

Use of prosthetic materials in the health care of wildlife in calakmul

ENCALADA, Alberto†, LÓPEZ, Verónica, DUARTE, Ivonne, GONZÁLEZ, Evarista and GONZÁLEZ, Luisa

Cuerpo Académico Salud y Producción Pecuaria. Escuela Superior de Ciencias Agropecuarias. Universidad autónoma de Campeche, Campus IV.

Facultad de Odontología. Universidad autónoma de Campeche.

Facultad de Contaduría y administración. Universidad autónoma de Campeche.

Received January 1, 2014; Accepted June 22, 2014

The purpose of this article is to review the literature on the use of dental biomaterials that can be used in wildlife confined to rural areas of the reserve of Calakmul and this needs rehab for various physical damages caused them difficulty survive and where the support of experts in dentistry provides alternatives to regain their health through the use of biomaterials. Dentistry was chosen because it is one of the areas where interdisciplinary work can provide various treatments based on their prosthetic experience in human and veterinary traspalarlos the area. For this work is organized in three sections, the first refers to an explanation of the materials used in dentistry that are likely to be used in the care of animals, the second is a review of work done in various species which are used biomaterials through support to dentists, the third is an analysis of the cost / benefit of this type of veterinary care in wild species and concludes with some recommendations.

Prosthetic rehabilitation, wildlife, biomaterials, cost / benefit

Citation: ENCALADA, Alberto, LÓPEZ, Verónica, DUARTE, Ivonne, GONZÁLEZ, Evarista and GONZÁLEZ, Luisa.

Use of prosthetic materials in the health care of wildlife in calakmul. ECORFAN Journal-Ecuador 2014, 1-11: 59-67

† Researcher contributing first author.

Introduction

The Calakmul Biosphere Reserve is a site rich in biodiversity where the interaction between man and animals is very diverse resulting in extensive use of wildlife by the inhabitants of this area as medicine, food and pets. (Duarte, 2010; Guiascon 2012 et al.).

As the productive activities of the inhabitants of this area lies within a landscape of tropical forest evergreen, pets, now called pets besides dogs and cats are also animals such as birds, reptiles and even medium-sized mammals like the call "peccary or javelina. "

Scarce resources of families living in this area make poor medical care for their pets; however as living animals are not exempt from suffering injuries or illnesses that endanger their survival skills.

Injuries or illnesses that affect animals' conventional company and / or exotic are diverse:

a) Hereditary / genetic problems: presence of cleft lip, malformations, presence of agenesis, prognathism.

b) Nutritional problems, which are common in exotic or non-traditional animals because these animals no longer are given the power that comes from nature and although there are foods that provide the nutrients they require, in the for rural families, the price of these foods prevents access the null and offer them there on these sites.

c) Neoplastic degenerative problems that depend heavily on the age of the pet animals to the wild-origin are greater longevity in captivity by not having the pressure of being hunted for their wild predators.

d) Problems of infectious nature, which often are reservoirs of diseases communicable to human and the prevention of which is done in conventional pet vaccine and deworming, however it is not for exotic pets so it is advisable to acquire hatchery authorized, if unlikely at Calakmul.

e) Problems of traumatic origin such as those caused by mishandling by the owner or by collisions or falls from these accidents cause fractures in various parts of the body.

Veterinarians use different treatment techniques for these conditions and thus provide health care to its diverse patients. In the case of non-conventional or wild animals these treatments deserve special attention since often is poorly studied species that not even their basic biology is known. However, to ensure the health and welfare of the patient support alternatives to improve them, one being supported with professionals from other areas of health, as in the case of dentistry are sought. Due to the great support that this discipline can have in the veterinary area the aim of this paper is to provide an explanation of the various procedures that can be performed in wild animals through the use of dental materials (biomaterials) and get the actual spending such interventions. For this work is organized in three sections, the first refers to an explanation of the materials used in dentistry that are likely to be used in the care of animals, the second is a review of work done in various species which are used dental materials, the third is an analysis of the cost / benefit of this type of veterinary care in wild animals and concludes with some recommendations.

Dental materials that can be used in care of wildlife.

Since ancient times man has experimented with certain types of materials like gold, wood or plastic to replace parts of the body that have been affected by illness, accident or aesthetics currently have implemented different procedures, methods and therapeutic techniques due to the discovery of new inert materials that allow biological biocompatibility to rebuild or replace certain body parts.

