



## Surgical approach in correction of a crack in the gnathotheca of a black swan (*Cygnus atratus*, Latham, 1790) – First case report

[Abordagem cirúrgica em correção de fissura na gnatoteca em um cisne-negro  
(*Cygnus atratus*, Latham, 1790) – Primeiro relato de caso]

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### ABSTRACT

The black swan (*Cygnus atratus*, LATHAM, 1790) is a bird kept as an ornamental in zoos. Because of their long beaks they tend to have a reserved prognosis in musculoskeletal disorders such as beak trauma, secondary to skull bone fractures, presenting irreversible lesions. The aim of this report is present a clinical surgical innovation in the repair of a black swan's gnathotheca fissure with the application of non-conventional materials used. It was observed that one of the swans kept in a zoo display area had difficulty feeding, with associated weight loss. It was observed tissue loss and a lacerative lesion in the caudal sublingual region of its beak. The lesion was corrected by a separate simple suture in the cranial region of the beak and with a x-clamping using steel surgical wire and the application of dental resin in the distal region to perform a sustentation bridge in the beak end-gap. After 12 days, the animal was able to feed again and remained perfectly adapted to the restoration, reestablishing the anatomical and physiological function of its beak.

Keywords: corrective surgery, prosthesis, ranfoteca, sublingual cleft, zoo surgery

### RESUMO

*O cisne-negro (Cygnus atratus, Latham, 1790) é uma ave mantida como ornamental em zoológicos. Por apresentar bicos longos, tende a ter prognóstico reservado em afecções musculoesqueléticas, como traumas de bico secundários e fraturas de ossos do crânio, com lesões irreversíveis. O objetivo deste relato é apresentar uma inovação clínica cirúrgica no reparo de fissura na gnatoteca de um cisne-negro, com a utilização de materiais não convencionais. Observou-se que um dos cisnes mantidos em uma área de exibição de um zoológico apresentava dificuldade para se alimentar, com perda de peso associada. Constatou-se perda tecidual e lesão lacerativa na região sublingual caudal de seu bico. A lesão foi corrigida por meio de sutura simples separada na região cranial do bico e posterior sutura em x com fio cirúrgico de aço, finalizando com aplicação de resina odontológica na região distal para realização de ponte de sustentação do bico. Após 12 dias, o animal conseguiu se alimentar novamente e se manteve perfeitamente adaptado à restauração, restabelecendo a função anatômica e fisiológica de seu bico.*

Palavras-chave: cirurgia corretiva, prótese, ranfoteca, fissura sublingual, zoocirurgia

### INTRODUCTION

The black swan (*Cygnus atratus*, LATHAM, 1790) is a water bird belonging to the Order Anseriformes, family Anatidae, native to

Australia, which has adapted well to the conditions of New Zealand and Tasmania (Santos *et al.*, 2018). There are eight species and subspecies of swans, three from the southern hemisphere, including the black swan, and five

from the northern hemisphere (Iqbal *et al.*, 2021). Due to its aesthetic beauty and ornament, the bird was transported to many continents as an ornamental bird and kept under human care, in zoos and parks (Vieira *et al.*, 2016). It is the only exclusively herbivorous aquatic bird, feeding on freshwater aquatic vegetation and pastures; its habitat includes coastal marshes, lakes, and lagoons (Prazeres *et al.*, 2013; Santos *et al.*, 2018). It is a monomorphic species and exhibits

reproductive activity at 2 to 4 years of age (Beemster and Klop, 2013).

In the birds, the beak is formed by a bone structure covered by an epidermal structure that is keratin derived. The upper part is called maxilla (or rhinototeca) and the lower part is the mandible (or gnathototeca), together they form the ranfoteca (Gil, 2001; Speer and Powers, 2016) as seen in the figure 1.

