Use of intramedullary pin for humeral fracture repair in a *Chamaeleo chamaeleon*

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Abstract. A common chameleon (*Chamaeleo chamaeleon*) with a humeral fracture was treated by internal fixation with a retrograde approach under general anesthesia. The intramedullary pin from a 22 gauge hypodermic needle allowed the two humeral fragments to juxtapose and the oblique shape of the fracture prevented rotation. After three months a cartilaginous callus was formed therefore the implant was removed.

Keywords: *Chamaeleo chamaeleon*, intramedullary pin, humeral fracture, internal fixation.

INTRODUCTION

Mediterranean chameleons or common chameleons (*Chamaeleo chamaeleon*) are widespread in Europe, Africa and Asia. This species is sexually dimorphic: only males have a protrusion on their hind heels, with females often being larger than males. Although it is an endemic species, chameleon is no longer seen in the wild in Sicily, and they are highly protected by the Convention on International Trade of Endangered Species and Convention of Bern. It is strictly forbidden to keep them in captivity. Unfortunately in several North African countries such animals are commonly sold to tourists and then illegally imported to Italy.

CLINICHAL CASE

An adult female of common chameleon (*Chamaeleo chamaeleon*) was referred to the veterinary center "Centro Veterinario per Animali Esotici" (Palermo, Italy) by the authorities, because it was found in Mazzara del Vallo (TP) near the urban center.

Considering that there are many harbors on the Sicilian coast, and this animal was found near an urban area was suspected that it could have escaped from an indoor terrarium where it was illegally kept. On clinical examination it was noticed that the patient was in very poor condition and the right front limb appeared fractured. Radiography showed an oblique fracture of the metaphisis of the left humerus (fig. 1). Morever a cloacal wash for a coprological exam was performed; using a a magnification of 40x *Examita sp*. and *Eimeria* were observed. Coccids were treated with single dose administration of toltrazuril (Bayer) 5mg/kg per os and flagellates with metronidazole (Zambon) 50mg/kg per os q24 h for 5 days.

Force feeding and fluid therapy were administered orally for supportive care before osteosinthesis. After few days the chameleon was premedicated with butorphanol (Intervet) at 0.2mg/kg intramuscularly and then anesthesia was induced with alphaxalone (Vétoquinol) at

Fig. 1 – Radiographic dorsoventral projection of the scapula-humeral joint of an awake common chameleon. This view showed an oblique fracture of the metaphisis of the left humerus.

5mg/kg administered intramuscularly. It was intubated with a 20 gauge blood catheter used as tracheotube and anesthesia was maintained with a mix of oxygen at 0.5L/min and isoflurane (Esteve) at 3%; lidocaine chlorohydrate 2% (Esteve) with dose of 1mg/kg was injected over the surgical incision to alleviate the discomfort associated to the manipulation of bone fragments during the surgical procedure.

After disinfection of the surgical field with a clorexidine 4% solution (ICF) the skin was incised over the elbow to approach the distal epiphisis of the humerus. An intramedullary pin created by a 22 gauge hypodermic needle was inserted normograde in the medulla while the proximal fragment of the humerus was aligned. An x-ray showed that proper contact of the two bone fragments was not achieved (fig. 2). For this reason the intramedullary pin was removed and a retrograde approach was performed instead. Again skin over the fracture was disinfected and lidocaine was injected before cutting the skin and dissecting the muscles to isolate the proximal portion of the humerus. Another hypodermic needle was pushed into the medulla until it passed the cortex of the humerus, muscles and skin of the shoulder. Once the distal portion of the humerus was isolated the attachment of the needle was cut and the needle was pushed backwards into the medulla of the distal part of the humerus to allow the two portions of the bone to meet thereby reducing the fracture.

