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The Monteggia Lesion

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The Monteggia lesion is a typical example of a double bone injury, characterized by a radial dislocation and a fracture of the ulna. This definition is different from Monteggia's, published in 1814,[10,11] when he made known the first two observations of "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." Soon afterward, Malgaigne[9] stated that: "any fracture of the ulna, without exception, can be found with a radial dislocation." Hamilton[8] was of the same opinion. Nevertheless, many authors have insisted on keeping the original definition given by Monteggia: an ulnar fracture

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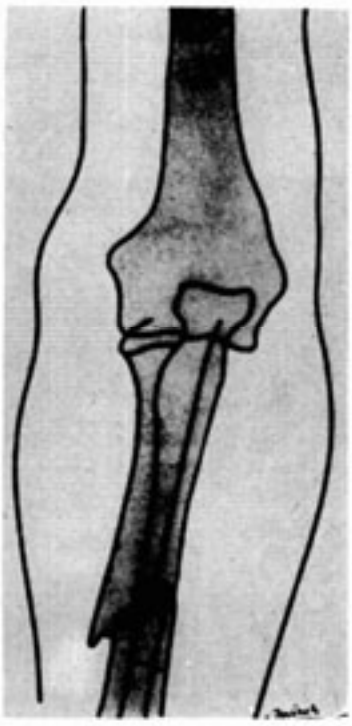


FIG. 1. Lesions of Monteggia fracture, Type 1. (*Left*) Lateral view. (*Right*) Front view.

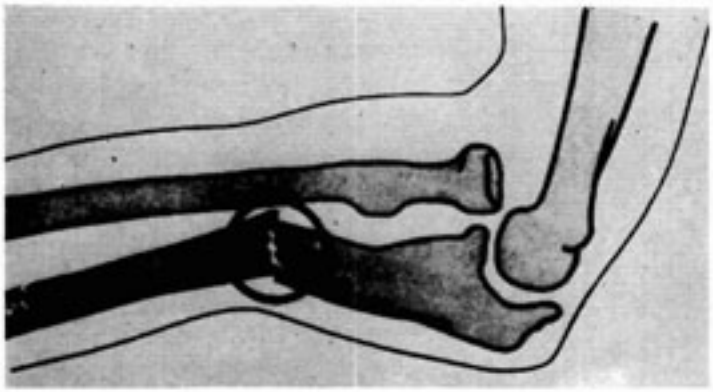


FIG. 2. Illustration of rotation at the moment of the fall. The hand being on the ground, the rotation of the body and with it the upper arm outward provokes an internal rotation movement of the forearm—pronation. (Figs. 2-7, 11, 12, 17-26, 28 and 29, from Bado, J. L.: The Monteggia Lesion, Springfield, Thomas, 1959)

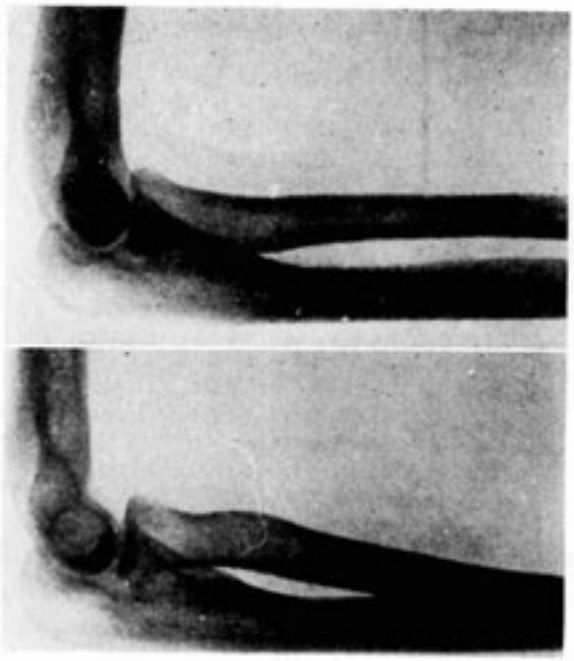


FIG. 3. (*Top*) The bicipital tuberosity is posterior; full pronation. (*Bottom*) The bicipital tuberosity is anterior; full supination.

located between the proximal third and the base of the olecranon.

The most frequent site of fracture is at the junction of the proximal and the middle thirds of the ulna (statistics show 60 to 70%); this localization must not be considered as being exclusive. A traumatic lesion can present all the characteristics described by Monteggia with the ulnar fracture located proximal or distal to this level. Therefore, the location of the fracture at the level of the ulnar diaphysis does not define the "Monteggia lesion." Since the dislocation of the radial head can be ante-

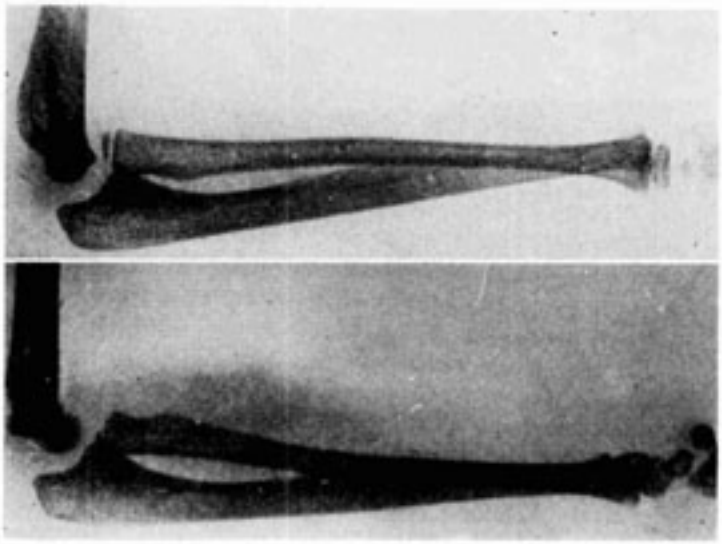


FIG. 4. (*Top*) With pronation the radius "shortens." The wrist conjugal cartilages of the radius and the ulna are at the same level. (*Bottom*) With supination the radius "lengthens." Looking at a roentgenogram of the wrist, one can know if the radius is in pronation or supination.