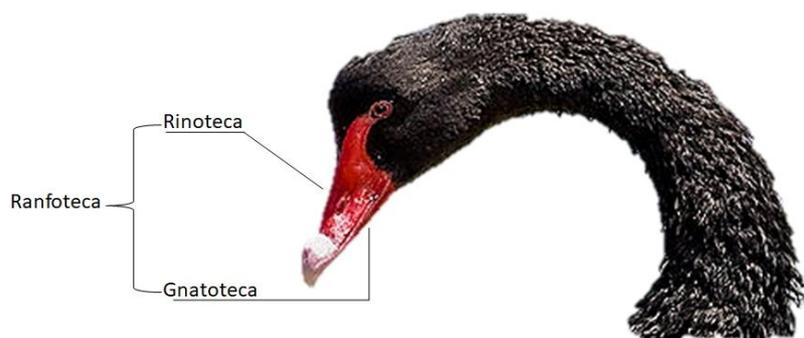


Figure 1. Diagram showing the ranfoteca with the anatomical subdivisions in black swan (*Cygnus atratus*). Adapted of Fecchio, 2010. Photo by Fir0002\_flagstaffotos [at] gmail.com.

At the gnathototeca there is the sublingual space, a triangular structure, in the portion of the buccal floor located under the free part of the tongue. It is the most important floor of the mouth supporting structure (Schnellbacher *et al.*, 2010).

In the Anseriformes Order, the rhinototeca is composed of a relatively broad and flat incisor bone, rostrally elongated and medially domed with the maxillary and nasal bones. The mandibular bone is horizontal, and the gnathototeca narrower than is apparent, fitting ventromedially to the rhinototeca. The ranfoteca has transverse corneal lamellae that are sensitive to touch, innervated by the trigeminal nerve endings (Braithwaite, 1977). In *Cygnus atratus* the keratin of the beak is much thinner compared to other birds except for the tip, which contains a tactile sensory.

Case reports of beak disorders in birds have become common in the clinical routine, but they are summarized in severe beak fractures in other species such as: parrots (*Amazona aestiva*), Ararajuba (*Guaruba guarouba*) and passerines (*Gnorimopsar chopi*), and in cases of failure to thrive (Arnaut, 2006; Speer and Powers, 2016). Some factors can generate exaggerated growth of the beak, leading to the crossing of rhinototeca

and gnathototeca (scissor beak), shortening of the upper or lower beak (brachygnathism), infections, necrosis, and fractures (Arnaut, 2006). Due to the thinner keratin in the black swan's beak, they may favor ranfoteca lesions (Prazeres *et al.*, 2013).

Deformations in the beak structure in birds can occur mainly due to the ingestion of inadequate proportions of nutrients, but also due to mite infestations such as *Cnemidocoptes* spp., wear failures and traumas (Cousquer, 2003). The affections of beaks in general may be responsible for the impairment of the function of this structure, such as food apprehension during foraging behavior. In addition, depending on the degree of involvement, the animal may fail to eat properly, feel pain, change its behavior and, therefore, have its general state of health compromised, leading to starving and death if surgical corrections are not conducted.

The surgical technique must consider the ease in obtaining the materials to be used, its feasibility and the perfect adaptation of the bird in the post-surgical period, allowing it to be reinserted to its habitat living without the need of interventions by the caregivers so that it can have an independent life.

### *Surgical approach...*

The objective of this work was to report one clinical case and the surgical approach to fix a crack in the sublingual region in a *Cygnus atratus* beak.

#### **CASUISTRY**

The affected animal was a *Cygnus atratus* adult male, weighing 6 kg, kept on display in an enclosure with a lake in the Parque Ecológico de Americana "Cid Almeida Franco", Municipality of Americana, State of São Paulo - Brazil. At the time of feeding and cleaning the swan's enclosure, the keepers observed atypical behavior such as irritability, followed by difficulty in apprehending the swan and aggressiveness towards others of the same species during feeding. As a result of these observed signs, the bird was physically restrained, removed from the enclosure, and sent to the technical veterinary medical sector of the institution.

With signs of anorexia and apathy, a physical examination identified that the animal had no tissue at the base of the gnathotheca, due to a cleft in the caudal sublingual region, measuring approximately 4.5cm of width, in an "A" shape. Because the partial tongue exposure through the ventral fissure and little ability to swallow food, the swan had a poor prognosis if not treated. Therefore, the bird was sent to the zoo surgical center to correct this condition.

