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# Morphological Analysis of the Cleft Palate in Dogs (*Canis lupus familiaris*)

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**Abstract:** The cleft palate is a defect of longitudinal fusion that affects the bone and the mucosa in the midline of the hard palate. This defect in the fusion of the palatal lateral shelves from the maxillary processes results in an open cleft between the oral and nasal cavities, also known as secondary palatine cleft. The objective of this work is to report the morphological characteristics of palatine clefts observed in stillborn dogs and neonates submitted to euthanasia. Six dogs were evaluated, from each animal the following data were obtained: clinical history, weight and morphometric data. Externally, data regarding to: sex, fur color, malformations, and evaluations of natural openings were evaluated. Every evaluated animal was delivered by caesarean section, 50% of stillborn infants had cleft lip associated with secondary cleft palate, 50% were female and only one stillborn was a mongrel dog. All others were from the brachycephalic races. It was observed that the cleft palate was found, in great majority, in females, proving the association of sex with this congenital anomaly. In this sense, clinical inspection, including physical examination and anamnesis should be part of the assessment of the neonate patient as parameters to reach a diagnosis and, when it is possible, to be associated with a radiographic image as a complementary method, being the radiography an important auxiliary exam in this context.

**Key words:** Malformation, oral cavity, neonate.

## 1. Introduction

The cleft palate, or palatosis, is a longitudinal fusion defect of varying lengths that affects the bone and mucosa in the midline of the hard palate. This defect in the fusion of the palatal lateral shelves from the maxillary processes results in an open slit between the oral and nasal cavities, which allows the cavity to intersect [1]. It can be associated with the cleft lip, or queilosquise, which is a primary palatine cleft, at the opening of the upper lip that occurs due to involvement of the primary palate (lips, premaxilla and incisive bone) and is a congenital malformation of the face, causing the deforming opening in the upper lip of the animal [2-4]. The primary cleft palate alone is rare, however the secondary cleft palate may occur alone or in combination with primary clefts [5]. Among the possible causes involved in the pathogenesis of congenital palatine clefts in dogs are those resulting from fetal injuries at specific stages of development: ingestion of teratogenic or chemical agents, nutritional deficiencies such as riboflavin, folic acid and vitamin A deficiency, therapies with corticosteroids, or possible hereditary factors [6].

Animals with both primary and secondary defects of the palate mostly die or are submitted to euthanasia. The palatal cleft lesion presents high lethality rates [3, 7]. Brachycephalic breeds (French Bulldog, Pug, Boston Terrier, Pekingese, Boxer, Bulldog, Shihtzu) are at greater risk than the others [7]. Beagle, Labrador Retriever, English Pointer, Shnnauzer, Pit Bull and German Shepherds are also predisposed to have this type of malformation [8].

In the cleft palate, clinical signs vary with degree of defect and may include unsatisfactory growth of the neonate, drainage of milk through the nostrils during and after breastfeeding; as well as coughing, vomiting,

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sneezing during feeding and relapsing respiratory tract infections; respiratory infection and pneumonia because of food aspiration [9]. Abnormal respiratory sounds are identified on auscultation when aspiration pneumonia is present.

The diagnosis of both the cleft lip and the cleft palate is clinical, and the incomplete lip closure is easily recognized visually.

However, the incomplete closure of the pre-maxilla, hard palate, or soft palate requires thorough oral inspection. The use of anesthetics may be necessary for evaluation of the soft palate.

Some newborns afflicted with chyloschisis and palatoschisis are unable to suckle effectively and die soon after birth. Others present the nasal cavity contaminated by saliva and food. Diseases of the middle ear, which are often not recognized in the patient's clinic, also are associated with palatine crevices [5].

The genetic involvement of the primary cleft is complex; Initial studies have shown that inheritance is generally recessive and may be linked to two genes, one autosomal and one sexual. Due to possible hereditary involvement, reproduction of the affected animals is not recommended [10]. Sterilization is recommended. Females are more commonly affected than males [5].