FIG. 5 (*Left*). Monteggia Lesion, Type 1. Man, 45 years old. Reduction through maneuvers in supination. Observe on prereduction films that the bicipital tuberosity is oriented posteriorly (pronation). After reduction the bicipital tuberosity is oriented anteriorly (supination).

FIG. 6 (*Right*). Monteggia Lesion, Type 1. Boy, 4 years old. Fracture of the ulnar shaft; anterior angulation; dislocation of the radial head. Reduction by maneuvers in supination; good result. Follow-up: 2 years.

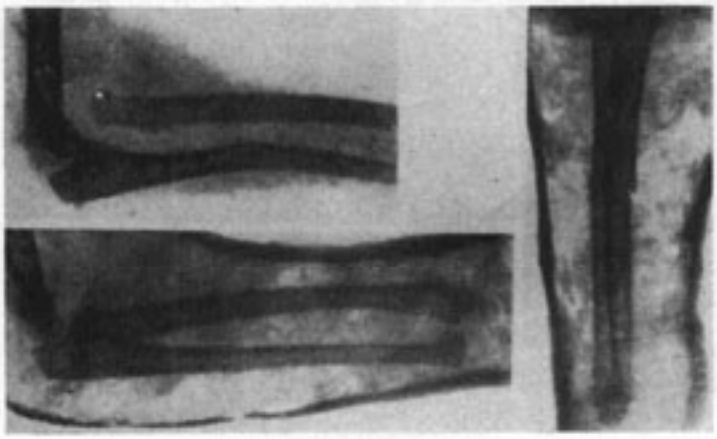


FIG. 7. Monteggia Lesion, Type 1. Boy, 6 years old. Fracture of the ulnar shaft; anterior angulation; dislocation of the radial head. Reduction by maneuvers in supination; good result. Follow-up: 3 years.

rior, lateral or posterior, any dislocation found with an ulnar fracture constitutes the anatomic-clinical picture of the lesion discussed by Monteggia.

Keeping these considerations in mind, we shall be able to classify under the term "Monteggia lesion" a group of traumatic lesions having in common a dislocation of the radio-humero-ulnar joint, associated with a fracture of the ulna at various levels or with lesions at the wrist.

This concept is different from that described by Monteggia in 1814, which represents only one type. I prefer the term "Monteggia lesion" for the following.

CLASSIFICATION

A. Monteggia Lesion

Type 1

Anterior dislocation of the radial head
Fracture of the ulnar diaphysis at any level with anterior angulation
60% of cases

Type 2

Posterior or posterolateral dislocation of the radial head
Fracture of the ulnar diaphysis with posterior angulation
15% of cases

FIG. 8 (*Top*) and FIG. 9 (*Bottom*). Monteggia Lesion, Type 1. Boy, 3 years old. Fracture of the shaft of the ulna with displacement: anterior angulation; dislocation of the radial head. Reduction: maneuvers in supination; good result. Follow-up: 3 years.

Type 3

Lateral or anterolateral dislocation of the radial head
Fracture of the ulnar metaphysis
20% of cases

Type 4

Anterior dislocation of the radial head
Fracture of the proximal third of the radius
Fracture of the ulna at the same level

Next to these 4 great anatomo-clinical types there exists a series of "equivalents" that possess very similar characteristics, especially in their mechanism of action and in their treatment.

B. EQUIVALENTS

Type 1

Anterior dislocation of the radial head in child or adult. This entity in the child is known as the "pulled elbow syndrome" (Figs. 12, 13).
Fracture of the ulnar diaphysis with fracture of the neck of the radius (Fig. 14)
Fracture of the neck of the radius (Figs. 15, 16)
Fracture of the ulnar diaphysis with fracture of the proximal third of the radius. The radial fracture is always proximal to the ulnar one.
Fracture of the ulnar diaphysis with anterior dislocation of the radial head and fracture of the olecranon

FIG. 10. Monteggia Lesion, Type 1. Boy, 11 years old. (*Top*) Fracture of the shaft of the ulna with an intermediary fragment; dislocation of the radial head after unprofitable attempts toward reduction. (*Bottom*) Five months after reduction by supination movement.

FIG. 11. Old Monteggia Lesion. (A) At 3 months. (B) The dislocated radius was reduced by supination. Open reduction of the ulnar fracture with an intramedullary wire.

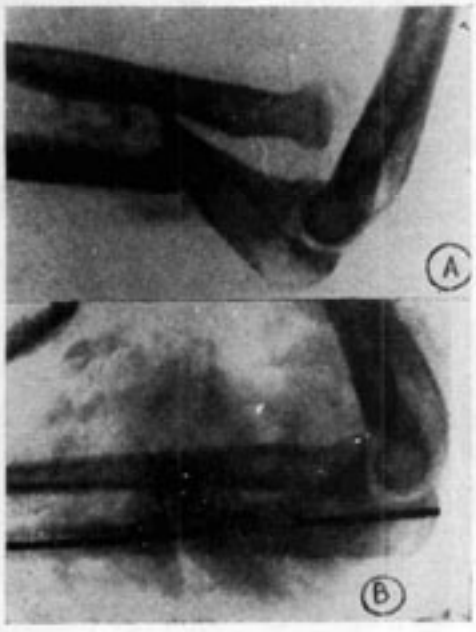
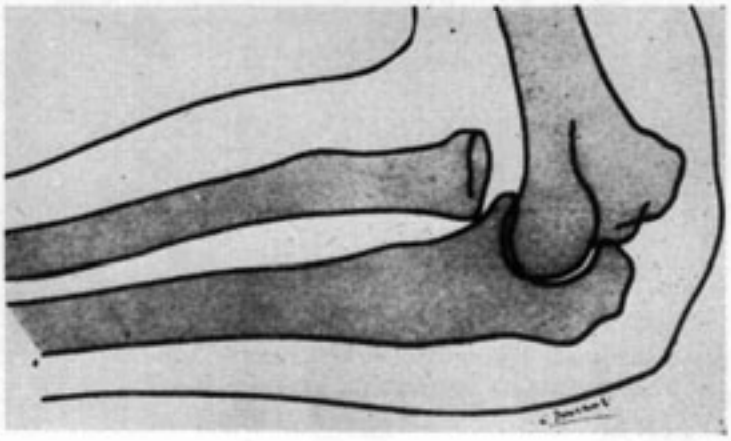


FIG. 12. Anterior dislocation of the radial head. This is the equivalent of the Monteggia Lesion, Type 1.