The swan was sedated using a multimodal protocol using Zoletil® 50 (Tiletamine Hydrochloride 125mg/ml associated with Zolazepan Hydrochloride 125mg/ml, Virbac, Brazil) at a dose of 10mg/kg/IM, associated with Tramadol® (Tramadol Hydrochloride 125 mg/ml, Cristália, Brazil) 5mg/kg intramuscularly. With the animal sedated, and in the supine position, local asepsis was performed with 2% chlorhexidine disinfectant (Carpenter e Marion, 2017). After disinfection of the surgical region, the slit was surgically debrided in its initial third in the cranial region and simple raffia was applied with isolated stitches - Nylon thread

1-0 to approximate and partially repair the edges (Figure 2).



Figure 2. Approximation of the edges, after surgical debridement of the cranial portion, promoting the reestablishment of the tissue homeostasis of the sublingual cleft of the black swan. Ventral exposure of the tongue is noted (black arrow), and the edges of the lesion are delimited by de serrated arrow.

With the proximal third sutured, the second stage began with four perforations in the lateral face of the gnathotheca, drilling two parallel holes on each side, using a surgical drill of 1.5mm. In these perforations, a 0.6mm surgical steel wire was passed, thus forming an X-shaped floor, and delicately fixed with an orthopedic twister, resulting in a fixed structure to provide a base for the tongue (Figure 3).

Then a self-curing acrylic resin (VIPI Flash®, polymethylmethacrylate, Vipi Produtos Odontológicas, Brazil) was applied and distributed between the steel wires occupying the empty space, developing an internally smooth structure without roughness to accommodate the tongue, eliminating the discomfort of the black swan.

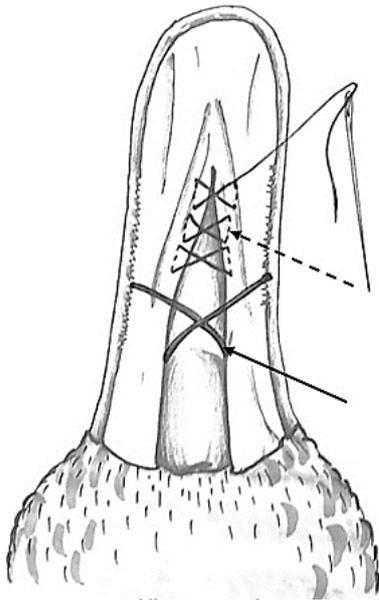


Figure 3. Fixation of cerclage wire in the ventral part of the gnathotheca as a bed for application of acrylic resin. X-shaped cerclage thread (arrow), and suture thread approaching the scarified edges for healing (serrated arrow).

Postoperatively, analgesia was administered: 25mg/kg/IM, Bid, for 3 days of Dipyron 0,5% (Laboratório Teuto Brasileiro S/A, Brazil) and 0.5mL/kg IM, Sid, for 5 days of Meloxicam 0,2% (Maxicam®, Ourofino Saúde Animal LTDA, Brazil). Antibiotic therapy was performed with 0,5mL IM, TID, during 7 days of Cephalexin 15% (Rilexine®, Virbac do Brasil ind. e com. LTDA., Brazil).

During recovery, forced feeding was done with finely cut vegetables to facilitate the ingestion and to minimize pain and after 12 days the swam returned to eating normally and the resin remains fixed in its gnathotheca, showing no signs of rupture or detaching from de beak. In the post-surgical period, the beak restoration was prioritized to avoid suture dehiscence, deflection of cerclage and acrylic resin detachment.

### DISCUSSION

During recovery, forced feeding was done with finely cut vegetables, to facilitate the ingestion and to minimize pain and after 12 days the swam returned to eating normally and the resin remains fixed in its gnathotheca, having no signals of rupture or detaching from de beak. In the post-surgical period, the beak restoration was prioritized to avoid suture's dehiscence,

deflection of cerclage and acrylic resin detachment.

This report is a rare case because of the difficulty to diagnose such advanced condition in an exotic bird without a known clinical history. The developmental anomalies the crack causes are still poorly understood and are multifactorial and variable, characterized by fights in the enclosures between animals of the same species, collision and/or predation (Huynh *et al.*, 2019; Iqbal *et al.*, 2021). Also, beak fractures are very common, particularly in species with a large and long beak as in the Swan (Sagar, 1995).

