Type IV Monteggia fracture in a cat

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Case Report

Type IV Monteggia fractures are very rare in veterinary medicine and only a few case reports have been published (1, 2). Four types of Monteggia fractures have been described (3). Type I is the most common in humans and animals, and type IV is rare. The case described in this report is a cat with an atypical type IV Monteggia fracture with cranio-lateral dislocation of the radial head and considerable displacement of the proximal fragment of the radius.

Introduction

Monteggia fractures are fractures of the proximal third of the ulnar diaphysis associated with dislocation of the radial head. They are rare in veterinary medicine and only a few case reports have been published (1, 2). Four types of Monteggia fractures have been described (3). Type I is the most common in humans and animals, and type IV is rare. The case described in this report is a cat with an atypical type IV Monteggia fracture with cranio-lateral dislocation of the radial head and considerable displacement of the proximal fragment of the radius.

Case report

A one-year-old, intact, male, European cat was referred to our clinic for surgical treatment of an open fracture of the radius and ulna after being bitten by a dog 24 hours earlier. The referring veterinary practitioner had applied two skin staples after premedication with acepromazine (0.05 mg/kg, i.v.) and morphine chlorhydate (0.2 mg/kg, i.v.), anaesthesia was induced with thiopental (10 mg/kg, i.v.) and maintained with isoflurane in oxygen.

Treatment with cephalexin (30 mg/kg, i.v.) was continued. Ringer lactate was administered intravenously at a rate of 5 ml/kg/hour during surgery. The cat was placed in lateral recumbency. The left forelimb was prepared for aseptic surgery. Initial surgical treatment involved debridement of all necrotic soft tissues, followed by high volume irrigation with a 0.9% isotonic NaCl solution.

The radius and ulna were exposed by a cranial approach. The subcutaneous fat and superficial antebrachial fascia were incised on the same line. On retracting the skin margins, the distal part of the proximal fragment of the radius could be seen through the deep antebrachial fascia on the cranial part of the incision, between the extensor carpi radialis muscle and the flexor carpi radialis muscle. A one-year-old neutered male cat was referred for a grade II A open radius and ulna fracture. The mid-diaphyseal radial and ulnar fractures were associated with lateral radioulnar and radio-ulnar dislocations. From these abnormalities, a diagnosis of type IV Monteggia fracture was made. The annular ligament was found to be intact on examination and the radial head was correctly positioned and stable after fracture reduction and plate fixation. Eighteen months postoperatively, the cat did not exhibit any signs of lameness or any signs of pain on palpation and mobilisation. Signs of mild osteoarthritis were present on radiographs.

Type IV Monteggia fractures are very rare in animals. The combination of a radial head dislocation with an intact annular ligament is uncommon. This pattern allowed a single reconstruction with two plates without a radio-ulnar screw.

Keywords
Radius, ulna, fracture, cat, Monteggia

Summary
A one-year-old neutered male cat was referred for a grade II A open radius and ulna fracture. The mid-diaphyseal radial and ulnar fractures were associated with lateral radioulnar and radio-ulnar dislocations. From these abnormalities, a diagnosis of type IV Monteggia fracture was made. The annular ligament was found to be intact on examination and the radial head was correctly positioned and stable after fracture reduction and plate fixation. Eighteen months postoperatively, the cat did not exhibit any signs of lameness or any signs of pain on palpation and mobilisation. Signs of mild osteoarthritis were present on radiographs.

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References
1. Bado’s classification, this injury was an open type IV Monteggia fracture (3).
2. Moreover, according to Gustilo’s classification, this fracture with considerable soft tissue damage but adequate soft tissue coverage of the fractured bones, would be classified as a type III A open fracture (4–7).
3. After premedication with acepromazine (0.05 mg/kg, i.v.) and morphine chlorhydate (0.2 mg/kg, i.v.), anaesthesia was induced with thiopental (10 mg/kg, i.v.) and maintained with isoflurane in oxygen.
4. Treatment with cephalexin (30 mg/kg, i.v.) was continued. Ringer lactate was administered intravenously at a rate of 5 ml/kg/hour during surgery. The cat was placed in lateral recumbency. The left forelimb was prepared for aseptic surgery. Initial surgical treatment involved debridement of all necrotic soft tissues, followed by high volume irrigation with a 0.9% isotonic NaCl solution.
5. The radius and ulna were exposed by a lateral surgical approach. The subcutaneous fat and superficial antebrachial fascia were incised on the same line. On retracting the skin margins, the distal part of the proximal fragment of the radius could be seen through the deep antebrachial fascia on the cranial part of the incision, between the extensor carpi radialis muscle and the flexor carpi radialis muscle.
I. Irubetagoyena et al.: Type IV Monteggia fracture in a cat

and the common digital extensor muscles. The dislocated radial head was exposed by careful dissection between the common digital extensor and the lateral digital extensor muscles.