The external part of the needle over the shoulder was turned over the skin and the surgical incision was closed using a mattress suture. An x-ray after surgery confirmed both the correct position of the needle and the fracture reduction (fig. 3). An epoxy resin was placed over

Fig. 2 – Radiographic dorsoventral projection of the scapula-humeral joint of a common chameleon under general anesthesia; note the improper contact between the two bone fragments by the use of a intramedullary pin with a normograde approach.

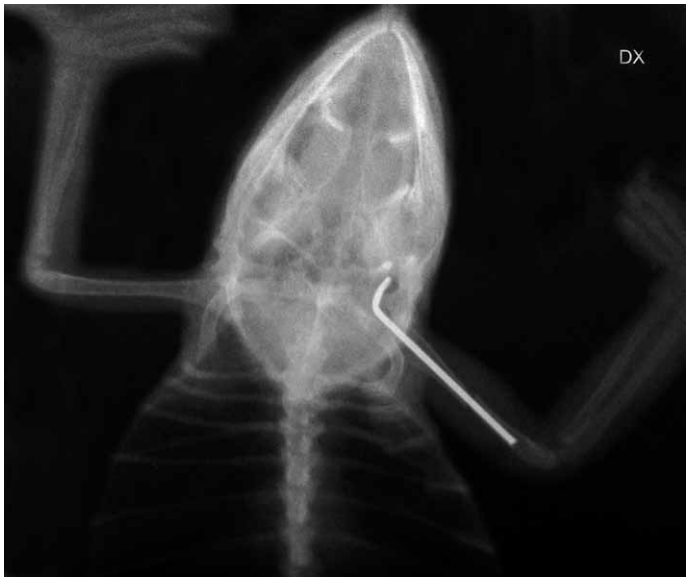

Fig. 3 – Radiographic dorsoventral projection of the scapula-humeral joint of a common chameleon under general anesthesia. This view showed the correct position of the intramedullary pin in the humerus achieving proper contact between the two humeral fragments.

the external part of the intramedullary pin to protect the skin of the shoulder and to maintain it in place by limiting the rotation forces (fig. 4).

Surgical recovery was uneventful and the chameleon began to use the leg immediately. Post-operative therapy consisted of 5mg/kg of enrofloxacin (Bayer) administered orally every 24 hours for 10 days and 0.2mg/kg of meloxicam (Boehrìnger) administered orally for 5 days. The follow-up at 7 and 30 days was uneventful. An x-ray performed three months after surgery showed the beginning of a cartilage callus (fig. 5). The increase in cartilage formation results in a larger callus which provides stability sooner than would be expected if using mammalian parameters for radiographic interpretation of fracture healing (Raftery 2001). At that time, both the epoxy resin and the intramedullary pin were removed under general anesthesia induced with buthorfanol 0.5mg/kg and alfaxan 5mg/kg IM. Three months later hence an x-ray confirmed the formation of proper exuberant bone callus (fig. 6) that was visible even from the exterior as a firm enlargement of the humerus over the fracture site (fig. 7).

DISCUSSION

The principles of fracture repair in reptiles are similar to those described for domestic species but anatomical, physiological and behavioral particularities must be considered. An external coaptation is a rapid, simple and inexpensive technique to stabilize fractured rear or front limbs in lightweight reptiles. In such cases affected limbs should be immobilized against the body/tail (Divers 2004, Mader 2006, Alworth 2011, Raftery 2011). Most lizards stand relatively flat or low and use abdominal undulation as an aid to locomotion, allowing them to

Fig. 4 – Detail of the epoxy resin placed over the distal portion of the intramedullary pin to protect the skin of the shoulder and maintain it in place to limit the rotational forces.