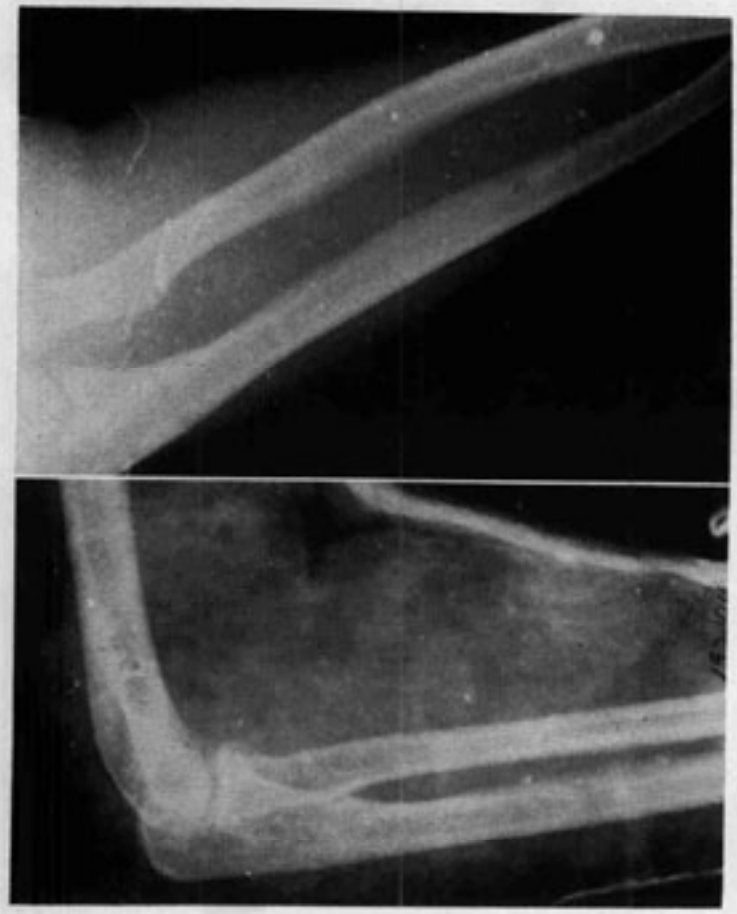


FIG. 13. Boy, 15 years old. Anterior dislocation of the radial head. (*Top*) The bicipital tuberosity is directed posteriorly: pronation. (*Bottom*) After reduction with a simple movement of supination.

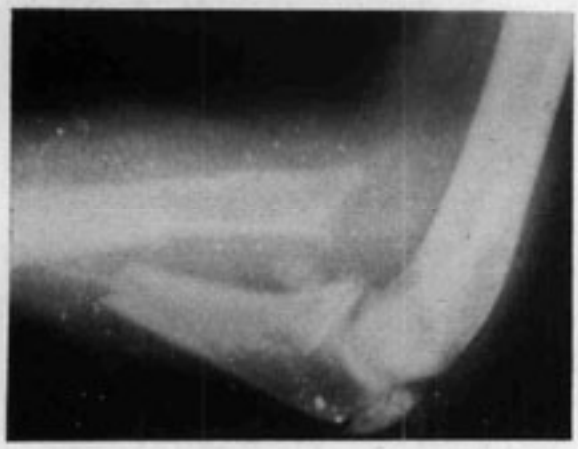


FIG. 14. Another equivalent of Monteggia Lesion, Type 1. Fracture of the ulnar shaft, anterior angulation. Fracture of the neck of the radius with anterior displacement. This lesion may be corrected by a supination movement.

Posterior dislocation of the elbow and fracture of the ulnar diaphysis, with or without fracture of the proximal radius

Wrist lesions may also be found with Monteggia lesions, Type 1 or equivalents:

- Radio-ulnar dislocation
- Slipped epiphysis
- Fracture of the distal extremity of the radius
- Fracture of the distal third of the radial diaphysis with sprain of the radio-ulnar joint (Galeazzi's lesion)[7]

Type 2. This has no equivalents other than epiphyseal fractures of the dislocated radial head of fractures of the neck of the radius.

Monteggia lesions Types 3 and 4 have no equivalents.

FIG. 15. Fracture of the radial neck corrected by supination. In some other cases the fracture must be corrected by "pronation" because its cause is "supination." The position of the bicipital tuberosity in the x-ray picture will indicate the type of rotation necessary to obtain reduction. These maneuvers must be done under anesthesia. If the fracture is impacted, open reduction is necessary.

MONTEGGIA LESION, TYPE 1

The characteristic feature is a fracture of the middle or the proximal third of the ulna, associated with an anterior dislocation of the radial head. It is the most frequent type in adults and children (60%) (Fig. 1).