Biomaterials have a very wide field of application ranging from devices for mass and daily use in health centers to sophisticated pieces used to promote tissue regeneration or replacement organs. (Angela M. Villegas. 2008)

Biomaterials must meet the starting conditions to be biocompatible and ensure a certain half-life. In turn, they have to provide the specific services required by the application they are intended. Initially, it was relatively recently, during the last third of the twentieth century, biomaterials were essentially selected on the basis that they were able to meet certain biological acceptability industrial materials. However, today many biomaterials are designed, synthesized and processed for the sole purpose of having an application in the medical field.

Material	Use	Properties
<p>Metals and alloys: Stainless steel, cobalt-chromium, aluminum-zinc and titanium.</p> <ul style="list-style-type: none"> - Titanium screws, nails, bows and Erick splints. - Structures metal emptied. 	<p>They are used for bone plates, bone fractures and replacing lost structures.</p>	<ul style="list-style-type: none"> - High resistance. - Well above the bone elastic mode. - Conductors of electricity.
<p>Polymers. The most widely used polymers are:</p> <ul style="list-style-type: none"> - polyvinyl - polymethacrylate - polystyrene - copolymers. 	<p>Among its most important applications are developing prosthetic ocular implants and orthopedic devices among others</p>	<ul style="list-style-type: none"> - Absorption - Solubility in - Flexural - Flexural Modulus - Residual Monomer
<p>Resorbable membranes.</p> <ul style="list-style-type: none"> - collagen - copolymers - polyurethanes 	<p>Bone grafting. Tissue regenerator.</p>	<ul style="list-style-type: none"> - Allows passage of fluids and nutrients for tissue regeneration. - No toxic - Hypoallergenic - Easy adaptation

Table 1 Classification of biomaterials: uses and properties

Review of dental applications in medicine wildlife published

In veterinary medicine there are several branches being a veterinary dentistry. Veterinary dentistry is a specialty that deals with biomedical diagnoses and treats pathologies present in the oral cavity of animals (Calderon ET. Al, 2014). But the materials used in dentistry have been applied, as well as for other purposes beyond the correction common oral problems animals as ocular prosthesis implantation in birds (Kummerfeld and Neumann, 1982) in human medicine.

In medicine wildlife dentistry is more preventive than curative since the purpose is to improve their quality of life and prevent future problems, so in the review by Calderon ET. Al., (2014), dental care mentioned in animals: from omnivorous small volume (monkeys I fell) to large-sized carnivores (lions, tigers, jaguars).

In this review only describe oral pathologies presented in animals and their treatment, noting that "the care of oral health needs for these species may well be provided by trained professionals and inserts dentists in half of interdisciplinary work."

But beyond dental cleanings, care caries, and tooth replacement or filing of teeth, dentistry provides useful materials to improve the quality of life of different species of wildlife, the most reported among the scientific community regarding the care of birds and turtles.

In avian medicine; the use of dental and orthodontic acrylic enabled hardware repair disfiguring and / or traumatic peak (Rupiper, 1993) injuries. The bill is a highly specialized organ that covers multiple functions in power, communication, hygiene (grooming) and even useful in mating behavior and nest building (White-Calva, 2013) hence the importance of maintaining its integrity.

Traumatic fractures at the peak, occur frequently in self-injure birds objects in their enclosure or cage as a result of territorial fights (Bennet, 2001; Ritchie et al., 1994.). Being fractures more clinical cases reported in the scientific literature concerning birds big or strong peak as Calaos and ranfastidos or toucans and other birds with long beaks (Acrosta, 2002; Morris, 1990).

About 1990 Morris, ET. al., reported the repair of fractured gnatoteca (lower portion of the beak) of an African marabou (*Leptoptilos crumeniferus*) by amputation and subsequent placement of a prosthesis methacrylate.

In 2002 Crosta reports two cases of fracture of the anterior portion of the peak (rinoteca) in ranfastidos. Unlike gnatoteca fractures, which compromise rinoteca are more difficult to handle by the presence of small bones and kinetics or mobile nature of this structure. In this case prosthesis placement peaks but with other birds were performed. In one case the peak was from the same species and the other of different species, however the dental material used in both cases was the same: the rubber mounting by applying cyanoacrylate and acrylic dental prosthesis binding with its beak.

There is a report in 2009 by Vilar, JM ET. Al, on repairing the peak of a hornbill (*Aceros plicatus*). This bird had a complete fracture of the gnatoteca and he made two treatments being one of the construction and establishment of a constructed with the support of a dental prosthesis.

