

## CASE REPORT

### **VALGUS DEFORMITY OF THE CARPAL JOINT AND CARPOMETACARPAL BONES ('ANGEL WING') IN A GOSHAWK (*ACCIPITER GENTILIS*)**

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*Abstract:* A 4-week-old Goshawk (*Accipiter gentilis*) presented with bilateral valgus deformities of its carpal joints and carpometacarpal bones that were leading to an outward rotation of the primary flight feathers. This condition has frequently been described in waterfowl and is referred to as 'angel wing'. The report describes the successful treatment of the condition by bandaging the wings and by physical therapy.

*Key words:* angel wing, rotation of carpal joint or carpometacarpal bones, Goshawk, *Accipiter gentilis*, birds of prey

#### **Introduction**

The condition 'angel wing' describes a valgus deformity of the carpal joint and / or the carpometacarpal bones leading to an outward rotation of the primary flight feathers. 'Angel wing' can occur both uni- and bilaterally and is thought to be caused by the weight of the growing flight feathers placing excess stress on the muscles and ligaments of the carpal joint. If recognised early in the disease process in juvenile birds, simply taping the wing on itself can correct the condition. In adult birds surgical intervention in form of an osteotomy is necessary. Contributing factors include manganese deficiency, hypovitaminosis D<sub>3</sub>, genetic factors and environmental and management factors.<sup>1,2</sup> This condition is regularly reported in waterfowl. There are also reports in four species of bustard chicks and in psittacine birds such as budgerigars, macaws and conures.<sup>3-5</sup>

To the best of the authors' knowledge, there are no reports describing this condition in birds of prey. This case report describes a 4-week-old Goshawk chick suffering from bilateral 'angel wing'. The successful correction of the condition by bandaging the wings and by physical therapy is described and potential aetiologies are discussed.

#### **Case report**

A 4-week-old female Goshawk (*Accipiter gentilis*) presented with a marked outward rotation of the primary flight feathers of both wings. The owner acquired the bird one week prior to presentation and the deformity became progressively more obvious within that time. The bird was hand-reared and in

the process of being imprinted. The bird was feeding, casting and defaecating well. It was gaining weight and had successfully moulted from its second plumage to its juvenile plumage. The bird was in good body condition and weighed 730 g. Clinical examination revealed no abnormalities, except for the marked valgus rotation of the carpal joint and the carpometacarpal bones of both wings resulting in the primary flight feathers protruding dorsolaterally. There was no loss of motion in any of the joints in the wings. Based on the clinical presentation and physical examination 'angel wing' was diagnosed.

Due to the young age of the bird we elected to correct the condition by bandaging the wings to themselves, using a figure-of-eight bandage on each wing. First one layer of **Soff ban** ( ) was applied as padding and then several layers of **Vet rap** ( ) were applied to hold the wings in their position. The prognosis was guarded and the owner was considering using the bird as a breeding bird instead of a hunting bird depending on the success of correction. The owner was advised to change the bandages every two to three days and to perform physical therapy during the dressing changes. Physical therapy involved gentle manipulation of each joint of the wings from its maximum flexion to its maximum extension and holding each position for 15 to 20 seconds. Sessions were to be increased in intensity, number of repetitions, and frequency as each level was readily tolerated. The diet of the bird was evaluated, suggesting a variety of avian and mammalian derived food items and a calcium, phosphorus and vitamin D<sub>3</sub> supplement was advised.

One week after initiation of bandaging and physical therapy the bird presented for a follow up examination and there was already a considerable improvement. However as the rotation had not been corrected completely and there was no loss of range of motion in the wings, a further week of bandaging with regular bandage changes and physical therapy were advised. The bird had maintained good body condition.

The bird was not represented for one month after the second examination. When it finally presented the bird had a slight outward rotation of the alular bone on each wing but was otherwise clinically normal with no rotation in the carpal joints or carpometacarpal bones. The alular bones were rotated into their normal position and held in place by placing a suture around the base of the inner proximal alular feathers and the outer distal greater primary covers. PDS (Polydioxanon, Ethicon, Johnson-Johnson, St. Steven-Wolane, Belgium, W9950T) suture material (2 metric) was used and the owner was advised to leave the sutures in place until they disintegrate.

Two months after the third examination the sutures had disappeared and there was no evidence of any rotation in both wings. The bird's body condition was good and it was progressing well with its training as a hunting bird.

