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Surgical Repair of Proximal Humeral Fracture in Common Kestrel (*Falco tinnunculus*)

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Abstract : A common kestrel was admitted to Chungnam wild animal rescue center, having been unable to fly. On the physical examination, the bird was presented with contusion and swelling on its right humerus closed fraction and had pain response. Radiographic examination was explicitly revealed closed fracture on right proximal humerus. Its closed fracture was reduced with tie-in fixator and figure-of-eight tension band, and inserted pins on its right humerus surgery were removed on the 14th day after the surgery. As *Falco tinnunculus* was able to move its wings from Day 21st day, its rehabilitation was done at outdoor facility and it was successfully released. Proximal humerus reduction with tie-in fixator and the wire was a success, and this treatment with reference to this study will be surely effective to support the other wildbird's reduction stability.

Key words **:** Common kestrel, proximal humerus fracture, Tie-in fixator, Figure-of-eight tension band.

Introduction

In the past few decades, due to rapid urbanization, the habitat for wildlife has been relatively reduced as the space in the wild occupied by humans is enlarged. As a result, most wild animal's species are becoming more exposed to threats. In particular, specific wild birds have been increasingly rescued due to collision with artificial structures (5,10). The most distressed wild raptors are predominantly common kestrel and the humerus is a frequent site of fracture (10).

The common kestrel (*Falco tinnunculus*) is a small bird-of-prey belonging to the family Falconidae and the order Falconiformes, and it is protected as a natural monument number 323-8. It is a common sedentary species of Korea, preferring suburban area and sometimes urban buildings as a habitat (6).

Avian fractures involving the humerus of the bird occur frequently with a midair collision between bird and things such as vehicles, buildings and electric wires. Fracture of the humerus can be classified into one of three parts according to the location; proximal fracture which occurs from shoulder joint to the pectoral crest, diaphyseal fracture from the end of pectoral crest to shaft of humerus, and distal fracture (4,9).

This case report describes and will be found the successful reduction method of proximal humerus fracture using some technical method to help to treat any wild birds troubled with similar symptoms.

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Case

A common kestrel with its right wing problem found in Gong-ju county was admitted to Chungnam Wild Animal Rescue Center on August 27th, 2016 (Fig 2A). The initial weight of a common kestrel was about 174 g, and the pattern and condition of feather suggested that it was juvenile female. On physical examination, the bird was found to be bright, alert and responsive. Its general health status was a body condition score 2/5 with a mild form of the dehydration. Closed fracture on its right humerus with an adjacent soft tissue mild swelling was seen. the left brachial vein for collecting 0.5 ml blood sampling was chosen for basic blood test, and the results were all in the normal reference range. Performing radiographic examination confirmed humerus fracture (Fig 1A). Pain response was positive indications suggesting that there is no nerve damage.

Figure-of-eight bandage with body wrap prevented from further damage and restrained wing motility. Tail-guard was also applied not to damage tail feather (Fig 2B). After the figure-of-eight bandage, meloxicam (0.5 mg/kg PO q12h, Metacam®; Boehringer Ingelheim) and warm Hartmann solution (10 ml/kg SC, Hartmann's Sol; Daihan Pharm) were injected for analgesia and rehydration, respectively.

Reduction surgery was performed the following day after body condition got stable. Isoflurane (Ifran®; Hana Pharm) was used for mask induction, followed by endotracheal intubation with ET tube (ID:2.0 OD:2.9). Heartbeat was monitored with Audio patient monitor (A.M.Bicford Inc.; Newyork. USA), while checked body temperature with digital thermometer. It was induced with 5% isoflurane and maintained with 2~3% isoflurane in 100% oxygen 2 L/minute.