Fecchio in 2008 and in 2010 performed very interesting papers on the strength of repaired with dental material which shows that the repaired specimens show a third of the tensile strength that has an original peak fractures. This should be taken into account as patients with prostheses do not eat food in its original form which shall be considered the owner or rehabilitation for the management of bird food. One of the benefits of using dentures is that they allow the immediate return of the injured to their normal functions Animal and give the owner the right time to incorporate into your routine new maneuvers in relation to feed and drink the bird (Morris, 1990).

In this regard the report Vilar, ET. al., (2009) the owner decided to leave the prosthesis since the animal and ate and drank without this. Thus in their work Fecchio, ET. al., (2008, 2010) recommends that the prosthesis fixation by toucans acrylic resin, other fastening techniques are also used as banding that allow the bird use the prosthesis with the original functions of the peak.

In 2013 the work of Torres, Maria Y. ET appears. Al., describing an entire protocol performed on a macaw (Ara Araunah) to repair a complete fracture of the peak (ranfoteca) by a dental prosthesis that even has the color of natural bird's beak. This work was performed by a multidisciplinary team and resulted in a prosthesis that allowed the normal life of the animal during the period of the union of the prosthesis to the face of the bird. As in the other cases this union was weakened by the use and had to correct regularly. So these authors recommend that the prosthesis should be examined regularly for loss of strength and endurance as well as the need for more studies like Fecchio ET. al., (2010) with respect to the pressing force and strength in different species of birds and the need to develop studies to innovate materials and techniques of setting fractures in birds.

Another condition commonly observed in birds in captivity is prognathism (larger than rinoteca gnatoteca) and the so called "peak scissor" lateral deviation or gnatoteca (Bennet, 2011). For treatment Schnellbacher ET. Al., in 2010 described a technique considered to have greater advantages than those commonly used; "Technical Clipsham" and technique using Kirschner wires (K needle).

The technique proposed by this author relies on rapid fixing a dental curing compound cold that uses the natural structure of the ranfoteca (peak) birds as support even requires deep anesthesia (in calm patients) and reduces incidence of iatrogenic damage that occurs with other techniques.

Self-mutilation in birds is a condition in which the correct identification of the origin of self-mutilation is a key factor for treatment as it can be, infectious, parasitic and behavioral nutritional origin. If the origin of self-mutilation or behavioral feather picking is there a series of steps to correct the cause of the stress of this behavior among these is the use of dental acrylic accessories. This report also has the characteristic that this applied to birds of prey, which are species in which this condition is rare. The dental acrylic is used to remove the sharp peak (or raptorial) is because the dental acrylic paints standing on the peak and transforms it into a rounded peak that prevents damage to the bird also occurs. Smith (2009) highlights the importance of proper diagnosis and the use of this treatment as the last alternative in these cases.

Birds also have lesions in their upper limbs (wings) and pelvic (legs). Among the injuries associated with these body regions are the presence of fractures, which compensation includes the use of splints as a means of restraint; to surgical procedures (Harcourt-Brown, 2002) regard; called methylmethacrylate acrylic resin (MMC) has been used to create splints and can fulfill the function of connecting rod-stabilizer in reducing fractures, allowing pinning even in multiple planes in spinal surgery (Rupiper, 1993; Cavero, 2005).

Rupiper (1993) uses a compound in the light curing splinting bird. This type of procedure can be used in birds of different sizes: from estrildids (known as finches or birds diamond) to individuals of African gray parrot (*Psittacus erithacus*) without using the Elizabethan collars how uncomfortable they are for non-human vertebrates patients. In small birds, the use of epoxy resins are almost forced because not exist in the appropriate market that size bearings (García Plana, 2008).

15-28% of raptorial bird order (hawks, eagles, hawks) presented in veterinary clinics have eye injuries large proportion caused by trauma. Severe eye injuries requiring enucleation or evisceration content ocular cavity. These surgical techniques in birds cause a bad aesthetic and worse cause an asymmetric distribution of weight in the head, preventing the flight and decreasing its activity to hunt, to decrease this use of silicone implants is presented in spherical form, including in the case described by Graham, et. al., (1999) allowed the bird in treatment be released to the wild.

All clinical case reports are accompanied by photographs that explain part of the process to perform the procedures. But to be performed must be taken into account variables such as: (. Schnellbacher 2010 et al.) Patient age, patient owner, the ability and willingness of the patient to be manually fed. Moreover, in case of fracture repair; treatment success is directly related to the extent of the fracture and the affected area, with fractures near the most complicated face due to biomechanical forces suffered during the post-surgical (Torres, Maria Y., et. al. 2013). While dentures are not as secure as for the patients to return to nature, anyway lets them more autonomy and method can serve as a basis for better prosthetics for wild animals in the future.