## Discussion

This condition is variously known as 'angel wing, or slipped wing, healed-over wing, crooked wing, sword or spear wing, rotating wing, airplane wing, straw wing, flip wing or dropped wing'.<sup>2,5</sup> 'Angel wing' describes a valgus deformity of the growing carpometacarpal bones and / or carpal joints resulting in a rotation laterally to approximately 180 degrees, causing the primary flight feathers protruding when the wing is folded to the body when resting.<sup>5</sup>

'Angel wing' is most frequently described in larger waterfowl such as geese and swans, both captive and wild.<sup>2</sup> Tropical and temperate species of waterfowl are particularly affected. 'Angel wing' is also more common during warmer weather when young birds are able to use more dietary energy for growth and less to maintain body temperature. Male birds seem to be more frequently affected.<sup>6</sup> The condition has also been seen in psittacine birds such as budgerigars, macaws and conures.<sup>5</sup> 'Angel wing' has been described as the commonest musculoskeletal abnormality in four species of bustard chicks from 0 to 30 days of age.<sup>4</sup> This case report describes the condition 'angel wing' in a Goshawk fledgling. To the best of the authors' knowledge there are no other reports about the development of 'angel wing' in raptors. However, a similar valgus deformity of the carpometacarpal bones and carpal joint has been observed by one of the authors in several fast growing larger raptors, including another Goshawk fledgling (Forbes, personal communication, 2004).<sup>7</sup>

The juvenile Goshawk described in this case report is mirroring predilective factors found in waterfowl. It is a young representative of a temperate species of raptors. The bird presented in early June and it is a female bird. Among raptors female birds grow bigger than male birds, while with waterfowl this ratio is usually inverse.

The condition is caused by the weight of the growing flight feathers that are placing an excess force on the muscles and ligament of the carpal joint and the carpometacarpal bones.<sup>5,8</sup> It is seen during the blood feather growth phase. It is likely that the condition is multifactorial, including factors of genetic origin, incubation and hatching problems or malnutrition.<sup>5</sup> Manganese and vitamin D<sub>3</sub> deficiencies are discussed as contributing factors, but genetics and growth management seems to have a greater impact.<sup>1,2,8</sup> In waterfowl, affected birds are usually those that feed on grass that contains a crude protein content of 17-18%. The condition is exacerbated when feeding higher protein content grower pellets to these birds, such that the birds grow faster than they were designed to.<sup>8</sup> High levels of protein, calcium and phosphorus imbalances and hypovitaminosis D<sub>3</sub> may also result in too rapid growth of blood-filled (and relatively heavy) flight feathers being carried on inadequately mineralised bone.<sup>5</sup>

Excessive growth rate in combination with an imbalance in calcium, phosphorus and vitamin D<sub>3</sub> can be discussed as possible cause for the development of 'angel wing' in the described case. In feeding raptors it is important to offer them as much variety as possible to ensure a balanced diet.

The Goshawk fledgling in this case was mainly fed on day-old chicks. Feeding just one food type increases the risk of calcium: phosphorus ratio imbalances, excessive fat intake, and the deficiencies of vitamins and minerals, leading to management related diseases such as metabolic bone disease and angel wing.<sup>7</sup> Some studies discussed possible low levels of calcium in day-old chicks, yet other studies stated that day-old chicks have the correct calcium: phosphorus ratio and suitable calcium levels, which are required by growing birds of prey.<sup>9-11</sup> It is important to take the composition of the food fed into consideration. When feeding this fledgling the owner commonly removed the yolk of the day-old chicks. With this practice valuable fat-soluble vitamins, lipids, carotenes and other essentials are withdrawn from the diet and its calcium: phosphorus ratio is also decreased. When feeding larger carcasses to smaller or young birds the bones must be broken, otherwise the birds will eat only the meat, which is easier to consume. It is vital to consider that it is not the diet, which is offered which is critical, rather the diet which is eaten. If more than 10% of the daily food intake is meat, as opposed to whole carcasses diets, supplementing with minerals and vitamins is essential.<sup>12</sup>

Regarding the aetiology of 'angel wing' in waterfowl the interaction of excessive energy, excessive protein, excessively rapid growth and inadequate exercise are discussed.<sup>6</sup> These factors are well recognised to contribute to rotational bone deformities of the tibiotarsus in immature ostriches.<sup>13-15</sup> Another study investigating skeleton development in psittacine birds, however, explained the high rate of juvenile osteodystrophy in hand-reared parrots by excessive premature exercise.<sup>16</sup> One obvious difference is the fact that waterfowl and ostriches are classified as nidifugous birds while parrots and as well as hawks are nidicolous birds. **(altricial-precocial??)** One can speculate if in this case of 'angel wing' in an immature hand-reared Goshawk it was a matter of exceeding exercise of the wings prior to complete maturing of the musculoskeletal system. Both Goshawk fledglings that were diagnosed with 'angel wing' in our clinic were hand-reared (Forbes, personal communication, 2004). This, however, does not reflect a predilection of the condition in hand-reared birds, as those birds are normally observed very closely and a similar condition in a wild fledgling might simply go unnoticed.

A diagnosis is normally made by physical examination, during which flexion and extension of all joints in the wing can be both normal and abnormal. Sometimes there may be abnormal laxity in the joints and some subluxation of the tendon of the propatagium over the carpal area.<sup>5</sup> In this case the clinical picture was typical and radiography was considered unnecessary.

