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ZOOLOGY

Anatomical description of the salivary glands: parotid, mandibular and sublingual of the crab-eating-fox (*Cerdocyon thous*)

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ABSTRACT. Descriptive anatomical studies of wild animals are fundamental, since they provide subsidies for the elaboration of more adequate techniques of sustained management, contributing to the preservation of species threatened with extinction. Thus, the aim of the study is to anatomically describe the salivary glands: parotid, mandibular and sublingual of the crab-eating-fox (*Cerdocyon thous*). For this purpose, three carcasses of crab-eating-fox donated by Ibama were used. The animals were fixed with 10% aqueous formaldehyde solution, dissected, analyzed descriptively and photographed. It was found that the parotid gland of the crab-eating-fox is located caudally to the branch of the mandible, in the rostroventral margin of the auricular cartilage. The mandibular gland is located in the atlantal fossa and extends to the basi-hyoid bone. The sublingual gland of the crab-eating-fox shows two parts: monostomatic and polystomatic. The monostomatics are located in the occipitomandibular region of the digastric muscle and the portion polysomatic is situated between the tunica mucosa of the oral cavity and the buccinator muscle. Based on the results, we conclude that the salivary glands of the crab-eating-fox are found distributed in the facial region and present anatomical characteristics that follow the same structural pattern described for other species of carnivorous mammals.

Keywords: comparative anatomy; wild animals; carnivores; morphology.

Descrição anatômica das glândulas salivares: parótida, mandibular e sublingual do cachorro-do-mato (*Cerdocyon thous*)

RESUMO. Estudos anatômicos descritivos de animais silvestres são fundamentais, pois fornecem subsídios para a elaboração de técnicas mais adequadas de manejo sustentado, contribuindo com a preservação de espécies ameaçadas de extinção. Dessa forma, o objetivo do estudo é descrever anatomicamente as glândulas salivares: parótida, mandibular e sublingual do cachorro-do-mato (*Cerdocyon thous*). Para isso, foram utilizadas três carcaças de cachorro-do-mato doados pelo Ibama. Os animais foram fixados com solução aquosa de formol a 10%, dissecados, analisados descritivamente e fotografados. Constatou-se que a glândula parótida do cachorro-do-mato situa-se caudalmente ao ramo da mandíbula, disposta na margem rostroventral da cartilagem auricular. A glândula mandibular está situada na fossa atlantal e estende-se até o osso basi-hióide. A glândula sublingual do cachorro-do-mato apresenta duas porções: monostomática e polistomática. A monostomática situa-se na região occiptomandibular do músculo digástrico e a polistomática entre a túnica mucosa da cavidade oral e o músculo bucinador. Com base nos resultados concluímos que as glândulas salivares do cachorro-do-mato são encontradas distribuídas pela região facial e apresentam características anatômicas que seguem o mesmo padrão estrutural descrito para outras espécies de mamíferos carnívoros.

Palavras-chave: anatomia comparativa; animais silvestres; carnívoros; morfologia.

Introduction

Comparative Anatomy is the Science that studies the morphology and anatomical structures that make up living beings, establishing a comparative and evolutionary analysis between organisms (Kardong, 2016). Currently the Comparative Anatomy presents high development, mainly due to the degradation and fragmentation of the natural environments (Leonel et al., 2013), which has resulted in the extinction of numerous species. In this concern, descriptive anatomical studies of wild animals are fundamental, since they provide important basic information for the knowledge about the biology and originate parameters that can be used as conservation strategies of the species (Margules & Pressey, 2000; Purvis, Gilttleman, & Brooks, 2005). In addition, these studies promote

subsidies for the elaboration of more adequate techniques of sustainable management, contributing to the preservation of endangered species (Caughley & Sinclair, 1994; Begon, Harper, & Townsend, 1996).

