VETERINÁRIA NOTÍCIAS

CASE REPORT

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USE OF PROSTHESIS IN A CAPARACE FRACTURE OF *Chelonoidis carbonarius* (Testudines: Testudinidae)

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Abstract: Testudines are members of the Reptilia class, they are ectothermic and differ from other reptiles by the presence of the shell, which covers most of their bodies. Shell fractures are common in these animals and can occur due to several factors, mainly trauma. This paper aims to report the use of prosthesis in a red-footed tortoise (*Chelonoidis carbonarius*). An adult female weighing 2.45 kg was sent to the Wild Animal Sector of Veterinary Hospital of University of Brasilia. The specimen presented carapace fracture caused by compress of garbage truck. Even after healing the lesion, there was persistent communication between the coelomic cavity and the environment, which caused recurrent pneumonia. After stabilization of the patient and treatment of infections, an adhesive cover was placed to isolate the coelomic cavity, which was changed periodically. Moreover, it was decided to make a prosthesis with acrylic resin, since it was not feasible to perform the repair by conventional methods. The method was satisfactory in the sealing of the carapace and the animal was monitored for a month without showing signs of pneumonia or any other complications.

Keywords: red-footed tortoise, reconstruction, reptiles, shell.

INTRODUCTION

The class Reptilia is divided into two subclasses, Anapsida, with the Testudines order, and the Diapsida, comprising Squamata, Crocodylia and Rhynchocephalia orders.

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Like other reptiles, the testudines are ectothermic and one of their particularities is the presence of the shell that surrounds the body. The order Testudines is divided into two suborders, Cryptodira, with vertical retraction of the neck, with representatives of aquatic, semiaquatic and terrestrial habits, and Pleurodira, whose representatives live in freshwater, retract the neck horizontally, have the intergular shield, except for sea turtles, and the pelvis fused to the plastron (DUTRA, 2014).

The handling of testudines is considered of low risk, since physical restraint is simple, being done by the sides of the body or caudal region of small and medium specimens (JEPSON, 2016). During the physical evaluation, an inspection of the shell should be carried out, since this structure has the same protective function as the skin and, when damaged, can be an infection gateway for bacteria, fungi, and parasites. Shell fractures are not uncommon, and the cause is multifactorial, ranging from domestic accidents to nutritional problems (BARTEN, 2006; ROFFEY & MILES, 2018).

Before performing the shell repair, it is necessary to evaluate and stabilize the patient, clean, debride and dry the wound (KAPLAN, 2002). The principles of fracture fixation must be applied in these situations, for this, the traction forces present must be minimized, which will result in good healing (DUTRA, 2014). Many materials can be used for hull fracture fixation, such as fiberglass, epoxy and polyester resin, dental acrylic resin, wire, transparent mesh (KAPLAN, 2002), screws, orthopedic plates, hooks, and orthopedic wires (MONTORO, 2018).

In some cases, there may be insufficient tissue for total fracture consolidation, which makes the use of conventional techniques difficult. In these situations, synthetic prosthesis can be used to restore the original shape and isolate the coelomic cavity from the external environment. The present study aimed to report a case of placement of a carapace prosthesis in a specimen of the red-footed tortoise (*Chelonoidis carbonarius*).

CASE REPORT

On August 11, 2015, an adult specimen of the species *Chelonoidis carbonarius*, female, weighing 2.45 kg, was forwarded to the Wild Animal Sector of Veterinary Hospital of University of Brasilia (HVet-UnB) by the Wild Animal Screening Center of Distrito Federal (CETAS-DF), Brasilia, Brazil. The animal was rescued from a garbage truck, in which the compacting press had fractured its carapace.

In the clinical examination, the presence of an incomplete fracture in the region of the vertebral shields of the carapace was observed and the animal presented apathy, with difficulty in locomotion. For analgesia, morphine[1] was prescribed at a dose of 4 mg/kg, intramuscularly (IM), once a day (GIBBONS et al., 2017).

On August 31, the presence of myiasis was verified in the fractured region. The larvae were manually removed, daily cleaned and chlorpyrifos[2] applied around the region.

[1] Morphine Sulfate 10 mg/ml, Hipolabor , Belo Horizonte, MG, Brazil.

[2] Lepecid® Spray 5g, Ourofino , Cravinhos, SP, Brazil.