Treatment involves the application of figure-of-eight bandages to bring the primary flight feathers back to the wing itself, in combination with calcium and vitamin D<sub>3</sub> supplementation and restriction of the growth rate. The correction is usually completed within a week. In this case correction required more than one week, which may be explained by the fact that the bird was already four weeks at the first presentation and that the rotation has not been addressed within the first 24 – 48 hours of occurrence. If mature birds are affected, the rotation can be corrected by osteotomy, involving cutting the major

carpometacarpal bone, rotating the distal fragment into a normal position and transfixing the fragments by standard osteosynthesis techniques.<sup>8</sup>

When advising the owner in this case there was emphasis on changing the bandages every two to three days to avoid contraction of the proapatagium. Contraction of the proapatagium is a common consequence of wing immobilisation.<sup>17</sup> Physical therapy aims to minimise the loss of range of motion, to prevent changes in soft tissue flexibility, to improve muscular strength, and to improve muscular and cardiovascular endurance. Additionally, it serves to promote neuromuscular re-education, allowing the patient to regain co-ordination for normal active daily living.<sup>18</sup> Different steps to provide physical therapy include passive range of motion, active range of motion, active-assisted range of motion, and adjunct techniques such as cold therapy, heat therapy and massage.<sup>19</sup> Passive range-of-motion exercises are performed by manipulating the limb through its entire range of motion, bringing it from maximum flexion to maximum extension. It is held in each position for 15-20 seconds.<sup>18</sup> Active range-of-motion exercises are the usage of the limb by the bird, as in flying or walking, depending upon the affected limb. Active assisted range-of-motion can be performed by providing a gently rocking perch, which forces the bird to move, flex, and grip in order to maintain balance. By holding the bird on the fist and gently moving the hand up and down the bird is forced to use its wings and many birds will paddle the legs if held just above a surface in an attempt to walk or perch.<sup>17</sup> In this case passive range-of-motion physical therapy was advised for the first two weeks. Once the bandages were removed active and active assisted range-of-motions physical therapy could be initiated. The owner failed to present the bird during this period of healing, however, keeping a bird free lofted in an aviary and normal training methods provide a variety of these movements.

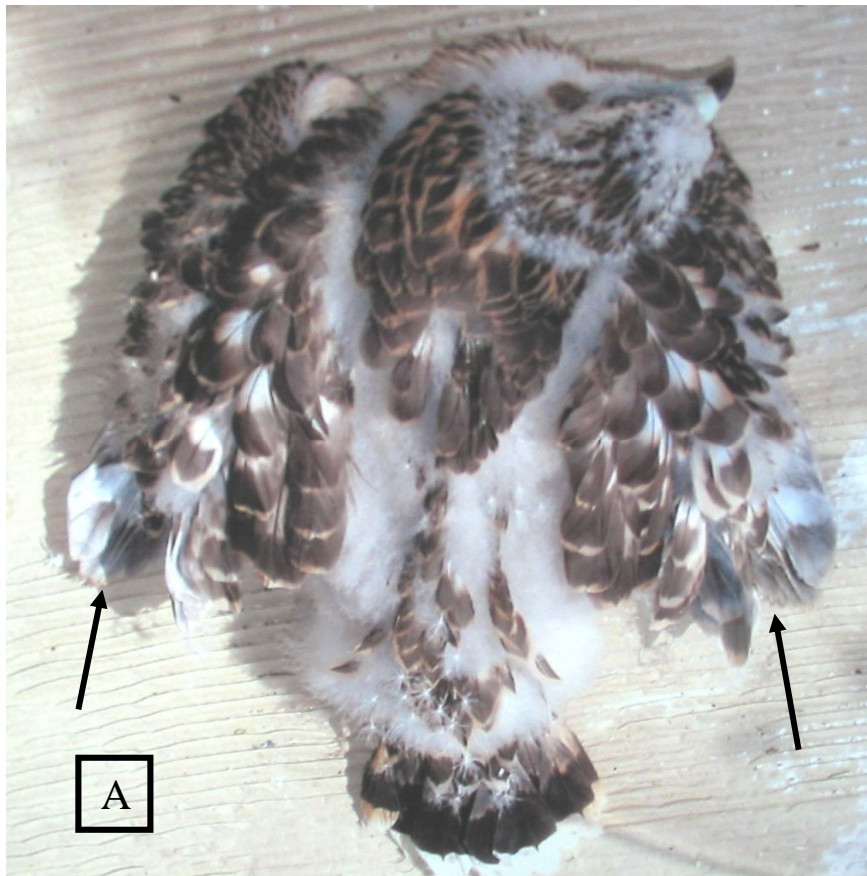
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**Figure 1 (A and B).** This Goshawk fledgling (*Accipiter gentilis*) presented with a valgus deformity of the carpal joint and carpometacarpus of both wings ('angel wing'). The weight of the growing blood feathers is causing a rotation of the immature bones resulting in the primary flight feather to turn outwards.





**Figure 2 (A and B).** The treatment for this Goshawk fledgling suffering from 'angel wing' consisted of applying figure-of-eight bandages to each wing with bandage changes every two to three days and physical therapy during bandages changes. After two weeks the condition was completely resolved.