Other unconventional patients attending veterinary clinics are turtles. Some common disorders of this type of patient is traumatic lesions of the carapace and plastron. These injuries are caused by attacks from other animals or, in case of exposure given free life boats or cars (Bennet. ET. Al., 2013). For the repair of these anatomical structures are used various materials such as: (Santos et al, 2009) fiberglass, epoxy resin, polyester resin, dental acrylics, cellulose acetates associated with cyanoacrylate adhesives and others.

Turtles also present limb fractures and splints created with heat sensitive plastic or acrylic materials can be used to stabilize fractures of long bones - radio (Mitchelle, 2002).

The group of mammals is no slouch in terms of use of biomaterials in their rehabilitation, about the search on report of a red deer (*Cervus elaphus*) found exposed at the level of the distal end of the metacarpal fracture right which you put a prosthetic carbon fiber cover material simulating hair. A state of good health after six months that the animal has been observed is reported (Erdikmen, ET. Al., 2012). The report also highlights the implantation of a silicone prosthesis of 43 mm in diameter in a flame underwent nucleation transparpebral presenting a neoplasm called retinoblastoma (Fugaro, ET. Al., 2005).

This brief review refers to wild animals, but in the use of biomaterials in common pets like dogs and cats and even farm animals, literature is extensive so the use of biomaterials in veterinary medicine presents a wide field of research and application.

Throughout history, millions of species have disappeared due to natural disasters, however, today, uncontrolled hunting and affectations having some birds, has led to the death and thus the disappearance of some species. Aprile (1996).

The growth has not been environmentally sustainable. With the increase of the Gross Domestic Product (GDP) grew the carbon dioxide emissions, waste generation and waste water discharge which reduced the cover of forests.

According to estimates from the National Institute of Statistics and Geography (INEGI), the total cost of depletion and environmental degradation represented 6.5% of GDP in 2011.

Within the Sector Program of Environment and Natural Resources 2013-2018, one of the objectives is precisely the conservation of forests and woodlands and the different species of animals than they are.

In the state of Campeche, there are birds that are endangered, which include: yellow-headed parrots, blue headed parrot, white-fronted parrots, songbirds and others.

This paper presents a proposal for the rehabilitation of wildlife is presented for the purpose of conservation of those species, making the quality of life and the permanence of their species in its habitat is improved.

While costs may vary depending on the number of animals that will implement the reconstruction, the greater the number of animals treated, decrease costs, achieving a higher profit. However, the aim is to increase the years of life of animals avoiding the extinction of their species.

The impact to be achieved is for the conservation of birds are endangered.

- Sector Program of Environment and Natural Resources from 2013 to 2018. SEMARNAT.

- April, GC Bertonatti 1996 Wildlife Rehabilitation Manual.

Conclusions

Biomaterials are a tool to improve the lives of injured wildlife animals, allowing them to maintain their vital functions. In some cases through planned rehabilitation programs allows them to return to the wild, so biomaterials are useful tools in the conservation of species.

There are few publications on the use of biomaterials used in the care of wildlife. Because of the importance in the conservation of several species of wildlife, and limited medical information about these animals; scientific publication of such clinical cases is necessary.

The development of multidisciplinary teams become necessary to provide good support treatment care is injured wild animals, domestic production or fauna.

Reference

Blancas-Calva, E. (2013). Un caso de deformación del pico en el tordo cabeza café (*Molothrus ater*). *Huitzil*, 14(1), 75-78.

Bennett, A. M., & Litzgus, J. D. (2013). Injury Rates of Freshwater Turtles on a Recreational Waterway in Ontario, Canada. *Journal of Herpetology*.

Bennett, R. A. (2011). Surgery of the Avian Beak. In Proceedings of the Association of Avian Veterinarians, 32nd Annual Conference. Seattle (WA) (pp. 191-5).

Calderón, Z. A., Crespo, M. V., Montilla, G. Y., Paris, I., & Rojas, I. P. (2014). Odontología veterinaria: Revisión de la literatura. Revista Venezolana de Investigación Odontológica, 2(1), 46-59.

Cavero, A., & Fernández, A. (2005). Utilización del acrílico dental (metil metacrilato) como barra estabilizadora-conectora para reducciones cerradas en fracturas de tibia/peroné o radio/cúbito en caninos. Revista de Investigaciones Veterinarias del Perú, 16(1), 17-23.