The crab-eating-fox is a neotropical wild canid that shows a wide distribution in South America (Machado & Hingst-Zaher, 2009; Trigo, Rodrigues, & Kasper, 2013). This species exhibits omnivorous feeding habit, and its diet is based on small vertebrates, invertebrates and fruits (Perini, Russo, & Schrago, 2010; Kasper, Trinca, Sanfelice, Mazim, & Trigo, 2014). According to Rocha, Reis, and Sekiama (2004), the crab-eating-fox plays an important role as a seed disperser due to its feeding habits. To perform this function, these animals shows salivary glands that play a relevant role in the enzymatic degradation of fruits and seeds (Rocha et al., 2004). In addition, the salivary secretions produced in these organs assist in the lubrication, chewing and swallowing of foods (Kardong, 2016). Thus, morphological parameters of the salivary glands can provide important information for the management of this species, assisting professionals who work in zoos and conservation units (Souza Junior, Mattos, Carvalho, & Santos, 2014). The anatomical description of salivary glands in wild species it is also an essential tool for understanding some zoonoses, such as rabies. Rabies virus initially multiplies in the cells near the site of inoculation, and then penetrates the peripheral nerves and spreads to the central nervous system and the salivary glands. Thus, the salivary glands are considered the natural reservoirs of rabies and wild animals are the main responsible for the transmission of this virus to humans (Acha & Szyfres, 1986).

Given the importance of the salivary glands and the scarcity of detailed information about the anatomical aspects of these organs in wild animals, the purpose of the present study is to anatomically describe the salivary glands: parotid, mandibular and sublingual of the crab-eating-fox (*Cerdocyon thous*). This work is the first to anatomically describe the three salivary glands present in this species, providing results for new considerations and implications on these organs.

Material and methods

This study is conducted in accordance with the ethical principles of the Brazilian College of Animal Experimentation (Cobea). In addition, we submit this work for analysis of the Ethical Committee on the use of animals (Ceua) of the *Centro Universitário de Rio Preto* (Unirp), with protocol number 01/17. In this study, three carcasses of the crab-eating-fox (*Cerdocyon thous*) (two males and one female of approximately three years) donated by Ibama were used, after they are collected in the northwest region of the state of São Paulo. The carcasses animals were fixed with 10% aqueous formalin solution (subcutaneous, intramuscular and intracavitary injections) and stored immersed in the same solution until processing (dissection). The preparation of the anatomical pieces followed standard techniques in macroscopic anatomical studies, with the use of scalpels, scissors and tweezers. For the macroscopic analysis, the salivary glands were dissected and photographed.

Results and discussion

Based on the dissections we observed that the parotid gland of the crab-eating-fox shows a grayish-yellow coloration, is distinctly lobulated and contains a larger volume compared to the other salivary glands. Shows an irregular triangular shape and a notch in its dorsal portion due to its proximity to the auricular cartilage. The parotid is located caudally to the branch of the mandible, disposed in the rostroventral margin of the auricular cartilage, at the level of the junction between the cranial and cervical regions. The ventral region of the parotid partially covers the superior margin of the mandibular gland, in this region the origin of the parotid duct is found, responsible for draining the saliva into the mouth vestibule. The parotid duct is formed by numerous radicles that originate in the ventral region of the gland, near the facial margin. These radicles present a rectilinear path on the lateral face of the masseter muscle and are ventrally parallel to the buccal branches of the facial nerve (Figure 1).

The mandibular gland of the crab-eating-fox shows a light-yellow color and a rounded outline. The referred gland is located in the atlantal fossa, extending to the basi-hyoid bone. It is partially covered by the parotid gland and the maxillary vein (Figure 2). The mandibular duct is situated in the deep face of the gland, that is, in its concave margin, and is composed by the union of small radicles. The radicles present a rectilinear trajectory that walk rostrally to the intermandibular region, until reaching the floor of the oral cavity.

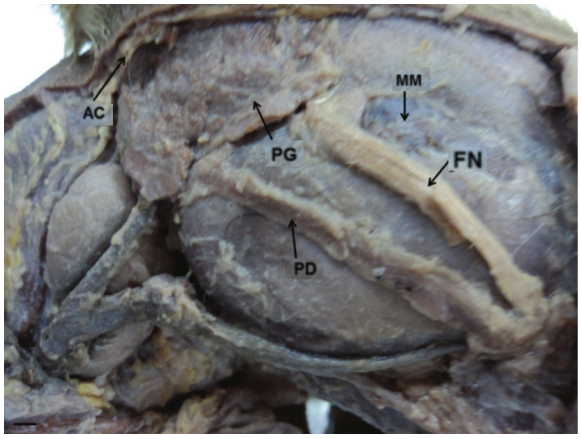

Figure 1. Photograph of the right lateral face of the crab-eating-fox, presenting the parotid salivary gland (PG), parotid duct (PD), auricular cartilage (AC), facial nerve (NF) and masseter muscle (MM).