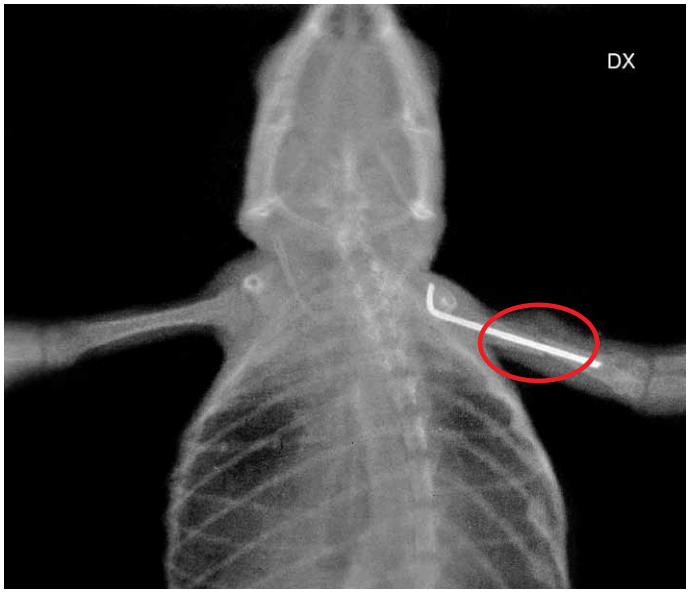

Fig. 5 – Radiographic dorsoventral projection of the scapula-humeral joint of a common chameleon three months after surgery showed the cartilage callus formation (red circle) over the fracture site.

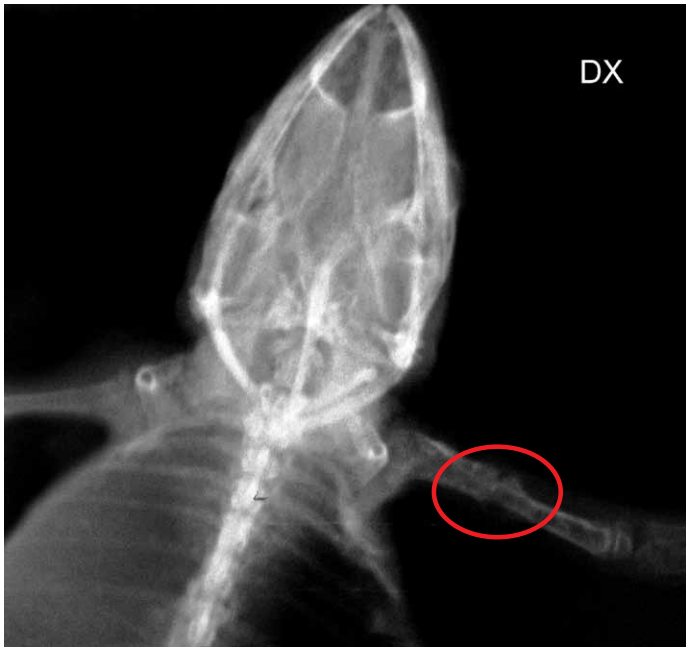

Fig 6 – Radiographic dorsoventral projection of the scapula-humeral joint of a common chameleon six months after surgery confirmed the formation of proper exuberant bone callus (red circle).

Fig. 7 – Detail from the exterior of the enlargement of the humerus due to the formation of proper exuberant bone callus.

ambulate even with this type of device (Mader 2006). This is not the case with chameleons. Unfortunately in the case of humerus and femur fractures the scapula-humeral movement and coxofemoral joints affect the healing process (Divers 2004, Mader 2006, Alworth 2011). Therefore, the above mentioned technique is not suitable for unstable fractures because the rotational forces applied to the fractures may delay healing (Raftery 2011). To prevent that risk the inclusion of a splint between limb and body or tail can be added (Mitchell 2002, Divers 2004, Alworth 2011) and the bandage should cross over the pelvic or pectoral girdle to the opposite limb, thereby stabilizing the hip or shoulder joint and achieving the goal of immobilizing the joint proximal and distal to the fracture (Mitchell 2002, Mader 2006, Raftery 2011). The major disadvantage of this technique is the risk of a decreased range of motion in the immobilized joint from periarticular fibrosis because it was immobilized in extension and traction for a long period (Mader 2006). For this reason the bandages should be regularly removed to prevent additional joint complications and tendon contracture (Mitchell 2002). Whenever possible, the limb should be splinted in normal gait position, so if a limited range of motion results after coaptation, the patient may be still able to ambulate (Mader 2006). In chameleons it is very hard to cast a front limb without affecting the normal locomotion and for this reason this possibility was rejected.