Traumatic injuries to the beak can be caused by bites, fights with other animals or hitting solid objects and can be classified as cracks, perforations, avulsions, and abrasions. Sequelae in beak trauma can generate infection of adjacent soft tissues and permanent deformities (Wheler, 2002). In this black swan there were no signs of infection in the adjacent tissues, avulsion, nor signs of necrosis that showed signs of sequelae due to fights or trauma due to other factors. Therefore, it was not possible to identify the cause of the injury to the animal in question since it was perceived late.

### *Surgical approach...*

At the beginning of the surgical procedure, tissue debridement was performed on both sides of the inner edge, with the aim of promoting neovascularization of the sutured tissues, but it was only possible to approximate one third of the edges in the distal region of the gnathotheca. For this reason, it was necessary to use cerclage wire accompanied with acrylic resin to decrease the space between the cracks in the most proximal region of the gnathotheca. In fact, the surgical intention was to build a resistant base for the tongue muscular structure and to mimic a real and natural structure for the patient, adhering to the beak anatomical structures.

Healing is one of the most important factors in surgery for wild or exotic birds, as it is a great indicator of a favorable diagnosis (Cazati *et al.*, 2021). The good blood supply present in rhamphotheca facilitates local healing of the surgery (Wheler, 2002; Cândido, 2017). Thus, this approach was fundamental for the healing process, as already successfully addressed in other species (Cazati *et al.*, 2021).

Among the challenges of this repair, the biggest was the transfixation of the cerclage wires between the bony edges of the gnathotheca, as it is a fragile structure, there was a risk of bone fracture. Cerclage associated with acrylic resin enables good results in similar cases (Wheler, 2002; Olsen, 2003; Speer and Powers, 2016). Other factors were considered positive for the use of acrylic resin, such as the early restoration of masticatory function, forming a light structure for the formation of a floor of the beak, impermeability to water and discreet to zoo visitors (Wheler, 2002). In the market, there are few materials suitable for poultry surgery and, therefore, the surgeon is forced to adapt materials used and designed for other functions. In this context, dental, orthopedic, and ophthalmic materials for humans have been shown to be efficient for veterinarians to perform repair surgery in animals.

After the surgical procedure, the swan was kept in the quarantine of the Ecological Park for twelve days receiving antibiotic therapy and clinical follow-up of the recovery process. After the recovery period, the swan underwent a new physical evaluation showing complete healing

and adhesion of the acrylic resin, with the absence of signs of inflammation, validating this surgical procedure corroborating Gomes (2018) statements, who advise to observe the tranquility at the time of feeding as an index to the perfect adaptation of the patient to new beak. Thus, once the bird recovered, it was returned to its original enclosure.

The procedure performed was of great value for the improvement of the levels of well-being, allowing the animal to obtain food naturally and without compromising its general state of health, in addition to a good coexistence in the group by reducing the behavior of aggression. Thus, we can even reinforce the idea that the repair of the beak and the restoration of its function contributed to improve the positive experiences of the animal in three physical-functional domains (health, feeding, and behavioral interactions) and ended up contributing to the general animal well-being.

Deformities in the species of anseriformes are difficult to notice or diagnose, because these birds are, most of the day, only observed from a distance in lakes, rivers, and streams, with aloof behavior making it difficult to diagnose this group of animals.

Healing is one of the most important factors in the surgery of wild or exotic birds, as it is a great indicator of a favorable diagnosis. The good blood supply present in the rhamphotheca facilitates local healing. However, the habits of these animals being semi-aquatic and living in humid places predisposes them to negative factors for the conditions healing, often culminating in contamination of the beak of such patients (Cândido, 2017). Therefore, periodically in *ex situ* conservation institutions, such as Ecological Parks, Zoos, Institutes and private properties, routine prophylactic examinations are necessary, assisting in animal welfare and the species maintenance.

Finally, regardless of the purpose of *ex situ* institutions, the main role is to promote the well-being of all animals in their herd, ensuring quality of life, associated with the evolution of veterinary medicine for wild and exotic animals (Pizzutto *et al.*, 2013).

## CONCLUSION

The surgical technique used, including the use of unconventional materials, proved effective for the repair of the gnathotheca fissure, making the reestablishment of the anatomical, physiological function and well-being of the black swan's beak possible.

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