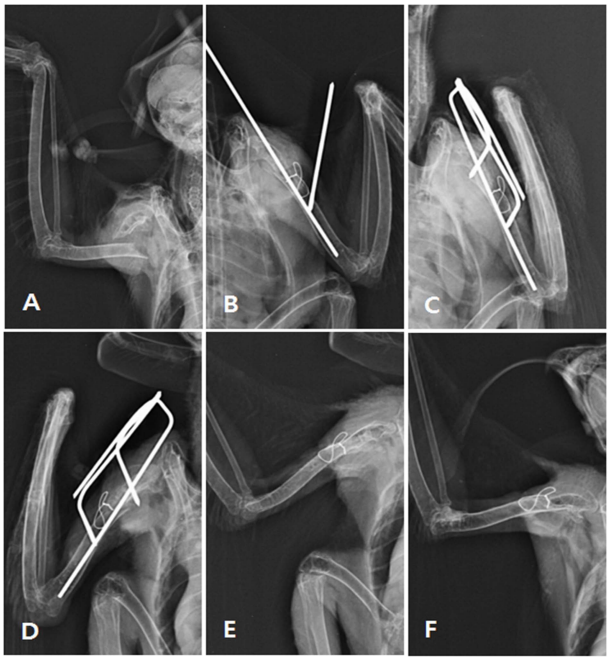

Fig 1. Radiographs show the right proximal humeral closed fracture in common kestrel (A). Radiographs were taken several times in order to confirm to be fixed pins properly and accurately during operation (B), Post-operation figure (C), Post-operative 5th day (POD) (D), After pin removal on POD 14th (E), and POD 60th before the release (F).

The bird was positioned dorsoventrally for the surgery. Feathers around the surgical area were removed and the surrounding surgical sites were fixed with micropore tape (3M; Anseong, Korea) not to leave a residue behind. the surgical region was disinfected routinely.

After incising skin around fracture region, Tissue debris, blood clots and micro-bone fragments were removed from the humerus fracture using a sterile cotton swab. After securing a clear view, fracture section region was checked and there was no severe damage of muscle and blood vessel. 0.6ϕ mm Kirschner wire (Topmedical; Seoul, Korea) was used to make two holes around fracture section region up and down; one hole was through the pectoral crest of the humerus and the other was perpendicular to the pectoral crest at 5.0 mm spot below the fracture, followed by inserting 1.1 mm IM pin (Imex veterinary Inc.; Texas, USA) to the proximal part in retrograde method. After inserting Orthopedic cerclage wire 0.2ϕ mm (HOLCO; Newyork, USA) in figure-of-eight way, fracture fragments were aligned properly and then IM pin was inserted into the humerus distal end. After fixing figure-of-eight wire, 1.1 mm ESF pins (Imex veterinary Inc.; Texas, USA) were inserted to the each fragment up and down. Incision line was realigned and incision site was performed simple continuous suture using 4-0 absorbable suture (Ailee co., Ltd.; Busan, Korea). The inserted IM pin was bent perpendicular to the inserting direction and fixed with cable-tie together (Fig 2C). Pin insertion area was covered with Sodium fusidate (fucidin®; dongwha) to prevent infection. The Wing from an operation was restrained by the figure-of-eight bandage with body wrap in order that movement of the affected right wing part was restricted.

Meloxicam (Metacam®; Boehringer Ingelheim Vetmedica) and enrofloxacin (15 mg/kg PO SID, Baytril®; Flavour Tablets, Bayer Healthcare) were prescribed for 2 weeks for postoperative care. Dressing of surgical wound was done regularly during the first 3 days after surgery, and disinfection was carried out once every other day after checking suture and infection condition around wound. Radiological examination was performed as a follow-up on 5th, 10th, 14th day respectively after operation and fracture region was verified to be normal. Pins were removed on 14th day and the bird was moved from ICU to indoor cage (Fig 1E). One-month-rehabilitation was undergone at field facilities during 21st day after operation, and the bird was finally released and gotten back to nature because there was no problem with its hunting and flight (Fig 2D).