It is important to insist on the mechanism of action of this fracture. It has been confirmed (Evans, Boyd[1,2,3,4,5,6]) that rotation, and more specifically forced rotation, is the cause. Evans gave this explanation: When a child falls forward on his outstretched hand, the forearm is in pronation, and at the moment of the fall the hand remains firm to the ground. A moment before the end of the fall, a rotational force is added from

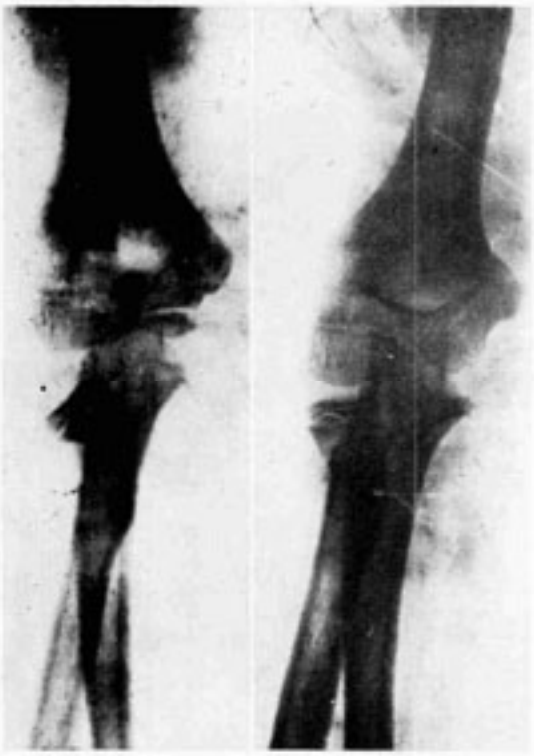


FIG. 16. Fracture of the neck of the radius treated by supination.

FIG. 18. The most frequent equivalent of the Monteggia Lesion is seen in infants under 3 years of age: the "pulled elbow syndrome."

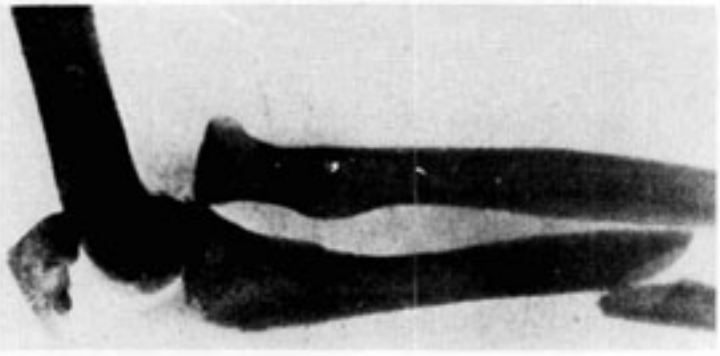
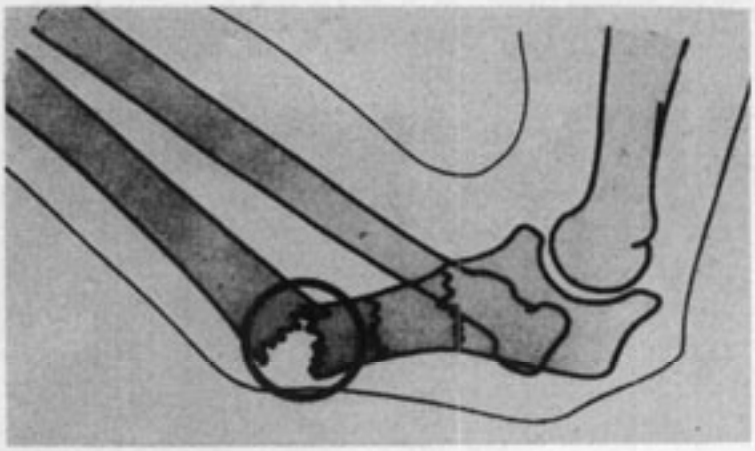


FIG. 17. Monteggia Lesion, Type 1, with fracture of the olecranon.

the trunk; this force is transmitted by an external rotation of the arm on the hand, thus exaggerating an already full pronation. Since the hand is fixed to the ground by the weight of the falling body, the degree of rotation exceeds the normal radio-ulnar pronation, and a transverse or oblique, with or without butterfly, fracture occurs in the ulnar shaft. At the same time the radius, being forced into extreme pronation, crosses the ulna at the junction of the middle and the proximal thirds. This contact acts as a fulcrum, forcing the proximal radius anteriorly to dislocate its head, or to break or exceptionally to do both.

A forced pronation then will be capable of causing 1 of the 4 following lesions:

1. Fracture of the ulna in its proximal or middle third with anterior dislocation of the radial head—Monteggia, Type 1
2. Fracture of the ulna at the same level as (1) and a more proximal fracture of the radius, especially in the child
3. Isolated anterior dislocation of the



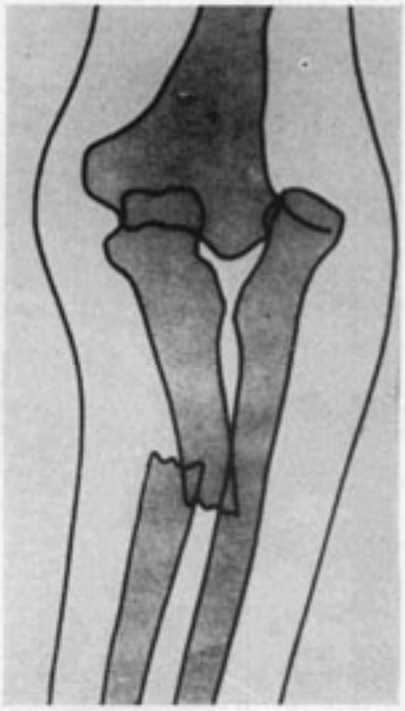


FIG. 19. Monteggia Lesion, Type 2. Fracture of the ulnar shaft; posterior angulation. Posterolateral dislocation of the radial head, seen very frequently with an open fracture.

radial head—the pulled elbow syndrome in the child (1)

4. Similar lesions to be detailed under "equivalents"—Monteggia lesion, Type 1.

Proof that the mechanism of forced pronation is most important in producing the Monteggia lesion, Type 1, is abundant.[4,5,6] We shall refer to only 3 such proofs

1. **Clinical Proof.** We know that the attitude of the distal segment of a dislocated articulation represents the movement which led to the dislocation. Here the attitude of the forearm of a child is one of pronation; therefore, the mechanism of action is also pronation.