An external fixation inserting one or more pins in each bone fragment would be really challenging, considering the size of the humerus of this patient. A mono-lateral external fixation (Type 1) could be unstable and a bi-lateral one would cause a skin wound in the underarm caused by the connection bar.

The fracture was oblique and that ensured the two portions of the humerus didn't rotate over the intramedullary pin. Moreover rotational forces at the fracture site are less of a problem in this reptiles because of their relatively slow movement. Muscles and tendons, if not damaged, can act to counter any rotational force, which is usually helpful in fracture stabilization and healing (Raftery 2011). The epoxy resin placed over the distal portion of the intramedullary pin to protect the skin of the shoulder helped maintain it in place limiting the rotation forces.

RIASSUNTO

Osteosintesi di una frattura dell'omero in un *Chamaeleo chamaeleon* mediante un chiodo intra-midollare

Un camaleonte comune (*Chamaeleo chamaeleon*) ritrovato a Mazzara del Vallo (TP) è stato portato dalle autorità competenti presso il Centro Veterinario per Animali Esotici (PA) per valutarne lo stato di salute. Durante la visita clinica si è notato che il camaleonte risparmiava l'arto anteriore sinistro. L'esame radiografico ha mostrato una frattura obliqua della metafisi dell'ulna. L'osteosintesi è stata eseguita mediante fissazione interna usando un ago da 22 gauge come chiodo centro midollare inserendolo in direzione retrograda. Il chiodo centro midollare è stato sufficiente a garantire l'approssimazione dei due monconi ossei ed ad impedire la rotazione, garantendo la formazione di una callo cartilagineo in soli 3 mesi. Le diverse tecniche di immobilizzazione esterna, suggerite in letteratura, avrebbero impedito la locomozione normale in un camaleonte durante la convalescenza. Inoltre queste ultime, diversamente da quanto accade con la fissazione interna o esterna, sarebbero potute risultare in una immobilizzazione sub-ottimale, rallentando considerevolmente i tempi di cicatrizzazione e aumentando il rischio di eventuali artrosi a carico delle articolazioni prossimali e distali. Una fissazione esterna è stata scartata per le dimensioni dell'animale e dei due frammenti omerali in particolare. Si ricorda inoltre che quando la frattura interessa la porzione prossimale dell'arto, come nel caso in questione, non è possibile eseguire un impianto bilaterale ed è pertanto necessario optare per un impianto monolaterale che risulta meno stabile del precedente.

REFERENCES

Alworth, L. C., Hernandez, S. M. & Divers, S. J. (2011). Laboratory Reptile Surgery: Principles and Application. J Am Assoc Lab Anim Sci. **50** (1): 11-26.

Giandomenico, L. (2010). *Chamaleo chamaleon*. In: Brunetti L., Giandomenico L., Millefanti M. I Camaleonti di montagna, di pianura e nani, De Vecchi Editore, 82 pp.

Hernandez-Divers S. J. (2004). Surgery: principles and techniques In: Girling S. J., Raiti P. BSAVA Manual of Reptiles 2nd ed, BSAVA, 147-167.

Mader, D. R., Bennet, R. A., Funk, R. S., Fitzgerald, K. T., Vera, R. & Hernandez-Divers, S. J. (2006). Surgery. In: Mader. D. R. Reptiles Medicine and Surgery 2nd ed., St. Louise, Missouri, Saunders-Elsevier, 581-630.

Mitchell M. (2002). Diagnosis and management of reptile orthopedic injuries. Vet Clin North Am Exot Anim Pract, **5**(1), 97-114.

Raftery A. (2011). Reptile Orthopedic Medicine and Surgery. J Exot Pet Med **20** (2): 107-116.