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**RESTORATION OF RAMPHOTHECA IN BIRDS: A CHALLENGE?**

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**Introduction**

The avian beak is a continuously growing and dynamic structure composed of bone, vascular layers, keratin, dermis, and a germinative layer. The keratinized sheath covering the upper and lower beaks is called rhamphotheca and can be divided into the rhinotheca, or maxillary keratin, and the gnatotheca, or mandibular keratin. The median dorsal border of the rhinotheca is called the culmen, and the median ventral border of the gnatotheca is called the gonys. The edges of the rhamphotheca are called the tomia, and for the Toco Toucan as for other Toucans as for many other Ramphastids, are serrated or marked with “Schaugebiss.”.

The beak is used for foraging, feeding, social interaction, prehension of food or of nesting material, and in Psittacines, for locomotion. The rate of keratin replacement is strongly dependent on the use of the beak. Toucans are also known to engage in bill fencing behavior which is speculated to be an assertion of dominance. In large Parrots, the complete rhinotheca is entirely replaced in about six months, while in Toucans, the rhinotheca grows approximately 0.5 cm over a two-year period. The rate of growth of the gnatotheca is about two to three times faster than that of the rhinotheca.

Understanding the mechanical response of the beaks demands understanding of both materials, primarily keratin and mineralized collagen, the conformation of those constituent materials or structure in which they are assembled, and the interaction between the material properties and structure properties. Biological composites are for the most part composed of brittle (often, mineral) and ductile (organic) components. Mechanical properties of biological composite structures are known to exceed those of the individual constituent materials. The sandwich structure—thin, stiff exterior encasing a thick, low-density core—enables high flexural stiffness at low weight, where the requisite low weight presents a constraint for volant birds. Low weight of the bill allows for the Toucan to maintain center of mass inline with the wings. Mechanical properties and structure of Toucan bill have been studied by Seki et al. (2005), while methods for reparation of fractured beaks using acrylic resin have been investigated by Fecchio et al. (2007).

**Beak diseases**

A variety of congenital and acquired defects, including scissor beak and mandibular prognathism, can interfere with normal beak function. Examples of acquired lesions that can lead to malformations or necrosis of the beak include punctures, lacerations, splits and avulsions. Traumatic fractures, especially of the mandible, occur frequently in psittacine birds that get caught in hooks suspended from the ceiling of their enclosures or as a result of fighting. Injuries to the beak often bleed, and the hemorrhage needs to be stopped (usually with electrocautery. Do not use silver nitrate sticks - they are toxic to birds). The wounds must be cleaned and antibiotics and antifungals may need to be given. The beak has nerve endings, and pain or the displacement of the beak may make eating difficult or impossible. All birds with beak injuries should be examined by a veterinarian.

**Beak repair and prostheses**

A healthy beak is critical to the everyday survival of a bird, and minor injuries to this tissue can be serious depending upon the degree of associated soft tissue damage. Initially, therapy for any beak injury should be provided to control hemorrhage, maintain nutritional support and prevent secondary infection. Several techniques have been used for beak repair incorporating such materials as dental acrylic, cerclage wire and thermoplastic.

The prostheses can be classified, by the origin, in way similar to the grafts in autogenous prostheses (it comes from the same animal), homologous prostheses (it comes from another animal of the same species), Heterologous prosthesis (it comes from individual of different
species), synthetic prosthesis (made with inorganic material) and mixed (association of two or more types of prostheses). In practice, the autogenous prostheses are used when we recovered the fragment of lost beak, the prostheses heterologous are very a little used, however the prostheses homologous, synthetic and mixed are used frequently. Corpses of birds are used as suppliers of homologous prostheses, of which the beak should be dissected and removed in the possible most aseptic way. It is important to discard the infectious diseases as death cause of the corpses that will supply the homologous prosthesis. After removal of the beaks, these should be conserved in half aseptic capable to maintain the biological properties of the beak to the date of the surgical procedure of implantation. The conservation in glycerin 98% is a more common and accessible method economically. The glycerin 98% is an efficient middle of preservation of beaks to room temperature, because it maintains the material free from the contamination and it maintains the properties biomechanics. The beak should stay for at least 30 days submerged in glycerin to 98% before being used, and it should be moisturized with physiologic solution before use this.

Initially, it should take place radiographic exams for evaluation of the bone structures and woven soft adjacent of the ramphotheca remainder that will receive the prosthesis. Soon afterwards, this same one remaining it should be molded (with dental materials like alginate), as well as the other portion of the beak that will occlude in the prosthesis. The occlusion of the beak should be printed in wax for larger study reliability. The occlusion of the beak should be printed in wax for larger study reliability. It takes place, then, meticulous biometric evaluation of functional rebuilding of the occlusion and, soon afterwards, a model of the ramphotheca is made (it resins acrylic, plaster, etc). Like this, the prosthesis is made with base in the generated model.

The surgical procedure is initiate for debridement of necrotic tissue and removal of dirtiness of the remainder of the ramphotheca. Soon afterwards, the prosthesis must fastened to the remainder through cerclages and the contact surfaces between prosthesis and remainder should be covered with ribbon adhesive of cellulose and this covered with cianocrilate glue or with dental resins. To better adherence and homogeneity of the rebuilding, the same should have it surface completely (remainder and prosthesis) covered by a fine resin layer and, concluding the insert of the prosthesis, the whole ramphotheca should be covered with varnish of keratin fortification (Timol 2%, Sorbitol 2% and enamel base qsp).

The understanding of the biomechanics of the skull and of the forces that act during the oclusal movements it is essential for the making and positioning of the resin prostheses. Several factors as the individual anatomy, reduced weight of the beak and the ignorance of the intensity and distribution of the applied forces on the beak, besides the ignorance of the biocompatibility (interaction) of the resins with the keratin surface, are responsible for a great number of failures in the treatments.

Prosthetic beak devices require continuous replacement as the beak grows, and must be carefully monitored to prevent bacterial or fungal infections.

**Beak care**

Beak care is critical for the overall health of the bird. We can help promote beak health by ensuring the bird is getting all the nutrients he needs and detecting any problems early. Some at-home care includes:

- Daily checking the health of your bird. Look for cracks, overgrowth, or discoloration of the beak.
- Consulting an avian veterinarian if you suspect that your bird's beak is growing unevenly. This can indicate underlying problems such as liver or nutritional issues. Your avian veterinarian can determine the reason for the problem as well as trim it to prevent problems with eating or preening.
- Providing chewing toys, any toy that a bird has to work at chewing will help keep his beak trim. These include build-your-own toys that you can make by alternating mineral pieces with rope, wooden, blocks, and plastic.
- Including different textures of perches, including cement perches specifically made for beak and nail health.
- Housing the bird in a proper size cage.
References:


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