The diaphyseal fracture of the ulna was identified, reduced and temporarily stabilized with small pointed reduction forceps. The uninjured annular ligament and ulnar portion of the collateral lateral ligament were identified by partially elevating the anconeus muscle. The space beneath the annular ligament was cleaned of blood clots, fibrin and soft tissue.

The radial head could be repositioned beneath the annular ligament fairly easily under direct visualization. The radial fracture was reduced with small pointed reduction forceps. The elbow could be mobilized in flexion, extension and rotation, with good stability of the radial head.

Using the AO principles, the fracture of the radius was definitively stabilized with a craniolateral eight-hole 2.0 dynamic compression plate with seven cortical screws and the fracture of the ulna with a lateral eight-hole 2.0 dynamic compression plate with six cortical screws. The radial plate was applied in compression and the ulnar plate in bridging fashion. The surgical wound was closed routinely.

Postoperative radiographs showed good reduction of the radial fracture and an incomplete reduction of the ulnar fracture (Fig. 2A and 2B).

Firocoxib (5 mg/kg, p.o., s.i.d.) was administered postoperatively for six days and cephalexin (30 mg/kg, p.o., b.i.d.) for 15 days. The cat’s activity was restricted for eight weeks. Clinical and radiographic re-evaluations were performed at two, four, and eight weeks, and 18 months after surgery. During the follow-up period, the owner was also contacted by telephone six months after surgery. The cat walked without any visible signs of lameness after four weeks. Mobilization of the elbow in flexion and extension, compared to that of the contralateral elbow, was normal and appeared to be pain free. Eight weeks after surgery, the radiographs showed satisfactory healing of the radius and ulna and an osseous proliferation between the radius and ulna without complete synostosis (Fig. 3A and 3B). The owners reported that there were not any signs of pain or lameness of the left forelimb six months after surgery. Eighteen months after surgery, the cat walked normally and without lameness. The joint mobilization was pain free and the range-of-motion in flexion and extension was similar to the contralateral limb. However, radiographs showed a complete radio-ulnar synostosis (Fig. 4A and 4B).

Discussion

In 1814, Giovanni Monteggia first described a “fracture of the proximal third of the ulna and an anterior dislocation of the proximal epiphysis of the radius” in humans. Bado classified this Monteggia lesion into four types in 1967 (3):

- **Type I**: Cranial radial head dislocation and ulnar diaphysis fracture with cranial angulation.
- **Type II**: Caudal radial head dislocation and ulnar diaphysis fracture with cranial angulation.
- **Type III**: Lateral or craniolateral radial head dislocation and ulnar diaphysis fracture.
- **Type IV**: Cranial radial head dislocation associated with ulnar and radial diaphysis fracture.

Monteggia fractures are rare in humans, representing about 0.7% of elbow fractures and dislocations and 7% of fractures of the radius and ulna (1). This fracture is also rare in animals and is usually the result of motor vehicle trauma in dogs and falls in cats (1, 8–13). It is therefore frequently associated with other lesions such as pneumothorax, wounds, or other orthopaedic injuries. The most common Monteggia fracture reported in animals is a type I fracture. Type IV fractures are rare, representing 3.5% to 11.8% of the Monteggia fractures cited in veterinary literature reviews (1, 2).

In this clinical case, the cat had been bitten by a dog and had sustained a fracture...
of the ulna and radius with dislocation of the radial head. The head of the radius was dislocated laterally. The proximal bone fragment of the radius had been considerably displaced, probably due to trauma linked to the dog bite. Thus, in Bado's classification, this would be a type IV Monteggia fracture (3). Only one other report of a type IV Monteggia fracture involving a dog bite has been published (12).