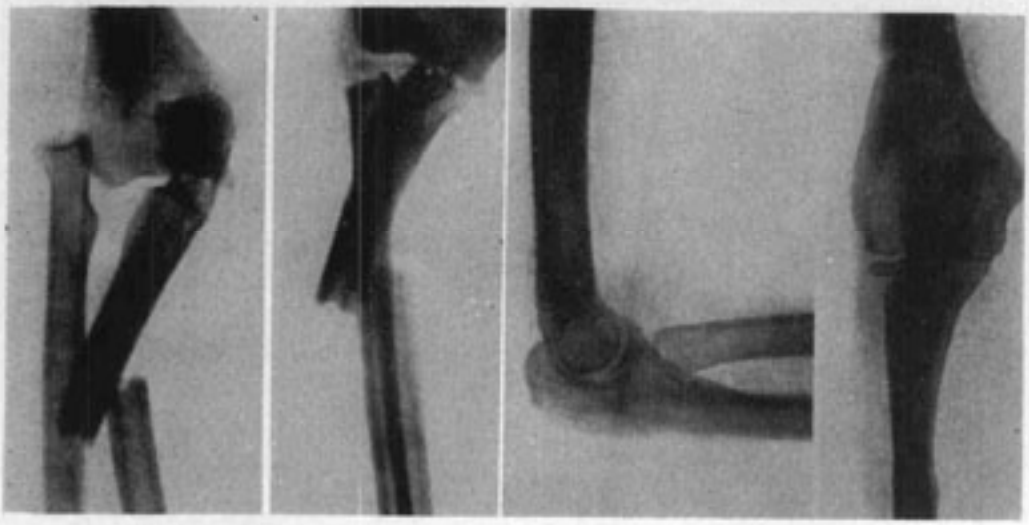


FIG. 20. Monteggia Lesion, Type 2. Man, 32 years old. Fracture of the ulnar shaft; posterolateral angulation; posterolateral dislocation of the radial head; open fracture. Treatment: resection of the radial head; intramedullary nailing of the ulna. Result 1 year later: flexion-extension, 160°-70°; almost complete pro-supination.

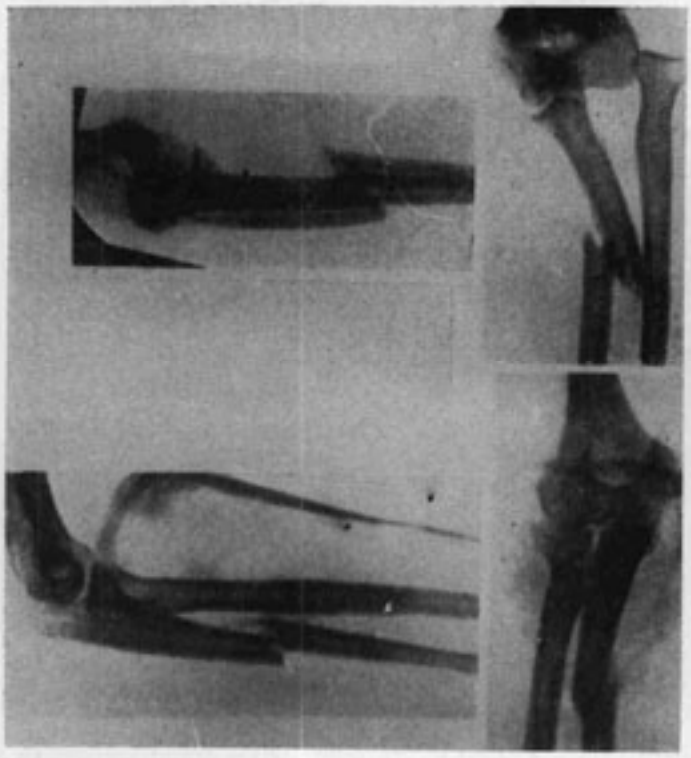


FIG. 21. Monteggia Lesion, Type 2. (*Top*) Immediately after injury. (*Bottom*) After reduction by manipulation.

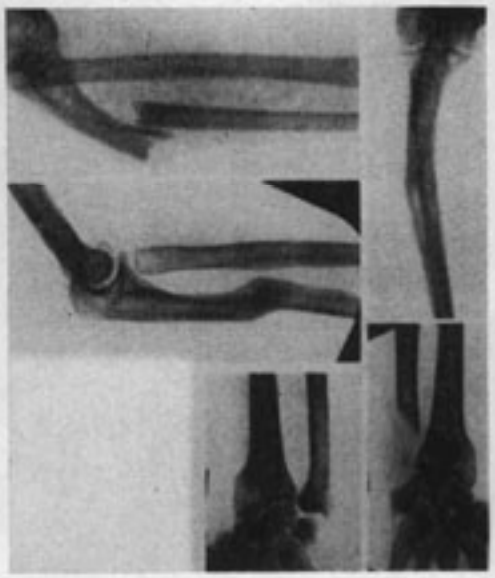


FIG. 22. Monteggia Lesion, Type 2. Man, 42 years old. Fracture of the ulnar shaft; posterior angulation. Posterior dislocation of the radial head with open fracture. Open reduction of the ulnar fracture; resection of the radial head. Dislocation of the distal radio-ulnar joint. Resection of the distal end of the ulna. Result: flexion-extension of the elbow 165°-65°; prosupination 50%.

2. **Roentgenographic Proof.** In lateral views of Type 1, the biceptical tuberosity of the radius is posterior (Fig. 5), indicating full pronation. In full supination the tuberosity would be anterior (Fig. 3).

The wrist will show also pronation on roentgenograms. The radius is shorter than the ulna in full pronation.

3. **Therapeutic Proof.** This evidence, because of its usefulness, is the most important. Supination and slight traction are capable of reducing this displacement very easily.