Discussion

Most fractured avian patients met with a disaster are under

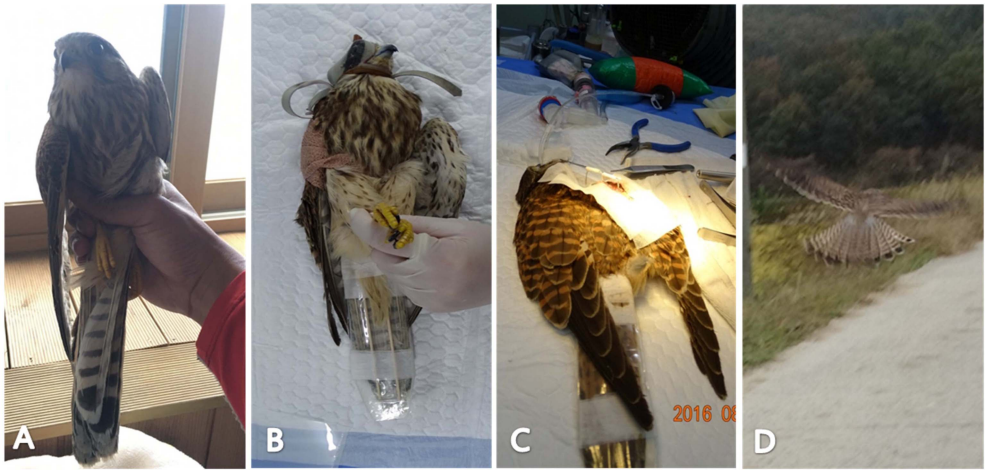

Fig 2. Rescued common kestrel with the right wing damage (A). Figure-eight bandage and tail-guard were performed before surgery (B). IM pin and ESF pin were fixed with cable-tie together in surgery (C). The common kestrel was released after 60th day Rehabilitation (D).

severe stress due to physical and psychological reasons such as external injury resulted from collision, the initial trauma and the additional stress of physical restraint and fracture assessment should be performed after taking maximum stability (2). Pre-operative primary blood tests such as PCV, blood glucose, plasma protein and biochemical tests are helpful in identifying the conditions of the injured bird (1,3).

The most important principles in avian wing fracture reposition are to minimize the damage of soft tissue, and to arrange bone fractures in order, and finally to stabilize from fracture to original form by matching them up correctly and properly (1,2,9). The functions of muscle, tendon, ligament and joint must be normal and harmonious among themselves because the bird's flight is especially essential behavior in avian species (1,2,9).

Avian bone is thin and contains high calcium generally and therefore its bone tends to occur fracture longitudinally (3,4,7,9). When it comes to the fracture, the open fracture and the comminuted fraction are caused mainly by a little amount of the peripheral soft tissue and a poor-developed periosteum (1,3,9). Humerus has features like pneumatic bone that medullary cavity of bones connects to the air sac and thus as blood and debris are removed, debridement with water may result in asphyxia, air sacculitis, or pneumonitis (2,7). Callus formation in avian species is similar to the mammals, the birds, however, get faster recovery than the mammals (1,2). Endosteal callus formation in endosteum makes the fractured bone stabilize faster than periosteal callus formation if bone fracture is properly aligned (1,4,7). Care should be taken of minimizing the damage of the soft tissue and the joint stiffness (ankylosis). Excessively a prolonged bandage (more than two weeks) should be avoided as it might result in muscle's atrophy, ligament's atrophy and joint problem (1,2,3).

In the case of proximal humerus closed fracture that is not severe dislocation, that fracture may only nurse using figure-of-eight bandage, but most of the humerus fracture could be mostly reduced with orthopedic surgery (9). Because muscle to protect bone are relatively little, birds' fracture of humerus occurs in the middle part and the lower middle part, that is, in two thirds of the fracture of humerus (2).

Under the influence of pectoral muscles attached in ventral of pectoral crest being proximad of humerus and deep pectoral, proximad rotates torso longitudinal directions inside and the distal under the influence of biceps muscle of arm is up to the outside (2,5,7). After the fracture occurs, distal fragment is pulled toward shoulder joint by these muscles, which seriously results in bone fragments to overlap each other. If rigid fixation of fracture region cannot be ensured, the muscles of fracture region gets damaged, the skin tears and fracture bone protrudes outward due to violent motion of wings. Therefore situationally using properly a wrapping bandage, constraint must be required to minimize soft tissue damage (1,4).

Even though approach to the humerus fracture in operation could involve both dorsally and ventrally, dorsal approach is preferred to reduce technical risk in case of proximal fracture (2,3,7). When approached dorsally in operation, care should be taken of to damage axillary nerve and radial nerve (3,7,8). In case of the bird under anesthesia, breathing is relatively smoothly in dorsoventral position posture and thus this position is preferred in avian species as vessel injury and nerve damage is less likely to happen as well as respiratory stability can be achieved (7).

There is a little difference in orthopedic reduction of humerus according to the anatomical locations. Pins such as tie-in fixator (TIF) in humerus shaft, cross-pin and TIF in distal humerus, and cross-pin using K-wire or cross-pin with tension band in proximal region are used (3,9).