In animals, the surgical treatment of the cleft lip (cheiloplasty) has a primarily aesthetic character [11]. In the case of the cleft palate, whether primary or secondary, surgical treatment should be postponed if possible up to 45 days or preferably at three months of age reduction of anesthetic risk. Clinical support should include catheter feeding to maintain the puppy's nutritional status at an appropriate level and the chance of aspiration pneumonia is reduced until the time of surgery [12].

Surgical techniques include mucous flaps, grafts, and prostheses [13]. The purpose of surgery is to reconstruct the nasal floor, complete closure of the cleft. The most common complications are dehiscence and subsequent incomplete scarring of oronasal fistula. The prognosis is good for animals with successful repair [5].

## 2. Material and Methods

The study material was 6 dogs, stillborn and neonate submitted to euthanasia, weighing between 85 and 200 grams that were donated for study to the Animal Anatomy Section of the Morphology and Animal Pathology Laboratory (LMPA) of the Northern Fluminense State University Darcy Ribeiro—UENF, between the years of 2014 and 2015. From each animal data were obtained: clinical history, weight and morphometric data. Externally they were evaluated: sex, coat, malformations and evaluations of natural openings. Although the diagnosis of the cleft palate is clinical, and the incomplete closure of the lip is easily recognized visually, in these cases, the use of digital radiography exam was also implemented in order to perform a more thorough oral inspection, especially related to incomplete closure of the premaxilla and hard palate.

## 3. Development

### *3.1 Result*

3.1.1 Case 1—Cleft Lip, Cleft Palate, Encephalocele and Anencephaly

The animal was born in normal birth, and died immediately after birth. It weighed 120 grams and 13 centimeters in length; it was a male and showing brown fur with a white spot on the ventral thoracic region. The malformation exhibited a sacculate cystic structure in the rostro-dorsal portion, adjacent to the opening of the incisor associated with the wide palatine cleft, that divided the skull and face, compromising the nostrils (and the nasal bone), and the nasal septum formation.

3.1.2 Case 2—Cleft Lip and Cleft Palate

Born of cesarean section, he underwent artificial catheter feeding, but died hours later. It weighed 150 grams and 14 centimeters in length; it was a female, showing white fur with black spots. The external

examination showed a malformation on the upper lip, facing the left quadrant, which was contiguous with the opening of the hard and soft palate (secondary palate). These malformations are respectively chyloskele (labioleporine) and palatoschisis (palatine cleft), which stretched deep all over the palate.

3.1.3 Case 3—Palatine Cleft

This stillbirth came by caesarean section and was submitted to euthanasia minutes after its birth. The newborn weighing and length was 152 grams and 12 centimeters. It was a female, showing white coat with black spots scattered around its back, around the orbit and a single spot in the ventral region of the body, on the ribs next to the xiphoid cartilage facing the right antimere.

Upon oral cavity inspection, it was noticed that the incomplete closure of the hard palate extended and extended towards the soft palate, the malformation was palatal cleft type (palatosis).

3.1.4 Case 4—Anasarca, Palatine cleft, Macroglossia and Hypotroids

Animal was born by cesarean, stillborn. Weight and length were 124 grams, and 11 centimeters. A male canine, had white coat and low-density fur.

During external examination it was clear the generalized edema, typical alteration of congenital malformation known as Anasarca or Walrus Syndrome; the sparse coat indicated congenital hypotrichosis-like alteration. The oral cavity examination revealed macroglossia, represented by tongue thickness and cleft-like appearance. There was also a wide and deep cleft palate compromising the secondary palate (hard and soft) in all its extension, including the incisive bone (primary palate).

3.1.5 Case 5—Palatal Cleft, Genital Atresia, Omphalocele and Hypothectosis.

Animal was born by cesarean and died naturally after. The weight was 85 grams and measured 14 centimeters in length; it has no sex defined due to genital atresia, it showed a grayish coat and a white spot on the ventral thoracic region (external).