SIGNS AND SYMPTOMS

Clinically, this type of fracture-dislocation reveals itself by pain, functional incapacity of the elbow and a characteristic deformity. The forearm and the hand remain in a fixed attitude of pronation, active motion being impossible. Passive attempts to modify this attitude are met with firm resistance and intense pain. There is a tumefaction at the level of the ulnar fracture and a filling of the anterior aspect of the elbow caused by the anterior disloca-

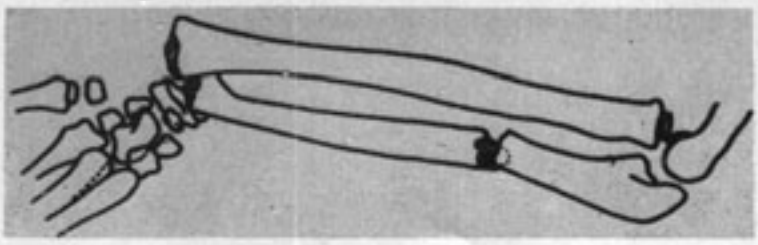
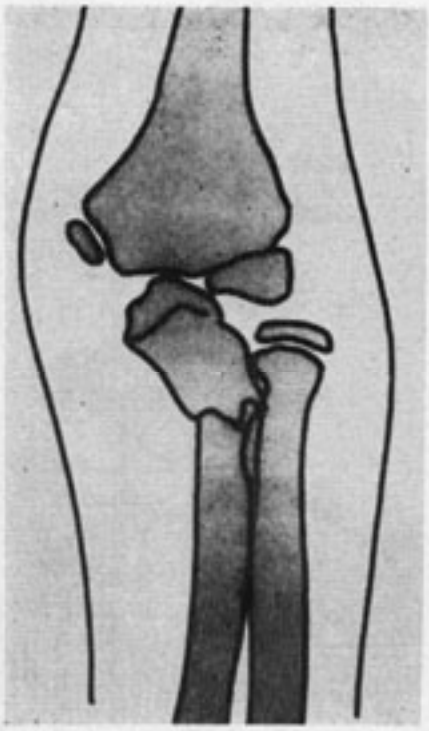


FIG. 23. In the Monteggia Lesion, Types 1 and 2, injuries of the wrist occur frequently.



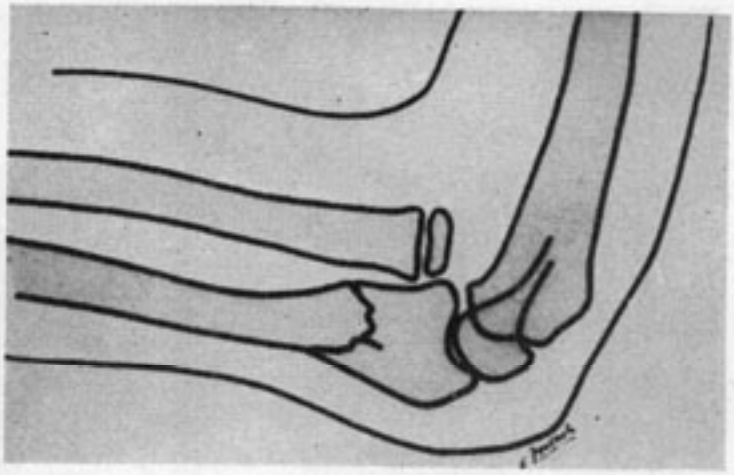


FIG. 24. Monteggia Lesion, Type 3. Fracture of the ulnar metaphysis and lateral dislocation of the radial head. Radial nerve paralysis is very frequent.

tion of the radial head. Movements at the elbow joint are almost impossible and extremely painful. Exposure of the ulnar fracture is generally seen through an *anterior* wound.

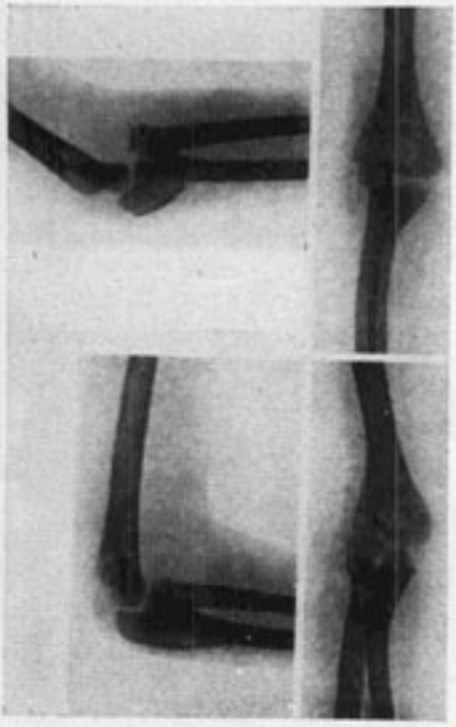


FIG. 25. Monteggia Lesion, Type 3. Boy, 3 years old. Reduction by manipulation. Result: 100% successful.

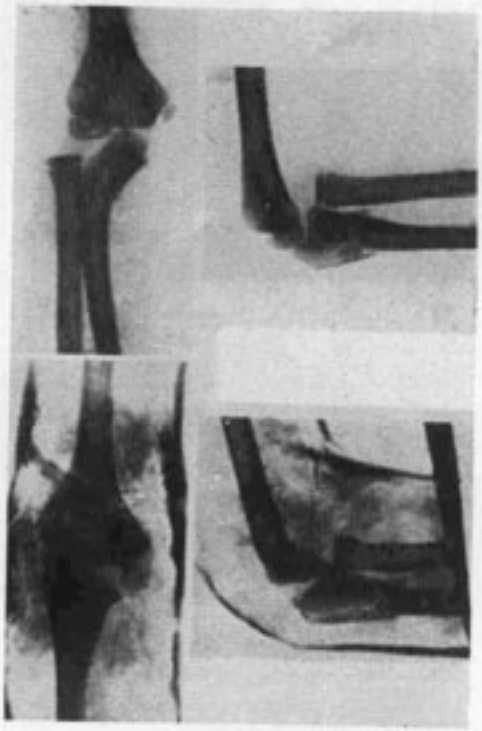


FIG. 26. Monteggia Lesion, Type 3. Boy, 9 years old. Reduction by manipulation. Result: 100% successful.