Tie-in fixator (TIF) is the most common surgical method in humerus fracture. This method in operation is being used with both intramedullary (IM) pins and external skeletal fixator (ESF) pins for the reduction of fracture bone gap or periarticular fracture (3,4,7). The diameter of the IM pin from 50 to 65% of the medullary cavity should be selected (1,3,4). In case of small raptor, however, applying both ESF and IM pin which are more than 50% of medullary canal at the same time tends produce iatrogenic fracture due to spatial limitation. In this surgery, 1.1 mm IM pin with 40% of the isthmus, that is, the narrowest point of the medullary canal was applied to this bird. It is possible to use the size of 0.9 mm of the smaller ESF pin than the size of 1.1 mm of the ESF pin. When IM pin is inserted in the proximal direction, there should be no injury to the shoulder joint, and when inserted into the distal direction, good care should be taken of not to involve triceps tendon and elbow joint damages by transpiercing distal humerus (2,4). When it is inserted the direction of shoulder joint in order to reduce this damage, it should be inserted to the outside of the humerus lumen as far as possible, and be careful not to penetrate the humerus while the distal insertion is performed. Distortion could be occurred during reduction only with tie-in fixator, in the process of bending 90^{o} degrees of the IM pin and fixing cable-tie. Micromovement also might be occurred in restraint of the operation field for forcing feeding right after the surgery. During fixing cable-tie, the fixed cable tie would be able to move due to frictionless of cable-tie and pin and therefore cable-tie might as well be fixed using super glue. Little distortion of proximal humeral exert a strong influence on the flight ability in contrast with shaft of humerus (2). Even though micromovement or distortion was somewhat overcome through continuous rehabilitation, the distortion could become fatal in exquisite flight when rapacious bird, specially kestrel, was hunting. If fixing Cerclage Wire with a figure-of-eight tension band shape in order to minimize distortion of this fracture, time required for full-rehabilitation could be shortened.

Because adjacent soft tissue and vessel tended to be adhesive by beginning of the formation of connective tissue and callus and then following that heavy damage on nerves and vessels was resulted in during the surgery, fracture surgery should be performed for the fast recovery as soon as possible (3).

When it comes to the open fracture with inflammation, you had best an inflammation treatment preliminary to the surgery (5). The right cure way must properly be selected according to the site of injury, fracture type and fracture direction, and also depending on the elapsed time. Treatment method on surgery should be cautiously decided after accurately understanding and considering the physical conditions and the size of fractured bird.

Conclusion

A common kestrel rescued or presented with closed fracture state of proximal humerus was treated with bone reduction using tie-in fixator and figure-of-eight tension band. In two weeks after the surgery, Radiographically, callus formation was observed and then the fixed pin was removed. Flight ability of the bird was improved through rehabilitation training at outdoor space at 3 weeks. It was confirmed in flight test that fracture site was fully recovered months post-rehabilitation and the bird was successfully released in rescued area. In this case report, there were no problems during fracture healing by the use of TIF and figure-of-eight tension bands in proximal humeral fracture.

Acknowledgements

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Reference

1. Bennett RA, Kuzma AB. Fracture management in birds. J Zoo Wildlife Med 1992; 23: 5-38.
2. Coles BH. Essential of avian medicine and surgery, 3rd ed. London: Blackwell. 2007: 164-178.
3. Doneley B. Avian medicine and surgery in practice: companion and aviary birds. London: Manson. 2010: 266-284.
4. Helmer P, Redig PT. Surgical resolution of orthopedic disorder. In: Clinical Avain Medicine, Vol 1. Palm beach: Spix publishing Inc. 2006: 761-774.
5. Kim YJ, Kim SH, Gown MJ, Park CM, Lee H. A Case of External Fixation for Humeral Fracture in a Common Buzzard (Buteo buteo). J Vet Clin 2004; 21: 409-412.
6. Lee US, Koo TH, Park JY. A field guide to the birds of Korea. Seoul: LG. 2014: 106.
7. Martin H, Ritchie BW. Orthopedic surgical technique. In: Avian Medicine: Principles and application. Lake worth: Wingers. 1994: 1137-1169.
8. Orosz SE, Ensley PK, Haynes CJ. Avian surgical anatomy: thoracic and pelvic limbs. Philadelphia: WB saunders. 1992: 4-57.
9. Redig PT, Ponder J. Orthopedic surgery. In: Avian Medicine, 3rd ed. Missouri: Elsevier. 2016: 312-320.
10. Kim TI, Kwon YS. Bone Fractures in Raptors in the Daegu-Gyeongbuk Region; A Retrospective Study. J Vet Clin 2016; 33: 261-265.