniquet at the root of the limb for temporary ischaemia were accomplished. A posterior longitudinal approach to the ulna was acted to deeply reach both the lateral and medial compartments of the forearm and elbow to provide open reduction and internal fixation (ORIF)⁸. Synthesis of the ulna was always carried out using a 3.5 mm Locking Compression Plate (LCP) applied to the dorsal surface⁷. In Bado IV lesions, ORIF or replacement of the radial head was performed via the same approach.

In all cases, during surgery, the instability of the elbow was examined under valgus and varus stress in maximum extension and at 30° flexion. The O'Driscoll pivot shift test was used to



Figure 1. A 57 years old female patient reported a Monteggia lesion with fracture of radial head (Bado IV), complicated by a coronoid fracture. Long arm X-Ray (A,B) and CT (C,D,E) in emergency room.

assess the stability of the lateral collateral ligament apparatus and to rule out posterolateral rotational instability (POLRI) in the humeroradial joint⁹.

Patients, who under anaesthesia showed instability of the radial head, underwent suture of the annular ligament and suture of the radial component of the lateral collateral ligament, as needed, according to the surgical technique described by Giannicola et al.⁸.

During hospitalisation, a long-arm cast was applied for analgesic purposes until the surgical wounds were healed entirely on average 16 days (12-21) for patients with a stable relocation of the radial head and for patients who underwent ligamentous suture or proximal radius stabilisation.

Pharmacological prophylaxis with indomethacin 25 mg 3 times a day for 20 days was administered to prevent peri-articular ossifications. Vitamin D intake was recommended to improve bone healing.

The rehabilitation protocol for the first 10 days included only active movement, consisting of pronosupination, flexion and elbow extension. Passive kinesiotherapy was then performed and continued until suitable functional recovery was achieved, even with muscle relaxant drugs.

X-ray controls were planned at 1, 3, 6, 12 and 24 months and then annually. Fracture healing was radiologically assessed by examining callus size, cortical continuity and progressive fracture line¹⁰.

Clinical outcomes were evaluated with the Mayo Elbow performance Score ¹¹, which investigate criteria such as pain, range of motion (ROM), stability and usability of the arm in everyday life. A Visual Analogue Scale (VAS score) was used to rate pain ¹². The degree of mobility was measured using the neutral zero method ¹³.

Results

Of a total of 3,652 patients who were treated over 5 years for forearm injuries, 30 (0.82%) met the study inclusion criteria, of whom 6 suffered from polytrauma. The mean age of patients was 48 years (26-63), 22 were male and 8 female. The degrees of injury reported are summarized in Table I.

Of 4 patients who reported a Bado IV lesion, 2 underwent ORIF of the radial head and 2 underwent prosthetic replacement. Only 2 patients (6.5%) needed a direct ligaments suture to restore elbow stability.

We found no post-operative complications such as infections, neurological deficits, non-union, recurrent dislocations, or instability of the radial head. Heterotopic periarthritic ossifications formed in 2 patients (both polytrauma patients) as early as one month, resulting in a reduction of the ROM. These patients did not undergo any other surgery because daily life activities were preserved according to Morrey's criteria ¹¹.

Fractures healed with good formation of bone callus as documented by X-ray controls with a mean time for radiological union of 12 weeks (8-20 weeks).

The Mayo elbow performance score showed good results at the last follow-up with an average of 85.6 (60-100)/100 (Tab. I).

Two patients who underwent ORIF of the radial head had delays in recovery of range of motion: at 3 months follow-up, the supination measured 40°. This limitation was no longer observed at the last follow-up, in which they had achieved mean supination of 68°. No difference in ROM between the various degrees of injury or treatment was observed at a follow-up of 24 months: mean forearm pronation was 85° (70°-90°), mean

supination was 70° (50°-90°), mean elbow flexion was from 9° of fixed flexion (0°-30°) to 135° (120°-145°) (Fig. 2).

The mean VAS score decreased from 8 pre-operative to 3 after one month and only 2 patients reported pain in maximum degrees of motion after 6 months. The average VAS score at 24 months follow-up was 1 (0-3) during activities and on average less than 1 at rest.

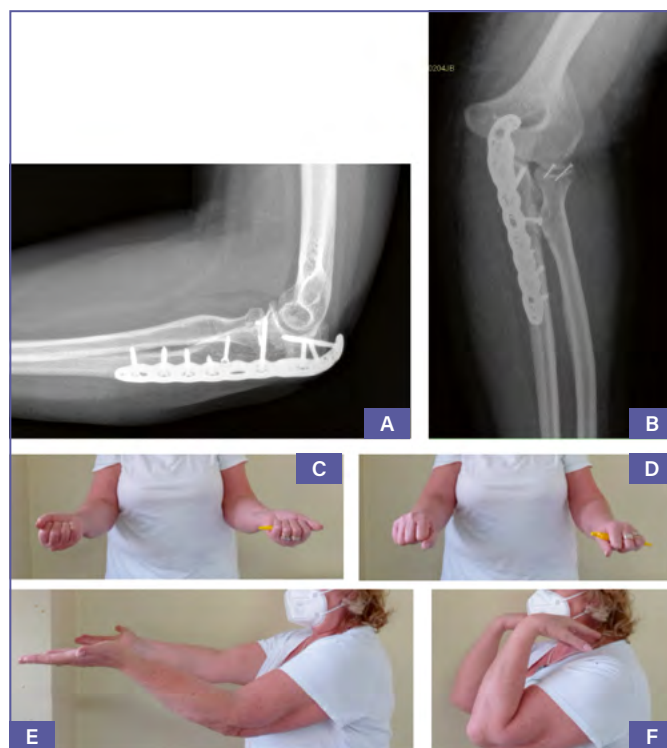


Figure 2. X-Ray (A,B) and clinical (C,D,E,F) follow-up at 24 months post surgery (Mayo elbow score ¹¹: 90/100; VAS ¹²: 1/10; elbow flexion ¹³: -30°, 135°; forearm pronation: 85°; supination: 90°).