The following day, a single dose of 5 mg/kg IM of levamisole[3] was applied (GIBBONS et al., 2017). After this episode, there was an evolution in fracture consolidation, with absence of secretion and beginning of granulation tissue formation.

Approximately six months after receiving the tortoise, the wound healed and, consequently, the frequency of cleaning was reduced. After one year, there was loss of mobility of the bone fragment, however without alignment with the rest of the carapace. Due to the non-alignment, it was suspected that the communication between the coelomic cavity and the external environment persisted due to three episodes of pneumonia in a period of six months, which occurred mainly in rainy seasons. To avoid new infections, a temporary seal of the carapace with tape was used, which was changed every 15 days.

In 2018, with the aim of improving the quality of life of the specimen, it was decided to manufacture a synthetic prosthesis. Initially, a mold of the deformation of the carapace was made with alginate[4]. Then, acrylic resin5 was used to produce a second mold, similar to the carapace failure, so that the prosthesis was sculpted without compromising the animal. The area of the lesion mimicked in the acrylic resin mold was isolated with varnish and filled with acrylic resin, so that a cover was formed to be fitted to the animal's deformation. Subsequently, the prosthesis was finished with the aid of a micro grinder, fixed with two-component epoxy[6] putty and painted with gouache paint[7] (Figure 1).

FIGURE 1 - Stages of the carapace prosthesis production for a *Chelonoidis carbonarius*. A: Fracture consolidated in vertebral shields of the carapace. B: Positioning of the specimen for the impression of the fracture in an orthodontic mass; C: First alginate mold. D and E: Acrylic resin mold mimicking the fracture. F: Second mold for making the acrylic resin prosthesis. G: Acrylic resin prosthesis. H: Prosthesis test on the tortoise for molding. I: Finished prosthesis and fixed to the carapace with epoxy putty. J: Final appearance of the prosthesis after painting with gouache paint.

DISCUSSION

Fractures in the shell of testudines can promote communication between the external environment and the coelomic cavity and predispose to infection, sepsis and death (SELLE-

[3] Ripercol® L Injectable 7.5%, Zoetis® , São Paulo, SP, Brazil.

[4] Dencrigel Alginate Dencril® 410g, Dental Cremer, Blumenau, SC, Brazil.

[5] Acrylic Resin , Classic, Campo Limpo Paulista , SP, Brazil.

[6] Durepoxi Solid, Loctite® , São Paulo, SP, Brazil.

[7] Tempera Guache, Acrilex®, São Bernardo do Campo, SP, Brasil.

RA et al., 2013; LONG, 2016). In the present report, this situation was observed in the specimen of *C. carbonarius* and caused complications related to recurrent pneumonia.

Bernardi et al. (2011) and Gomes et al. (2015) reported exposure of the coelomic cavity in testudines, due to trampling and dog bite, respectively. In the first case, there was rupture of the pleura and involvement of the lung in a mud turtle (*Kinosternon scorpioides*). In the second situation Gomes et al. (2015) discussed the exposure of the coelomic cavity, with liver and lung injury in a red-footed tortoise (*C. carbonarius*). In both cases, the treatments had a satisfactory result, without occurrence of deaths, as reported in this study. It was not possible to determine whether there was involvement of internal organs in the testudine in question, but no signs of active bleeding or suggestive radiographic changes were observed.

The treatment performed by Gomes et al. (2015), for lateral fractures of the tortoiseshell carapace involved cleaning the wound with saline solution and diluted degerming chlorhexidine, placing a dressing, antibiotic therapy, analgesics, anti-inflammatory drugs, fluid therapy and vitamin and mineral supplementation. The authors reported healing and closure of the coelomic membrane in two months, such observation in the animal of the present study was not possible due to the conformation of the fracture.

The consolidation of carapace fractures is a slow process that demands energy from the patient, whose metabolism is dependent on ambient temperature (LONG, 2016; ROFFEY & MILES, 2018). Keeping the animal in thermal conditions considered optimal, associated with the monitoring of other factors such as calcium level, contributes to a more effective healing. Because the bone fragment was already consolidated at the time of the decision to implement the prosthesis, there was no need for calcium supplementation in the animal's diet or environmental temperature control.