Canine and feline elbows have similar gross anatomy despite the absence of a strong interosseous ligament between the radius and ulna in the cat (14–16). Humeral radial stability is ensured by the joint capsule, medial and lateral collateral ligaments and the annular ligament of the radius. The lateral and medial collateral ligaments are attached proximally to the lateral and medial humeral epicondyles respectively, and both collateral ligaments divide distally into two crura, one radial and the other ulnar. The annular ligament of the radius encircles the radial head and is attached to the lateral and medial extremities of the radial incisure of the ulna and to the humeral epicondyle on the lateral side (16).

The radius and ulna are proximally united by the radio-ulnar joint and by the interosseous membrane. Usually, in Monteggia fractures, the annular ligament is torn and the interosseous membrane may be injured (17). The goals of treatment are fixation of the ulnar fracture and functional restoration of the annular ligament. Reduction and internal fixation of the fracture is achieved by using plates and screws, pins or Kirschner wires and figure-of-eight tension bands (16–19). Suturing of the annular ligament has been described, but in most cases suture reconstruction is not feasible or does not produce good results (17, 18). If the annular ligament cannot be reconstructed the radial head has to be immobilized against the ulna. This fixation is preferably achieved with screws placed between the ulna and radius in a caudocranial position. These screws have to be removed three or four weeks after surgery to allow the return of normal motion of the radius and ulna (16, 18).

In the case described here, displacement of the proximal radial fragment revealed a lesion of the interosseous membrane. Inspection of the proximal ulna revealed that the annular ligament and ulnar crus of the lateral collateral ligament were intact. Unusually, the radial head dislocation had occurred by sliding under the intact annular ligament. Movement of the elbow was assessed after repositioning the radial head beneath the annular ligament and temporary fixation of the radial and ulnar fractures with forceps. Flexion and extension of the elbow and pronation and supination of the antebrachium did not induce any abnormal movement of the radial head. Thus, it was decided to not use a proximal radio-ulnar screw to fix the radio-ulnar joint. Indeed, screw fixation of the radio-ulnar joint prevents pronation and supination movements, which are important in cats, and may lead to further lameness (17, 18). In this report, the fracture was an open fracture classified as a type IIIA open fracture (6). As indicated in the literature, a large percentage of fractures of the radius and ulna are open fractures because of the limited covering of soft tissue (17, 18). Treatment consists of meticulous debridement, high volume irrigation and stable osteosynthesis associated with antibiotic drug administration (20, 21). Application of a plate on the radius, in conjunction with intra-medullary pinning of the ulna is described in cats and dogs (22, 23). We preferred to use two plates to maximize fracture stability, which is fundamental when treating open fractures (6, 21). The incorrect reduction and plating of the ulna were essentially associated with caudal displacement of the distal fragment of the ulna, which did not induce elbow incongruity. Possible elbow incongruity could have been prevented by dynamic fixation of the ulnar fracture with one or two intramedullary pins. However, use of this technique has been associated with triceps tendon irritation in dogs (23). Cephalexin administration was stopped after 15 days because no clinical or radiographic signs of osteomyelitis were observed.

Radiographs obtained two months (Fig. 3A and 3B) and 18 months postoperatively (Fig. 4A and 4B) revealed the development of signs of mild osteoarthritis. Complete radio-ulnar synostosis was identified on the radiographic follow-up at

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eighteen months postoperatively, despite the absence of radio-ulnar screw. Development of the synostosis was probably linked to interosseous membrane rupture and periosteal trauma. However, this synostosis was not associated with lameness as reported by the owner and observed during clinical examination.

A high rate of complications is reported in the literature after surgical treatment of Monteggia fracture in humans with elbow osteoarthritis, neurological lesions, and significant impairment of joint motion being the most common occurring complications (1). However, neurological lesions are apparently rare in animals and good to excellent function is usually observed during follow-up. In this case, there were not any abnormalities observed during the clinical examination, 18 months after surgery. We speculate that the absence of lesions of the annular ligament and the decision to not use a proximal radio-ulnar screw probably facilitated recovery and minimized potential complications in this case. The outcome in this unusual case of type IV Monteggia fracture suggests that other cases could be treated successfully by plating the radius and ulna provided that the annular ligament is undamaged.

**Conflict of interest**

None declared.

**References**