

## **Repair of radial and ulnar fracture in a sparrowhawk (*Accipiter nisus*) using external coaptation: A case report**

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### **Abstract**

A 10 months old male sparrowhawk with open antebrachium fracture was referred to the Veterinary Teaching Hospital of the School of Veterinary Medicine, Razi University. Radiographic evaluation confirmed both radius and ulna fracture of the bird's wing. Following by debridement and irrigation of the damaged site, external coaptation using splint and bandage with access to food and water for 7 weeks was chosen as treatment protocol. Postoperative monitoring of patient via clinical and radiographic examination showed repair of the fracture within 7 weeks and the bird was able to fly.

**Keywords:** sparrowhawk; radius; ulna; fracture; external coaptation

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### **Introduction**

The aim of fracture repair is to preserve soft tissue structures, to rigidly immobilize the fracture by aligning fracture fragments and controlling distracting forces, to maintain the full range of motion in all joints affected by the fracture or method of fixation and to return the limb to normal function as quickly as possible. Bone fractures are common in both wild and captive birds (Rinkevich et al., 1999). Management of orthopedic conditions in birds usually involves nonsurgical (external coaptation), surgical (internal fixation with implants/external fixation) techniques or a combination of both (Bennett & Kuzina, 1992; MacCoy, 1992; Mathews et al., 1994).

External coaptation (bandages and splints) is a rapid and the least expensive technique of providing decreased movement of bone ends. In most situations, these methods act as primary stabilization technique when a limited post-range fracture of motion is satisfactory, a patient is too small to surgical repair, a fracture is minimally displaced or anesthesia and surgery would jeopardize the patient's life. In fact, external coaptation should be considered an emergency method of stabilizing fracture fragments until surgical

or additional support can be performed. Some companion birds may not require full return to flight. So wing fracture is managed effectively with external fixators (MacCoy, 1992). Fracture of the radius and ulna, in which the other bone is intact, can generally be repaired with external coaptation (figure of eight wing body wrap) and cage rest (Redig, 1986).

There was no exact report about orthopedic management of radius/ulnar fracture in sparrowhawk. Therefore, this report describes successful management of radius/ulnar fracture in a 10-month-old male sparrowhawk via using splints as an external coaptation.

### **Case presentation**

A 10 months old male sparrowhawk (*Accipiter nisus*) weighing 530 g with dropped wing, small wound in the its right wing and inability to fly was referred to the Veterinary Teaching Hospital of the School of Veterinary Medicine, Razi University. Rectal temperature of the bird was 41.9°C. The bird was off feed and dehydrated. Gentle palpation of the bird's wing showed a painful swelling in the proximal region of antebrachium. Plain radiography of the injured wing revealed open fracture of both proximal end of radius

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and ulna and elbow joint. The bird was sedated with xylazine (10 mg/kg; Alfazyne®, 2%, Woerden, Netherlands) at room temperature in a semi-dark calm environment. The wings were removed by cutting with a sharp scissor. The exposed fracture area was cleaned with commercially prepared solution containing 7.5% povidone iodine (7.5% povidone-iodine, Surgical scrub, Iran Nazhu Co., Tehran, Iran) followed by 10% povidone-iodine solution (10% povidone-iodine, Rasht, Iran). Debridement and irrigation of the damaged site was performed carefully with warmed sterile saline. Finally, all devitalized and necrotic tissue was debrided surgically. External coaptation using splint and bandage was used and the bird was forced to cage rest with access to food and water for 7 weeks. Antibiotic therapy was initiated with trimethoprim-sulpha (Trisul, Damloran Ph. Co, Borujerd, Iran), 20 mg/kg every 12 h for 7 days.