Valente et al. (2012) reported that placement of hemicerclage and epoxy resin promoted shell fracture healing in a d'orbigny's slider (*Trachemys dorbigni*) within 60 days. Sellera et al. (2013) state that the use of photodynamic therapy followed by red laser irradiation resulted in re-epithelialization and competent keratinization after four sessions, in 28 days, for the treatment of a green turtle (*Chelonia mydas*) shell fracture. In the present report, the loss of mobility of the fractured bone fragment occurred approximately after one year of treatment, probably due to the extension and positioning conditions of the bone fragment.

Bernardi et al. (2011) described a fracture coaptation performed using the cerclage technique, associated with the use of dental acrylic to seal and mobilize the fracture. In the present report, it was noted that conventional methods of coaptation repair would not align the displaced fragment, since it was consolidated, which would require a surgical fracture in the carapace.

The choice of technique and materials for making prostheses depends on the general condition of the fracture and its comple-

xity, in addition to the species, age and physical condition of the animal (SOUZA, 2006; SANTOS, 2009). There are recent reports of the use of prostheses developed with 3D printers (SANTOS et al., 2020; GUINNESS, 2021). However, in this report, the technique used was chosen due to the availability of more accessible and low-cost materials, in addition to the fact that it was not necessary to drill the shields to attach the prosthesis. Care should be taken to ensure that the acrylic resin would not contact directly to the animal's body before hardening, and avoid burns in the cavity due to the increase in temperature that the resin promotes when polymerizing.

The use of the prosthesis proved to be effective during the observation period and presented a satisfactory fit in the fracture with good sealing. No cases of pneumonia were observed after its placement, which improved the quality of life of the specimen as there was no longer the need to change the bandage frequently. However, a longer follow-up period is still necessary to evaluate its effectiveness to avoid pneumonia, as well as to change the part due to the animal's growth or wear of the manufacturing and coupling material. This technique can be reproduced for other cases related to fractures involving part of the shell, in which it is not possible to perform osteogenic distraction or fracture closure by conventional methods.

CONCLUSION

Although the placement of prostheses is an efficient technique in cases of great tissue damage and/or impairment of function, there are few studies addressing the use of different materials in the manufacture of these devices for testudines. In the present work, the prosthesis made with acrylic resin in an initial alginate mold proved to be a viable, cheap, and effective option, which makes its use possible when there is partial loss of the structure, with a satisfactory result in the recovery of the animal during the observation period.

EMPREGO DE PRÓTESE EM FRATURA DE CARAPAÇA DE *Chelonoidis carbonarius* (Testudines: Testudinidae)

Resumo: Os testudines pertencem à classe Reptilia, são ectotérmicos e se diferem dos demais répteis pela presença do casco, que envolve a maior parte de seus corpos. Fraturas nesse arcabouço ósseo são comuns e podem ocorrer devido a diversos fatores, principalmente traumas. O presente trabalho tem como objetivo relatar um caso de colocação de prótese em casco de jabuti-piranga (*Chelonoidis carbonarius*). Um exemplar adulto, fêmea, de 2,45 kg, foi encaminhado ao Setor de Animais Silvestres do Hospital Veterinário da Universidade de Brasília. O espécime apresentava fratura de carapaça provocada por prensas compactadoras de um caminhão de coleta de lixo domiciliar. Mesmo após a cicatrização da lesão, houve persistência de uma comunicação da cavidade celomática com o meio externo, o que ocasionava quadros de pneumonia recorrentes. Após estabilização do paciente e tratamento das infecções, foi colocada uma cobertura com esparadrapo para isolar a cavidade celomática, que era trocada periodicamente. Posteriormente, decidiu-se pela confecção de uma prótese feita de resina acrílica, visto que não era viável realizar o reparo por técnicas convencionais. O método se mostrou satisfatório na vedação da carapaça e o animal foi acompanhado durante um mês sem demonstrar indícios de pneumonia ou qualquer complicação.

Palavras-chave: jabuti-piranga, casco, reconstrução, répteis.

BIBLIOGRAPHIC REFERENCES

BARTEN, S. L. Shell Damage. In: MADER, D. R. **Reptile medicine and surgery.** 2ed. Philadelphia: W. B. Saunders Elsevier Company, p.893-899, 2006. https://doi.org/10.1016/B0-72-169327-X/50071-7

BERNARDI, E. L.; REOLON, M.; FINKLER, F.; DIAZ, J. S.; CARDONA, R. O. C.; MARTINS, D. B. Fratura de casco em quelônio - relato de caso. In: Seminário Interinstitucional de Ensino, Pesquisa e Extensão, 2011, 16, Cruz Alta. **Anais...**Cruz Alta: Unicruz – Centro Gráfico, 2011.