FIG. 27. (*Left*) Severe lateral dislocation of the radial head and fractures of the ulnar shaft. Intermediary type between 1 and 3. (*Right*) Corrected by supination treatment. After 6 months there was full function.

The roentgenologic aspect of this form is typical. The ulnar fracture can be seen at the proximal or middle third, with anterior *angulation*. The dislocation of the radial head is anterior, and the radius presents itself in full pronation; in the lateral view, the bicipital tuberosity is facing posteriorly. In the roentgenogram of the wrist, which is always necessary to study in this type of injury because of the frequency of associated lesions, the distal extremity of the radius and of the ulna are at the same level, indicating full pronation.

TREATMENT

The treatment usually is conservative. It could be said that *in fresh cases, it always is conservative* for the dislocation of the radius and in general for the fracture of the ulna. Sometimes, the fracture requires an *open reduction with intramedullary nailing*.

The reduction is obtained by maneuvers in an opposite direction to the producing mechanism; *i.e.*, in a *forced pronation* a gentle traction through the long axis of the forearm and supination. The latter movement is what actually corrects the anterior dislocation of the radial head and the deviation of the ulnar fracture (Figs. 6, 7, 8, 9, 10).

In children and in fresh cases it is so easy to obtain the reduction that we *use no anesthesia*. In old cases or in adults it is convenient to manipulate under general anesthesia.

The elbow is immobilized at 90° in a plaster cast with the forearm in moderate supination. The period of immobilization varies according to the age of the patient (for a child, 6 to 8 weeks is enough; then the plaster cast is removed, and physiotherapy done for 4 to 6 weeks). The period of immobilization in the adult is longer with an ulnar fracture, taking from 8 to 10 weeks.

RESULTS

Until December, 1965, we had treated

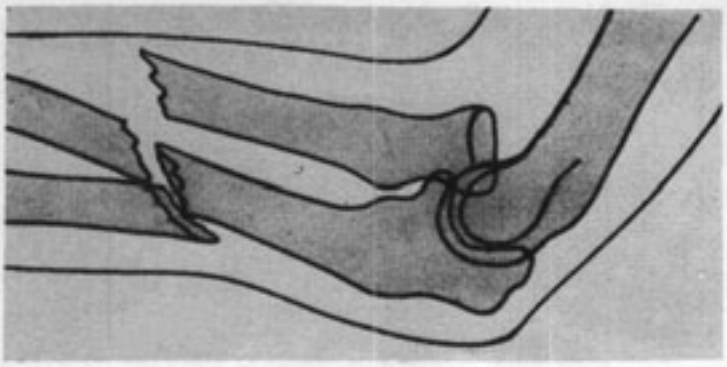


FIG. 28. Monteggia Lesion, Type 4. Fracture of the ulnar shaft, fracture of the radial shaft and anterior dislocation of the radial head.

40 cases of this type of Monteggia lesions —22 adults and 18 children. Most of them are very recent. The treatment we have advised for these cases always has given satisfactory results. The dislocation does not recur, the fracture site consolidates, movement of the elbow is complete after a period of from 8 to 10 weeks.

Results have been *excellent* in the child. A discrete limitation of flexion extension can be observed in the adult. We have had to make a secondary surgical reduction of the ulna by replacing a Kirschner wire in 2 cases. An anterior approach to the forearm produced no wound complications. With this experience, we can certify that the Monteggia lesion, Type 1, must be dealt with by conservative treatment in supination and that this treatment is the most rational one based on the physiopathology and the mechanism of production.

In old or unreducible fractures, it will be necessary to resort to open reduction. We believe that, in such cases, the technics described by Boyd[2] should be applied. We have had no opportunity to do this.

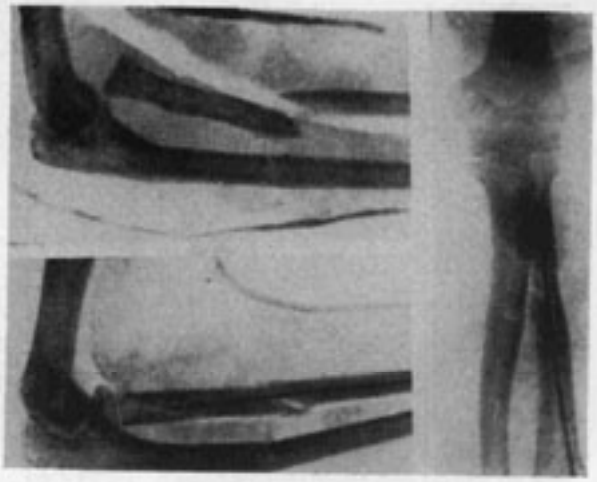


FIG. 29. Monteggia Lesion, Type 4. Man, 30 years old. Open reduction of the radial fracture. The radial head dislocation was reduced before the radial fracture with supination of the proximal fragment. Intramedullary nailing (Kirschner) in the radius. The ulnar shaft fracture was without displacement. Very good result; full prosupination after 6 years.

EQUIVALENTS OF THE MONTEGGIA LESION, TYPE 1

These equivalents have been enumerated previously. Most of them acknowledge *"rotation"* as the production mechanism. Treatment is again with traction and supination.

In fractures of the radius and of the ulna associated with a posterior dislocation of the elbow, it is necessary to reduce the dislocation in the usual manner; then a rotation movement in supination will be very useful in reducing the radial or ulnar fracture.

The "pulled elbow syndrome" (Fig. 18) has been known from the reports of Denis Fournier (1871) and Duverney since the middle of the 18th century. The latter described it with its characteristic sign: forearm in an attitude of pronation and impossibility to supinate, in children under 5 years of age. The accident appears when a child held by the hand is raised suddenly and roughly. From the clinical point of view, pain is noticed with a depression under the *humeral condyle*.