### Haematological and biochemical study

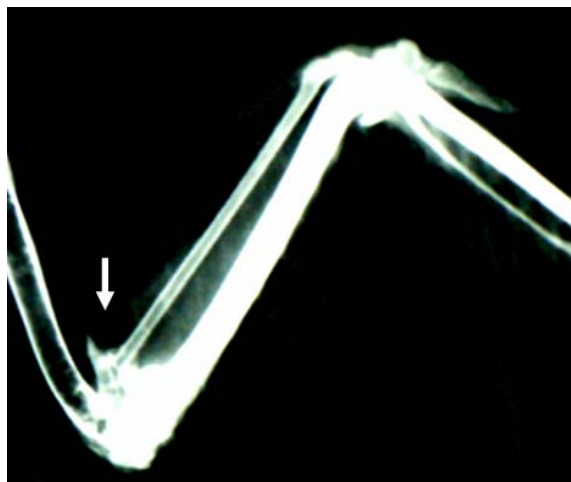
Blood sample of 2 ml was taken from the wing vein using a scalp vein in two separate tubes, with and without EDTA. Smears was prepared and stained with Natt and Herrick method (1952). The following parameters were determined.

RBC numbers was counted in a Thoma hemocytometer after the sample was diluted (1/200) in saline solution. Total WBC was determined on 1:50 diluted blood by means of Neubaur's counter chamber (Natt and Herrick, 1952). A drop of whole blood was smeared onto a glass slide for measurement of the percentile of heterophils and lymphocytes. A blood sample of EDTA was placed in a microhematocrit tube and centrifuged at 10000 rpm for 6 min to measure packed cell volume or hematocrit. Hb concentration was measured by adding 10µl of well mixed blood to 5 ml of droskin's reagent (Thrall, 2004). Also, glucose, total protein, albumin and alkaline phosphatase were measured with Auto Analyzer, Hitachi 911 at specific wavelength.

### Results

The fracture showed hard callus formation within 7 weeks post operative in the radiographic examination (Fig. 1). In fact, the fracture healed in 42 days and the bird was able to fly. Results for haematological values including total RBC count, PCV, white blood cell count (cells/µl), relative differential count (cells/µl), percentiles of heterophils and lymphocytes are presented in Table 1.

The total RBC counts value falls under normal reference values before treatment, However, PCV and Hb did vary greatly. The mean total WBC was 25000 cells/µl before treatment. This value falls higher than upper limit of normal counts for the falconiforms.



**Fig. 1: Fracture in proximal region of antebrachium in a 10 month old male sparrowhawk. White arrow shows open complete fracture of both proximal end of radius and ulna**



**Fig. 2: Lateral radiograph revealing a clinical healing of radius and ulna fracture after 7 weeks treatment using external fixation. White arrow shows hard callus formation after external fixation.**

Total WBC count showed a moderate increase, possibility due to high variability in total WBC number and percentile of heterophils and lymphocytes. The mean hematocrit was 30%, which falls under the range of reported value for falconiforms. Before and after treatment of wing fracture indicate huge differences in PCV and total WBC values.

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**Table 1: Paraclinic findings of some parameters before and after treatment of the sparrowhawk's wing fracture**

|                     | Total RBC<br>( $\times 10^6/\mu\text{l}$ ) | PCV<br>(%) | Hb<br>(g/dl) | Total WBC<br>( $\times 10^3/\mu\text{l}$ ) | Lymphocyte<br>(%) | Heterophil<br>(%) | Glucose<br>(g/dl) | Total protein<br>(g/dl) | Albumin<br>(g/dl) | Alkaline<br>phosphatase<br>(IU/L) |
|---------------------|--|------------|--------------|--|-------------------|-------------------|-------------------|-------------------------|-------------------|-----------------------------------|
| Before<br>treatment | 2  | 30         | 11.8         | 25.5                                       | 25                | 73                | 338               | 5.1                     | 1.7               | 26                                |
| After<br>treatment  | 2.1  | 33.5       | 13           | 13   | 48                | 61                | 344               | 4.8                     | 1                 | 24                                |

and percentile of heterophils and lymphocytes. The mean hematocrit was 30%, which falls under the range of reported value for falconiforms. Before and after treatment of wing fracture indicate huge differences in PCV and total WBC values.

Serum biochemistry parameters of pre and post treatment are compared in Table 1. Glucose values are similar with reported values before and after treatment. Level of total protein was in upper limit of reference values. Albumin concentration (g/dl) was within normal intervals compare to healthy birds.