GIBBONS, P. M.; KLAPHAKE, E.; CARPENTER, J. W. Reptiles. In: CARPENTER, J. W.; MARION, C. J. **Exotic Animal Formular**. 5 ed. Philadelphia: Saunders, cap.4, p.108-189, 2017.

DUTRA, G. H. P. Testudines (Tigre d'água, cágado, jabuti). In: CUBAS, Z. S.; SILVA, J. C. R. **Tratado de Animais Silvestres – Medicina Veterinária**. São Paulo: Roca, 2014. cap.16, p.219-258.

GOMES, R. P.; RIBEIRO, V. L.; PASCHOALOTTI, M. H.; KOKUBUN, H. S.; MARQUES, G. C.; COSTA, A. L. M.; TEIXEIRA, R. H. F. Tratamento de ferida em jabuti-piranga (*Chelonoides carbonaria*) mordido por um cão. **Revista MV & Z**, São Paulo, v.13. n.2, p.47, 2015.

GUINNESS, G. ***Guinness World Records* 2022**. Rio de Janeiro: HarperCollins Brasil, 2021, 226p.

JEPSON, L. **Tortoises and Turtles**. 2.ed. In:___. **Exotic Animal Medicine:** a quick reference guide. Saint Louis: Elsevier, cap.12, p.425-474, 2016.

KAPLAN, M. Turtle and Tortoise Shell Repair. **Herpetological Care Collection: Los Angeles.** 2002. Disponível em: http://www.anapsid.org/shellrepair.html. Acesso em 14 dez. 2018.

LONG, S. Y. Approach to Reptile Emergency Medicine. **Veterinary Clinics of North America: Exotic Animal Practice,** Baltimore, v.19, n.2, p.567-590, 2016. https://doi.org/10.1016/j.cvex.2016.01.013

MONTORO, M. M. Restauração de casco em testudines. **Revista Científica de Medicina Veterinária**, Garça, v.15, n.31, p.1-9, 2018.

ROFFEY, J.; MILES, S. Turtle Shell Repair. In: DONELEY, B.; MONKS, D.; JOHNSON, J.; CARMEL, B. **Reptile Medicine and Surgery in Clinical Practice.** 1.ed. Hoboken: Wiley Blackwell - John Wiley & Sons Ltd, 2018, cap.29, p.397-408. https://doi.org/10.1002/9781118977705.ch29

SANTOS, A. L. Q.; SILVA, L. S.; MOURA, L. R. Reparação de fraturas de casco em quelônios. **Bioscience Journal,** Uberlândia, v.25, n.5, p.108-111, 2009.

SANTOS, I.; NETO, M. O.; OLIVEIRA, M.; SCHETTINO, S. & LIMA, V. Prótese parcial removível de carapaça na reabilitação de jabuti-piranga (Chelonoidis carbonaria SPIX, 1824): relato de caso. **Enciclopédia biosfera**, Centro Científico Conhecer – Jandaia – GO, v.17, n.34, p.417-428, 2020.

SELLERA, F. P.; FERNANDES, L. T.; TEIXEIRA, C. R.; POGLIANI, F. C.; DUTRA, G. H. P.; NASCIMENTO, C. L. Terapia fotodinâmica na consolidação de fratura de carapaça em tartaruga-verde (*Chelonia mydas*). **Natural Resources**, Aquidabã, v.3, n.1, p.49-55, 2013. https://doi.org/10.6008/ESS2237-9290.2013.001.0005

SOUZA, R. A. M. **Comparação de diferentes protocolos terapêuticos na cicatrização de carapaça de tigres d'água (*Trachemys sp*).** 2006, 62p. Dissertação (Mestrado em Ciências Veterinárias) - Universidade Federal do Paraná, Londrina, PR, 2006.

VALENTE, P. E.; PAIVA, R. C.; NETO, G. S.; SEABRA, M. G. L.; JÚNIOR, M.C.; PONTES, K. C. S. Fixação de fratura de carapaça de cágado *Trachemys dorbignyi* (Tigre-d'água) com resina epóxi e hemicerclagem. In: SIMPÓSIO DE PESSOAS, ARQUITETURA E CIDADE, 4., 2012, Viçosa. **Anais...** Viçosa: UNIVIÇOSA, 2012, p.193-198.