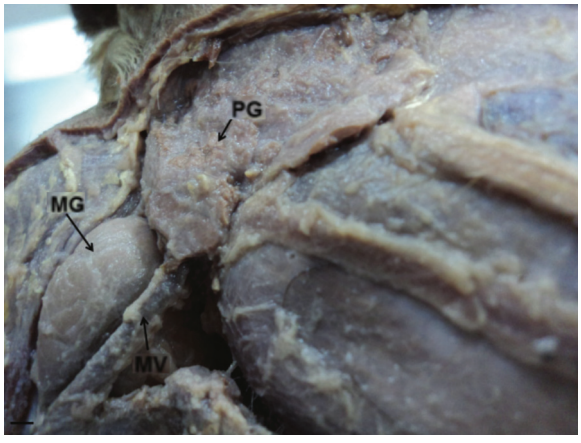

Figure 2. Photograph of the right lateral face of the crab-eating-fox, presenting the mandibular salivary gland (MG), parotid gland (PG) and maxillary vein (MV).

The sublingual gland of the crab-eating-fox shows two parts, a region named monostomatic and a rostral called polystomatic. The monostomatic sublingual gland is located in the occiptomandibular portion of the digastric muscle, it is in direct contact with the caudal region of the mandibular gland and is partially covered by the linguofacial vein (Figure 3A). Displays a duct of secretion named greater duct sublingual and that follows the path of the mandibular duct. On the other hand, the polystomatic sublingual gland lies between the mucosal tunica of the oral cavity and the buccinator muscle (Figure 3B).

The anatomical description of the salivary glands of wild species is fundamental, since they provide basic information for the knowledge of the species biology. This information can be used as conservation strategies, clinical treatments and the preservation of endangered species. In addition, the morphological information of the salivary glands obtained in this study can assist health professionals in the combat and control of zoonoses, such as rabies. Wild animals such as crab-eating-fox and bats are the main transmitters of rabies to humans (Acha & Szyfres, 1986) and the salivary glands are organs that serve as the installation and replication of this virus. Thus, morphological aspects of the salivary glands can serve as a tool for health professionals in deciding prophylactic measures. Despite the importance, information on the anatomical aspects of the salivary glands in crab-eating-fox is scarce in the literature.