## Discussion

Sparrowhawk (*Accipiter nisus*) is a small bird of prey in the family Accipitridae. Fractures and luxations usually occur in these birds from trauma during flight. Fractures to the wing require special attention, as flight feathers are attached to the periosteum of the ulna and major metacarpus. If the periosteum is elevated during surgical manipulation, the follicles may be damaged, resulting in deformed feathers or feather cysts. Avian long bones tend to shatter on impact, and their thin cortex offers less holding power for pins and other hardware when applying orthopedic devices (Olsen et al., 2000). Another problem for orthopedic repair is the limited soft tissue that exists over the long bones, which adversely affects fracture repair. Fracture fragments are often unstable, and the blood supply can be compromised (Redig, 2001). The aims of avian fracture management are to stabilize the fracture, to allow or promote load sharing, and to limit activity during the healing process (Redig, 2001). Although the cost of fracture repair is less of a concern for companion avian clients, it is a significant problem when treating wild birds. The fixation technique and its application should take into consideration the retention of bone length and the angular and rotational alignments of the limb. Exact anatomical reduction, however, may not be necessary. If an orthopedic device is to be used, it should provide rigid support and should be versatile, malleable, and lightweight (Orosz, 2002).

West and others (1996) maintained five mid-shaft humeral fractures of pigeons in figure-of-eight bandages for 42 days after surgery. But, their study revealed that a figure-of-eight bandage for the stabilization of mid-shaft humeral fractures is not an acceptable technique. In fact, the diagnosis of a fracture

of the radius or ulna is based on palpation and radiography. The prognosis is good when there is a simple fracture of a single bone. Single bone fracture(s) of the radius or ulna can usually be managed with minimal treatment, brailing, or figure-of-eight wraps (MacCoy 1992).

The main disadvantage of external coaptation is displacement and shortening, delayed healing, nonunion, or a combination of these outcomes (Redig et al., 2001). Proximal radial fractures may heal normally with a figure-of-eight wrap, because the relatively large muscle mass may help keep the bones aligned and may provide the necessary vessels for adequate blood supply (Orosz et al., 1992, Redig et al., 2001). Orosz (2002) described conservative management (bandage) of ulnar and proximal radial fractures for approximately 2 weeks to allow the development of sufficient fibrocallus. Study of Redig and others (2001) manifests that these fractures often heal sufficiently by the third week to remove the wrap and to allow restricted movement or cage rest for a complete heal by the fourth week.

Hematological and blood chemistry values were considered useful in determining general condition of birds. However, these parameters can be affected by a range of factors, such as method of storage, analysis, stress on animal and the age and the sex of patients (Balasch et al., 1976; Davis, 2005). Furthermore, it must be emphasized that responses to environmental stimulus varies greatly from species to species among falconiforms (Balasch et al., 1976; Scope et al., 2002). Because of these variations in parameters, establishing species-specific reference ranges is required in accurate interpretation of plasma values.

Data collection might be provided by sampling a healthy population of animal and wild-caught bird. However, in our study assessing the levels of normal interval conditions was not possible, because only a single bird was studied. There are few data on hematology of falconiforms (Balasch et al., 1976; Scope et al., 2002; Mitchell et al., 2008; Padrotova et al., 2009). Because of the variation in plasma biochemical values between species, the use of species-specific reference ranges are important in the accurate interpretation of plasma biochemical values. As such, the use of reported reference ranges could result in a bias towards accepting "diseases of captivity" as clinically normal and might result in misinterpretation

of data because of differing analytic techniques (McDonald et al., 2010).

For these reasons, collecting reference data from healthy, wild-caught birds and developing reference ranges with the use of common commercial laboratory technique is important (McDonald et al., 2010). However, in our study, assessing the levels of normal interval condition was not possible. Assessment of therapeutic efficacy after healing fracture process relies on hematological analysis (Scope et al., 2002; Mitchell et al., 2008). Hematological response to disease and inflammation has been previously described for several species of raptors (Clark et al., 2008). Usually falconiforms show only very subtle signs of disease making the detection of disease difficult (Parga et al., 2001).

