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Morphology and scanning electron microscope of the Laryngeal mound of the rock dove, *Patagioenas livia* (Columbidae)

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Twenty adult healthy rock dove of both sexes were used to study the morphological structures of the laryngeal mound in gross anatomy, histology and scanning electron microscope. The laryngeal mound of the dove was elongated pyramidal-shaped, contained laryngeal inlet and just caudal to the root of the tong. The laryngeal mound was a musculoskeletal structure in the floor of the pharyngeal cavity. It composed of cartilages and muscles and contains laryngeal glands located at the submucosa and it is compound tubulo-alveolar type. The laryngeal mound was covered by non-keratinized stratified squamous epithelium and its thickness decreased near the glottis. A layer of the lamina propria submucosa which composed of loose connective tissue is under the epithelium and contains mucous glands. Scanning electron microscope revealed that the mucosal surface of the laryngeal mound is a smooth surface and carry scattered conical papillae consisted of long giant and thick conical papillae and small ones which pointed caudally.

Keywords: rock dove, the laryngeal mound, gross anatomy, histology, scanning electron microscope.

INTRODUCTION

The rock dove (*Patagioenas livia*) is a member of the bird family Columbidae (doves and pigeons). Studying the tongue and larynx of birds is reefer the functional morphological of the avian feeding system. The laryngeal mound in birds performs both respiratory and digestive functions. The tongue of birds showing a clear variation in its form, size and shape and play a great role of feeding and drinking (Erdogan and Alan, 2012). The anatomy of birds larynx is different from that of mammals (Nash, 2007). Several authors described the structure of the larynx in birds (King and McLelland, 1984; Kabak et al. 2007; AL-Mussawy, 2011 ; Salma et al. 2018 ; Rajalakshmi et al. 2020). Igwebuike and Eze, (2010) mentioned basic data on the anatomy of the tongue and oropharynx of the African Pied crow. In the available literature, there are few studies on the laryngeal mound the rock dove. Madkour, (2022) summarized the anatomical description of the beak, oropharyngeal and nasal cavities of broad-breasted white turkey. Madkour and Khalaf (2022) described the morphological and ultra-structural features of the laryngeal mound of Egyptian Cattle Egret (*Bubulcus ibis*) with relation to bird life style. Very few studies were performed on morphological, microscopic and scanning electron microscopically on the laryngeal mound of the rock dove. The present study aimed to provide details about the laryngeal mound of the rock dove, especially in gross anatomy, histological examination and scanning electron microscopy.

MATERIALS AND METHODS

Twenty adult healthy rock dove of both sexes were used in the present study. The heads were separated and the laryngeal mound was dissected to describe the gross anatomical features. The Laryngeal inlet length, width, the Laryngeal mound length and length of papillae were measured.

Preparation of specimens for light microscopic investigation

The Laryngeal mounds were fixed in 10% neutral formalin. Then were dehydrated through ascending series of ethyl alcohol and cleared in xylene. Embedding was done in paraffin wax. Sectioning was done at 6 µm thickness using microtome and then subjected to routine staining Haematoxylin and Eosin (H&E) based on Carleton, (1980). For morph metrical measurements, photomicrographs of transverse section of The Laryngeal mound were viewed and captured by using a system of video camera coupled to an optical microscope and computer containing a software (the MOTIC Image Plus 2.0)

Preparation of specimens for scanning electron microscope (SEM)

For scanning electron microscopy, the posterior portion of the tongue and laryngeal mound was cut into suitable small pieces fixed in gluteraldehyde 5%, washed in cocodylate buffer for one hour and post fixed in a buffered solution of 1% osmium tetroxide at 37°C for two hours. Then, specimens were followed by dehydration in ethanol; complete dehydration in amyleacetate for two days, dried in carbon dioxide at sputter coated with gold. The specimens were examined under scanning electron microscope (JSM-6390-LA).