Table I. Demographics and clinical follow-up.

	Patients	Mayo elbow score ¹¹	Notes
Bado I*	2	92.5 (85-100)***	
Bado II	IIa: 4** IIb: 4 IIc: 7 IId: 3	76.25 (60-85) 88.5 (80-100) 90.65 (85-100) 76.6 (60-90)	3 polytrauma patients 2 polytrauma patients
Bado III	6	90.2 (85-100)	
Bado IV	4	84.5 (60-90)	1 polytrauma patient
Total	30	85.6 (60-100)	

*Bado Classification ³; **Jupiter Classification ⁴; ***Mean values at 24 months follow-up.

Discussion

Monteggia lesions are rare injuries and should always be suspected in the event of a fracture of the ulnar shaft. X-rays with a complete view of the forearm bones and a CT scan of the injured elbow are demanded to identify associated lesions ⁷ better.

Most of the authors do not differentiate adult patients from paediatric ones and do not differentiate acute management and surgical treatment, making interpretation of results difficult and treatment standardisation impossible ^{6,14,15}.

The standardization proposed in this report provides a clear therapeutic indication in adult patients with Monteggia lesions and facilitates the interpretation of the results.

At a mean follow-up of 24 months, we noticed better results with fewer complications, no revision surgery, and improved functional outcomes compared with similar reports ¹⁴⁻¹⁷. The reason could be that we excluded Monteggia-like and excluded the paediatric population, reporting treatment strategies exclusively in the adult population.

Our experience shows that the correct classification of the lesion, immediate reduction of the dislocation of the radial head, standardization of treatment of the ulna and stability tests of the elbow under anaesthesia represent fundamental elements to guarantee good results.

The immediate restoration of the radial column provides numerous advantages: acute reduction is more manageable, rarely requires patient sedation and immediately relieves patient pain, also allowing for partial realignment of the ulna fracture. Additionally, limiting swelling and bleeding may reduce the risk of periarticular heterotopic ossification (HO) formation ¹⁸ and prevent bone loss ¹⁹. These precautions allowed us to observe fewer complications than other authors ¹⁴⁻¹⁶. We registered only 2 patients who developed HO in a polytrauma condition. The correlation between polytrauma patients and ossification formation is not clear. However, it could derive from the immunological condition generated in this type of patient, and related to the systematic inflammatory state ^{18,19}.

Concerning inflammation, our choice arises to not allow immediate mobilization of the elbow, which was granted only after wound healing to avoid a long-term inflammatory reaction that can lead to the formation of HO ^{18,19}.

To minimise the risk of arthrofibrosis and stiffness and promote bone healing, our medical therapy included indomethacin, muscle relaxants and vitamin D, while keeping in mind that the key treatment principle in Monteggia lesions is stable anatomic alignment of the ulna.

All patients received ulna osteosynthesis of the ulna using modern fixation techniques. In all cases, ORIF with 3.5 mm LCP was applied to the dorsal surface of the proximal ulna in compression mode. Since posterior tensile forces are encountered at the apex of the proximal end of the ulna with active motion, a plate applied to the lateral or medial surface of the ulna is mechanically inferior to a plate applied to the posterior

surface of the ulna, which works as a tension band ^{15,20}. Ring et al. recommend fixation of the ulnar fracture with a thick plate, such as a 3.5 mm limited-contact dynamic compression plate, applied to the posterior surface of the ulna and contoured proximally to reach the tip of the olecranon ²¹. Semi-tubular or one-third tubular plates, as well as tension band-wire constructs, do not seem to be rigid or strong enough. The proximal contour allows addressing the proximal fragment with more screws. The most proximal screws are oriented at 90° to the more distal screws, creating a more stable construct ^{7,15,21}.

If necessary, other surgical procedures may be added, depending on the complexity of the case, such as synthesis of the associated radius fractures, prosthetic replacement of the radius head and suturing of ligaments in case of residual instability ^{22,23}. All of our patients received clinical stability tests of the elbow under anaesthesia and radiographic controls to possibly add surgical procedures needed to restore elbow stability, which were required in two patients.

Some authors reported that Monteggia fractures associated with radial head fractures tend to have worse outcomes ^{21,22}. In contrast to all studies as mentioned earlier, only our short-term results (3 months) showed a worse functional outcome of patients treated for an associated radial head fracture (Bado 4), with satisfactory results comparable to the rest of the current cohort at the final follow-up. Preservation of the length of the radial column by fixation or replacement seems to be a mainstay in treating these injuries ²³.

Conclusions

The immediate management of radius head dislocation and stable anatomic synthesis of the ulnar fracture, in addition to pharmacological prophylaxis with indomethacin and mobilisation of the elbow, guarantee good results and reduce possible complications, the most significant of which is stiffness in the long-term. It is essential to inform the patient that *restitutio ad integrum* after this type of injury is almost impossible.

Ethical consideration

All patients were treated according to the ethical standards of the Helsinki Declaration, and were invited to read, understand, and sign the informed consent form.

Authors' contributions

Conceptualization: TS and AF; data curation: TS, AF and FM; writing-original draft preparation: TS; writing-review and editing: TS, AF and FM; supervision: RE. All authors have read and agreed to the published version of the manuscript.

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Conflict of interest

The Authors declare no conflict of interest.

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