The stillborn had low density (hypotrichosis) coat and an abdominal wall opening around the umbilical region, exposing the peritoneum (omphalocele). Examination of the natural cavities revealed genital atresia and narrow palatine cleft extending along the hard and soft palate.

3.1.6 Case 6—Lipio Leporino, Cleft Palate, Anencephaly, Congenital Glaucoma and Bladder Exstrophy

This puppy was born by cesarean section from the fifth gestation of a female dog at the age of five years which had no history of medication use during the period before labor, and no malformations in neonates of previous births. It was submitted to euthanasia due to severe bleeding and multiple malformations.

The puppy presented 150 grams and 14 centimeters for weight and length. It was a female, with grayish coat with vertical linear spot on the ventral region of thorax and abdomen.

This one presented multiple malformations at the external examination. The bleeding was because a rupture of vessels in exposed tissue on the dorsal portion of the skull that was absent due to the anencephaly associated with acrania; it presented total palatal cleft (palatoschisis), labioleporine (cheiloschisis). The left eye presented a condition called buphtalmia as a result of a congenital glaucoma, the eye was clearly open and uncovered from the eyelid associated with the unaltered size of the right eye that presented closed eyelids as it normally should occur at birth. The left eye was distinctly larger than the contralateral eye and was projected out of orbital cavity. Left eye measured diameter was 6.25 mm while the right one has a 3.14 mm diameter.

In the pelvic region, caudal to the umbilical cord, there was a thin-walled vesicular structure filled with light yellowish fluid, suggesting urine retention. The abdominal cavity opening indicated an exposed urinary vesicle (bladder exstrophy).

Morphologically, the cleft palate identified in this study was presented as follows: deep cleft extending

throughout the palate; a cleft palate associated with the sculled cystic structure at the rostro-dorsal portion and contiguous with the opening of the incisive bone and as a wide cleft that divided the skull and face, compromising the nostrils and the nasal septum formation. The primary type cleft was easily diagnosed because the animal had an abnormal cleft on the upper lip, while the secondary cleft, although more common, often went unnoticed, requiring a meticulous examination of the oral cavity. The conventional radiography results did not contribute to the description of the malformations, considering that bone lesions were on the face (data not shown), because they presented tissue overlapping, making it difficult to interpret the image. The radiograph of the head of the animals head was efficient to evaluate the cleft palate, especially in cases in which the animal had no visible cleft palate, but through digital radiography, it was evidenced failure in the secondary palate ossification.

### *3.2 Discussion*

All the cases of malformation evaluated in this study had in common the fact that they came from parents of small races and subject to fad. Every was born by caesarean section, a common fact in the brachycephalic breeds, because they are more susceptible to dystocia and pelvic fractures. From the six cases of cleft palate, four were females and two were males; corroborating with the literature that states that females are more affected. Three of the animals presented cleft lip associated to the cleft palate, malformations that are commonly associated [5]. Most cases presented multiple malformations consisting of rare descriptions of the literature [14]. The animals with multiple malformations presented severe impairment of bone structures of skull components and central nervous tissue, being these cases incompatible with life [15].

For the diagnosis of this condition, it is essential to inspect the oral cavity directly during the physical examination, associated with the imaginary evaluation of the skull to visualize the complete separation of the palatine bones. Radiography is an important complementary exam, especially the digital radiography, which minimizes bone overlaps in the region.

## 4. Conclusion

Clinical examination, including physical examination and anamnesis, should be part of the neonate patient evaluation as methods to achieve the diagnosis of palatosis. Although radiographic examination is considered complementary exam, it is an important aid in diagnosis. Early identification favors the institution of therapeutic measures and nutritional support. However, further research is needed in the neonatology area, in order that the pathophysiology of these congenital conditions, especially the cleft palate, can be understood and, consequently, the development of prophylactic measures may be possible.

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