Many hypotheses have been brought forth to explain this situation. Nothing was left to incriminate: the bicipital tuberosity of the radius which hooks in the lateral border of the ulna (Gartner-Fèvre); the displacement of the triangular ligament in the distal radio-ulnar articulation (Tillaux); pinching of a synovial fold; the vertical and distal subluxation of the head of the radius; the posterior subluxation (Nélation); the radicular paralysis (Bessey), etc. The list is interminable. Nevertheless, it was known that a simple maneuver of slow and progressive supination with traction brought everything in order.

There can be no possible doubt now that the trauma which provokes this so-well-known syndrome is *a forced pronation*. The body of the child rotates, rolls, while the member is held fixed by its distal extremity.

FIG. 30. Monteggia Lesion, Type 4. Man, 28 years old. Severe fracture of shaft of both radius and ulna with displacement. Anterior dislocation of the radial head. Open reduction of the radial fracture and reduction of dislocation with supination of the proximal fragment. Good reduction of the ulnar fracture. Follow-up: 1 year. Good reduction of the ulnar fracture. Very good clinical result.

At first, it was supposed that the only mechanism of production was the upward traction on the child's hand, explaining the Anglo-Saxon designation of "pulled elbow syndrome." Children *falling from their height on the hand* thus repeat the mechanism of the fall which leads, in older children, to the "Monteggia lesion," Type 1. There is no doubt that the trauma in pronation, in one way or another, provokes *"anterior subluxation"* of the radial head.

We recommend the substitution of the words "pulled elbow syndrome" by "anterior isolated subluxation of the radial head" of the child or "rotation syndrome" which is nearer the physiopathologic truth. *Its mechanism is pronation,* and the treatment is supination as in the Monteggia lesion, Type 1.

MONTEGGIA LESION, TYPE 2

The characteristic feature in this type is a fracture of the middle or the proximal third of the ulnar shaft associated with a *subsequent* dislocation of the radial head (Fig. 19). It is a rather infrequent type and occurs exclusively in adults (15%). In the mechanism of production there is a direct and rotational force—"supination."

The clinical picture consists of pain, functional blocking of the elbow joint and a characteristic deformity; posterior angulation at the ulnar fracture; the radial head dislocates itself posterior and distal to the humeral condyle. This dislocated radial head (often fractured) frequently perforates the skin in the posterolateral aspect of the elbow joint. When the ulnar fracture is an open one, the wound is in the posterior aspect of the forearm. The roentgenologic picture is typical: there is a *posterior* dislocation of the radial head and often a fracture of the ulna with posterior angulation (Figs. 20, 21, 22).

In the Monteggia lesion, Type 2, the prognosis is not as good as in Type 1. At best, the results are only fair.

The treatment differs fundamentally from that of Type 1 lesions. When the disloca-

tion of the radial head is closed and there is no fracture, one can and must try the conservative treatment. With the elbow joint in 90° flexion, gentle traction and *pronation* are applied. These maneuvers usually reduce the dislocation. If after reducing the radial head dislocation the ulnar fracture is not reduced satisfactorily, an open reduction with intramedullary nailing is advisable some days later. When the dislocation of the radial head is open, the usual treatment of the wound should be accompanied by resection of the proximal radial epiphysis (*very often fractured*).

In this type of Monteggia lesion there *very frequently co-exists a lesion at the wrist* (Fig. 23).

MONTEGGIA LESION, TYPE 3

The characteristic feature in this type is an association of a fracture of the proximal ulnar *metaphysis* with a *lateral dislocation* of the radial head (Fig. 24). It occurs exclusively in children. The clinical picture is that of an evident deformity with an increased transverse diameter of the elbow joint. One may observe and feel with the finger the lateral dislocation of the radial head and on the posterior aspect of the forearm, and one can understand the lateral angulation of the ulnar fracture.

The elbow presents itself in semiflexion and the forearm in neutral prosupination. There is a functional blocking of the elbow, and pain follows.

Sometimes a radial paralysis occurs which disappears spontaneously within 6 or 8 weeks after reduction.

The mechanism of production is a direct trauma over the inner aspect of the elbow, with or without rotation.

One case (Fig. 27) is intermediary between the Monteggia Types 1 and 3. It was reduced through maneuvers of rotation without anesthesia.

The roentgenologic aspect shows two fundamental features: the metaphyseal fracture of the ulna just below the coronoid process with lateral angulation and the lateral dislocation of the radial head (Figs. 25, 26). Treatment is always conservative: reduction by gentle manipulations. The prognosis of this form is good: there is always complete recovery.

MONTEGGIA LESION, TYPE 4

The characteristic feature in this type is a *fracture* of the middle or proximal third of the ulnar shaft and *anterior dislocation* of the radial head (like Type 1) with a *fracture* of the middle third of the radial shaft (Fig. 28).

This type could be interpreted as an association of Type 1 and a fracture of the radial shaft. The radial shaft fracture warrants special handling during reduction. Permanent disability is possible with improper treatment. These are rather infrequent lesions (5%) and are found exclusively in adults. Clinical diagnosis is difficult because of the complex association of injuries, all simulating Type 1.

The treatment of Type 4 lesions is surgical. Open reduction of the anterior dislocation of the radial head is accomplished with supination of the proximal radius, thus reducing the anterior dislocation. Bringing the distal fragment to the fracture site with a tenaculum reduces the radial shaft fracture. Intramedullary nailing must be used to secure this last reduction. The same is done with the ulnar fracture, if reduction proves to be impossible by manipulation. Figures 29 and 30 show 2 cases of this type.

CONCLUSION

Monteggia's fracture is not a simple, isolated lesion. It occurs at all ages in children and has a very particular clinical picture that is sometimes referred to as "the pulled elbow syndrome."

Excessive rotation, a very common mechanism of injury in elbow and forearm trauma, often is not given proper consideration in the choice of the method of reduction and immobilization.

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