Acrosta, L. (2002). Alloplastic and heteroplastic bill prostheses in 2 ramphastidae birds. Journal of avian medicine and surgery, 16(3), 218-222.

Erdikmen, D. O., Özsoy, S., & Aydin, D. (2012). Partially Forelimb Amputation and Application of An Artificial Limb (Prosthetics) in A Free-Ranging Red Deer (*Cervus elaphus*). Kafkas Üniversitesi Veteriner Fakültesi Dergisi, 18(2), 347-350.

Fecchio, R. S., Gomes, M. S., Kolososki, J., Petri, B. S. S., Jr, J. L. R., & Gioso, M. A. (2008). Estudo da biomecânica oclusal e da aderência da resina acrílica auto-polimerizável (polimetilmetacrilato) em fraturas de rinoteca de tucanos (*Ramphastos toco*). Pesq. Vet. Bras, 28(7), 335-340.

Fecchio, R. S., Seki, Y., Bodde, S. G., Gomes, M. S., Kolososki, J., Rossi Jr, J. L., & Meyers, M. A. (2010). Mechanical behavior of prosthesis in Toucan beak (*Ramphastos toco*). Materials Science and Engineering: C, 30(3), 460-464.

Fugaro, M. N., Kiupel, M., Montiani-Ferreira, F., Hawkins, J. F., & Janovitz, E. B. (2005). Retinoblastoma in the eye of a llama (*Llama Glama*). Veterinary ophthalmology, 8(4), 287-290.

García-Plana, C., Cía, A., Picazo, R., Daza, M. A., García, E., Fragío, C. & Martínez, Y. (2008). Estudio retrospectivo de 11 casos de fracturas de cúbito en aves salvajes. REVISTA OFICIAL de, 321.

Graham, J. E., Larocca, R. D., & McLaughlin, S. A. (1999). Implantation of an intraocular silicone prosthesis in a great horned owl (*Bubo virginianus*). Journal of Avian Medicine and Surgery, 98-103.

Harcourt-Brown, N. H. (2002). Orthopedic conditions that affect the avian pelvic limb. Veterinary Clinics of North America: Exotic Animal Practice, 5(1), 49-81.

Mitchell, M. A. (2002). Diagnosis and management of reptile orthopedic injuries. Veterinary Clinics of North America: Exotic Animal Practice, 5(1), 97-114.

Morris, P. J., & Weigel, J. P. (1990). Methacrylate beak prosthesis in a Marabou stork (*Leptoptilos crumeniferus*). Journal of the Association of Avian Veterinarians, 4(2), 103-106.

Neumann, U., & Kummerfeld, N. (1982). [Implantation of an ocular prosthesis in a gray parrot]. Tierärztliche Praxis, 11(2), 195-199.

Puc Gil Román Abraham, Retana Guiascón Gustavo. (2012). Uso de la fauna silvestre en la comunidad maya Villa de Guadalupe, Campeche, México, Etnobiología, Vol. 10, No.2, pp. 1-11.

Rupiper, D. J. (1993). Application of Visible Light Curing Composite Splints to Fractured Avian Legs. *Journal of the Association of Avian Veterinarians*, 147-149.

Santos, A. L. Q., Silva, L. S., & Moura, L. R. (2009). Reparação de fraturas de casco em quelônios= Shell repair fractures in chelonians. *Bioscience Journal*, 25(5).

Smith, S. P., & Forbes, N. A. (2009). A Novel Technique for Prevention of Self-mutilation in Three Harris' Hawks (*Parabuteo unicinctus*). *Journal of avian medicine and surgery*, 23(1), 49-52.

Vilar, J. M., Altilia, G., & Spinella, G. (2010). Aspectos clínicos en la reparación del pico en un Cálao (*Aceros plicatus*, Foster 1781) mediante dos técnicas diferentes. *REDVET. Revista Electrónica de Veterinaria*, 11(1), 1-5.

Wheler, C. L. (2002). Orthopedic conditions of the avian head. *Veterinary Clinics of North America: Exotic Animal Practice*, 5(1), 83-95.

Schnellbacher, R. W., Stevens, A. G., Mitchell, M. A., Beaufre, H., & Tully Jr, T. N. (2010). Use of a Dental Composite to Correct Beak Deviation in Psittacine Species. *Journal of Exotic Pet Medicine*, 19(4), 290-297.

Villegas M. Angela. (2008) Tests of biocompatibility for dental materials. Review of the literature; *Rev. Estomat*, 16(2), 38-44.

Shalaby W. Shalaby. (1984) *Polymers and biomaterials*. New York, Plenum Press.