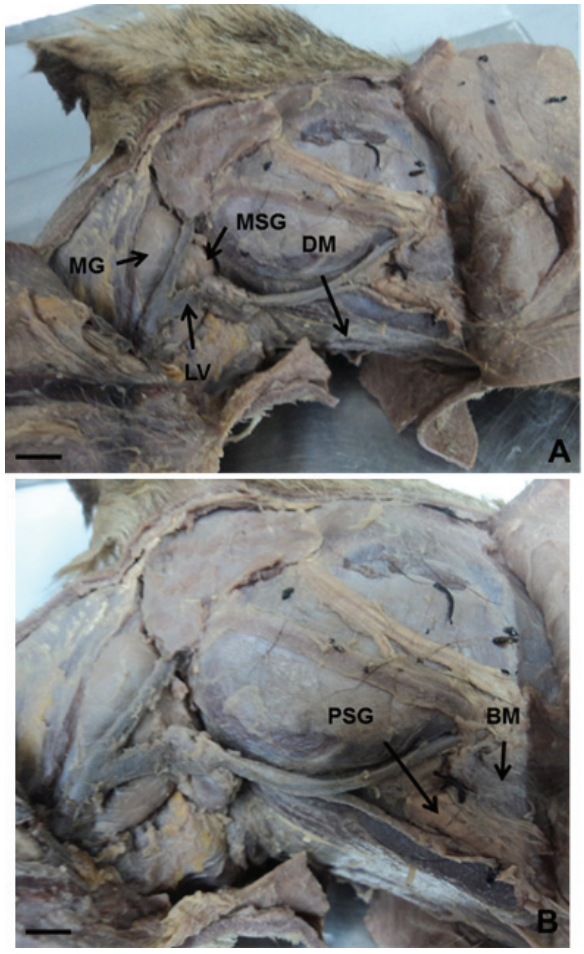

Figure 3. Photograph of the right lateral face of the crab-eating-fox. (A): Presenting the monostomatic sublingual gland (MSG), mandibular gland (MG), linguofacial vein (LV) and digastric muscle (DM). (B): Presenting the polystomatic sublingual gland (PSG) and buccinator muscle (BM).

In the present study, we observed that the salivary glands (parotid, mandibular and sublingual) of this species are found distributed in the facial region and formed by a series of rectilinear ducts that converge to the terminal secretory portions. The anatomical features found in the salivary glands of the crab-eating fox are morphologically similar to

those of other carnivorous mammals, especially domestic ones such as dogs and cats (Dyce, Sack, & Wensing, 2010). According to Ellenport (1986), the parotid gland of the dog showing irregular triangular shape, is located ventrally at the angle of the mandible towards the first cervical vertebra (atlas). On the other hand, in cats the parotid has a slightly more rounded shape, but with the same characteristics and location in dogs (Ellenport, 1986). The results described by these authors are similar to the morphology found for the crab-eating fox in our study. The location of the parotid duct of crab-eating fox, crossing the masseter muscle and ventrally parallel to the facial nerve, is analogous to the position found in other carnivorous mammals such as dogs (Mendonça, Silva, Cunha, & Coelho, 2004), raccoons and coatis (Santos et al., 2012). The parotid duct leaves the gland at the rostral edge, crosses the masseter muscle, and opens in the mouth vestibule, oppositely to the third or fourth upper premolar tooth in dogs and the second premolar in cats (Ellenport, 1986; Dyce et al., 2010). In raccoons and coatis, the parotid duct also begins in the ventral portion of the parotid gland, crosses the masseter muscle and ends in the vestibule of the mouth (Santos et al., 2012).

The anatomical characteristics of the mandibular and sublingual glands of the crab-eating fox also corroborate with the references found for domestic carnivorous mammals such as dogs and cats (Done, Goody, Evans, & Stickland, 2002; Dyce et al., 2010) and wild carnivores such as coati (Santos et al., 2010). In coatis it was observed that the mandibular glands are brown, partially covered by the parotid and are located between the atlantal fossa and the basi-hyoid bone (Santos et al., 2010). These results are similar to those described for dogs and cats (Done et al., 2002) and to the ones found in our study to crab-eating fox. The sublingual gland in racoon also is divided into two parts: the caudal part that is located in the digastric muscle and the rostral part near the mylohyoid muscle (Pereira et al., 2013). The secretory ducts of these glands (mandibular duct and greater sublingual duct) are also similar to those observed in dogs and cats (Done et al., 2002; Dyce et al., 2010) and coatis (Santos et al., 2010).

The anatomical similarities observed in the salivary glands of the crab-eating fox with the other carnivorous mammals (domestic and wild) are probably due to the phylogenetic origin of these species. These animals are probably very near in their phylogeny, that is, they are derived from the same common ancestor. Thus, there is a high degree of conservation of anatomical structures present in these species, which would confirm the hypothesis of a common origin, where the current forms originated from a possible common ancestor (Ackerly & Donoghue, 1995).

Conclusion

In conclusion, the results described in this study show that the salivary glands of the crab-eating fox are found distributed by the facial region and formed by a series of rectilinear ducts that converge to the terminal secretory portions. The anatomical characteristics of the salivary glands of this wild canid follow the same structural pattern described for other species of carnivorous mammals (domestic and wild). Further experiments, such as microscopic and molecular biology should be conducted to better understand the secretory cells of serous and mucous acini and thus to propose relationships with the eating habit of the crab-eating fox.

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