Typically, falconiforms have a PCV of 37-53%, Hb concentration 12-21 g/dl, WBC  $3-11 \times 10^9/l$ , usually with more heterophils than lymphocytes. Hematocrits of migrating healthy birds of prey may be significantly greater than those in captivity (Balasch et al., 1976; Padrtova, 2009; Velguth et al., 2010).

A PCV from 25 to 35% may indicate mild to moderate anemia (Michell, 2008). It is evident that acute or chronic blood loss due to trauma may cause moderate anemia with low hemoglobin concentration (11.8%) in this bird before treatment (Monks et al., 2000; Velguth et al., 2010). Concurrent dehydration may mask the signs of anemia (Monks et al., 2000; Powers et al., 1994). This means relatively reduced intake of water cause hemo-concentration that falsely increase PCV% to some degree. Interpretation of the results is complicated by a lack of knowledge of the duration of the inflammatory process. As all the birds originate from the wild, It is difficult to measure normal WBC counts accurately especially in raptors since these birds are unavoidably stressed when they handled. Physical restrain may alter the obtained results. However, it must be emphasized that the hematologic response to stress varies from species to species (Powers et al., 1994). Paraclinic findings indicate an inflammatory process accompanied with leukocytosis and heterophilia. However, there are great variations in the total WBC according to reported values for falcons (Balasch et al., 1976; Padrtova et al., 2009). The greatest concentration of total leukocytes reported  $16.45 \times 10^3 /\mu l$  due to inflammation (Clark et al. 2008). In poultry, the hematologic response to corticosteroids is leukocytosis with heterophilia and lymphopenia (Davis et al., 2008; Clark et al., 2008). Birds with a total white blood count above the third quartile (leukocytic) had an absolute heterophilia, which may reflect more of a catecholamine- induced stress pattern rather than a corticosteroid-induced heamogram (Powers et al., 1994). It showed cases with evidence of trauma from motor vehicle exhibited somehow heterophilia. Depletion of circulatory heterophils

following migration of cells to sites of tissue damages and subsequently replacement from the bone marrow cause heterophilia (Clark et al., 2008). The use of heterophil/lymphocyte ratio rather than the absolute number of heterophils or lymphocytes is more sensitive indicator of stress in raptors (Monks et al., 2000). Therefore, percentile of heterophils and lymphocytes may be appropriate for accurate reporting of these data. Careful assessment of the morphology of leukocytes, particularly heterophils, is a most valuable component in the interpretation of hematology values of these birds (Clark et al., 2008).

Results from biochemistry profiles in this study indicate that huge differences in plasma total protein, albumin concentrations and alkaline phosphatase activity compare to normal ranges in birds, but Glucose values are similar with reported values before and after treatment. The mean value of 5.1 g/dl for total protein was higher than reported previously for some falconiforms (Mitchell, 2008). However, accurate comparisons with previously reported results may not be possible due to the different techniques in measuring protein levels in blood such as biuret and refractometric methods (Powers et al., 1994). Furthermore, it might reflect differences in sample population, either because a single species was assessed (McDonald et al., 2010). Hyperproteinemia in most birds is indicated by plasma total protein concentrations of greater than 4.5 g/dl. This is usually the result of dehydration, acute or chronic inflammation. Total albumin value is about 3-5 g/dl in birds. Increased albumin concentration commonly is associated with dehydration. Variation in total protein value is often indicative of poor nutrition in raptors (Powers et al., 1994). Plasma ALP activity in birds primarily results from osteoblastic activity. Eventually, increase in the ALP activity is suggestive of skeletal growth and healing fracture (Thrall, 2004). However, in birds of prey this augment up to 2-3 folds compared with normal values (Monks et al., 2000). Because bone fracture is expected to result in muscle trauma, significance increase in plasma alkaline phosphatase is observed in this case before treatment.

The result of this study suggests that sometimes external coaptation with cage rest is suitable for antebrachium fracture repair in sparrowhawk.

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