RESULTS

Anatomy of the Laryngeal mound (Fig.1)

The laryngeal mound of rock dove was elongated pyramidal-shaped, contained laryngeal inlet. It located just caudal to the root of the tongue. It was a musculoskeletal oval structure projected dorsally inside the floor of the pharyngeal cavity. Its apex toward the tongue and its base toward the esophagus. The laryngeal mound divided into two halves by V- shaped laryngeal inlet.

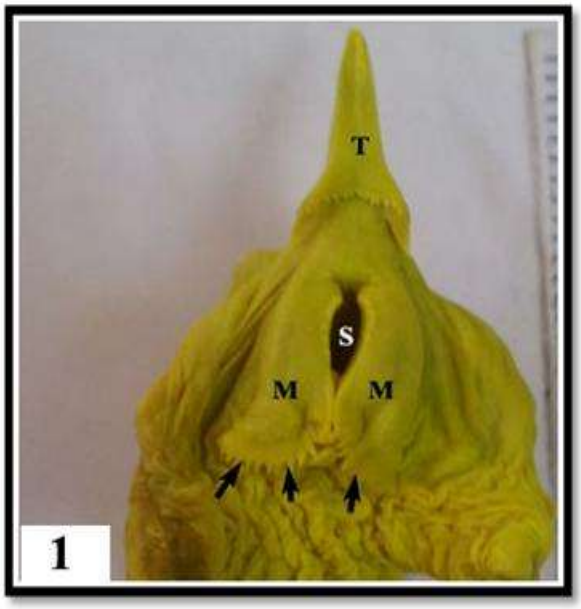

Figure 1: Photograph showing the dorsal view of the floor of the oropharynx , tongue (T), the laryngeal mound (M), laryngeal inlet (S) and caudal laryngeal papillae (Arrows).

The laryngeal mound were composed of hyaline cartilages (cricoid and Procricoid and paired arytenoid cartilages) connected by ligaments. The rostral part of the laryngeal mound contained laryngeal inlet (glottis).The rostral part of the inlet is wide and its caudal pone is narrow. On the caudal border of laryngeal mound there was a row of large sized transverse caudally directed conical pharyngeal papillae; distributed irregularly. Morphometry of the laryngeal mound is summarized in table 1

Table 1: Morphometry of the laryngeal mound (mm)

Dimension	Mean Length (mm)
laryngeal mound length	20.12 ± 0.82
laryngeal mound length	13.41 ± 0.78
Laryngeal inlet length	11.81 ± 0.14
Laryngeal inlet width	2.73 ± 0.19
Longitudinal papillae length	4.54 ± 0.46
number of papillae.	8-10

Histological structure of the Laryngeal mound (Fig.2)

Histological, the laryngeal mound is composed of epithelial layer, lamina propria, hyaline cartilage and muscular layer. The laryngeal mound covered by non-keratinized stratified squamous epithelium. The mean thickness of this epithelium at the thicker part was (153 ± 1.9 µm), thickness of this epithelium decreased near the glottis. Under the epithelium, there are layers of the lamina propria sub mucosa which composed of loose connective tissue connected with the perichondrium of the hyaline laryngeal cartilages and rich by collagen bundles. The laryngeal glands located at the submucosa and it is compound tubulo-alveolar type which consists of many secretory lobules, possessing a common duct which penetrated the mucosa to open into the surface of the laryngeal mound. The laryngeal glands reacted strongly positive with the PAS stain which means it secretes mucopolysaccharides. Under the submucosa on the left and right, there are arytenoid cartilages near the laryngeal inlet.Cricoid cartilage is present at the lateral and basal side of the laryngeal cavity.

Scanning electron microscope of the Laryngeal mound (Fig.3)

By scanning electron microscope,The mucosal surface of the laryngeal mound appeared smooth surface with detached keratin and the caudal part carry scattered papillae. The laryngeal papillae consisted of long giant and thick conical papillae and small ones which pointed caudally. The openings of the laryngeal glands were shown over the mucosal surface of the laryngeal mound.

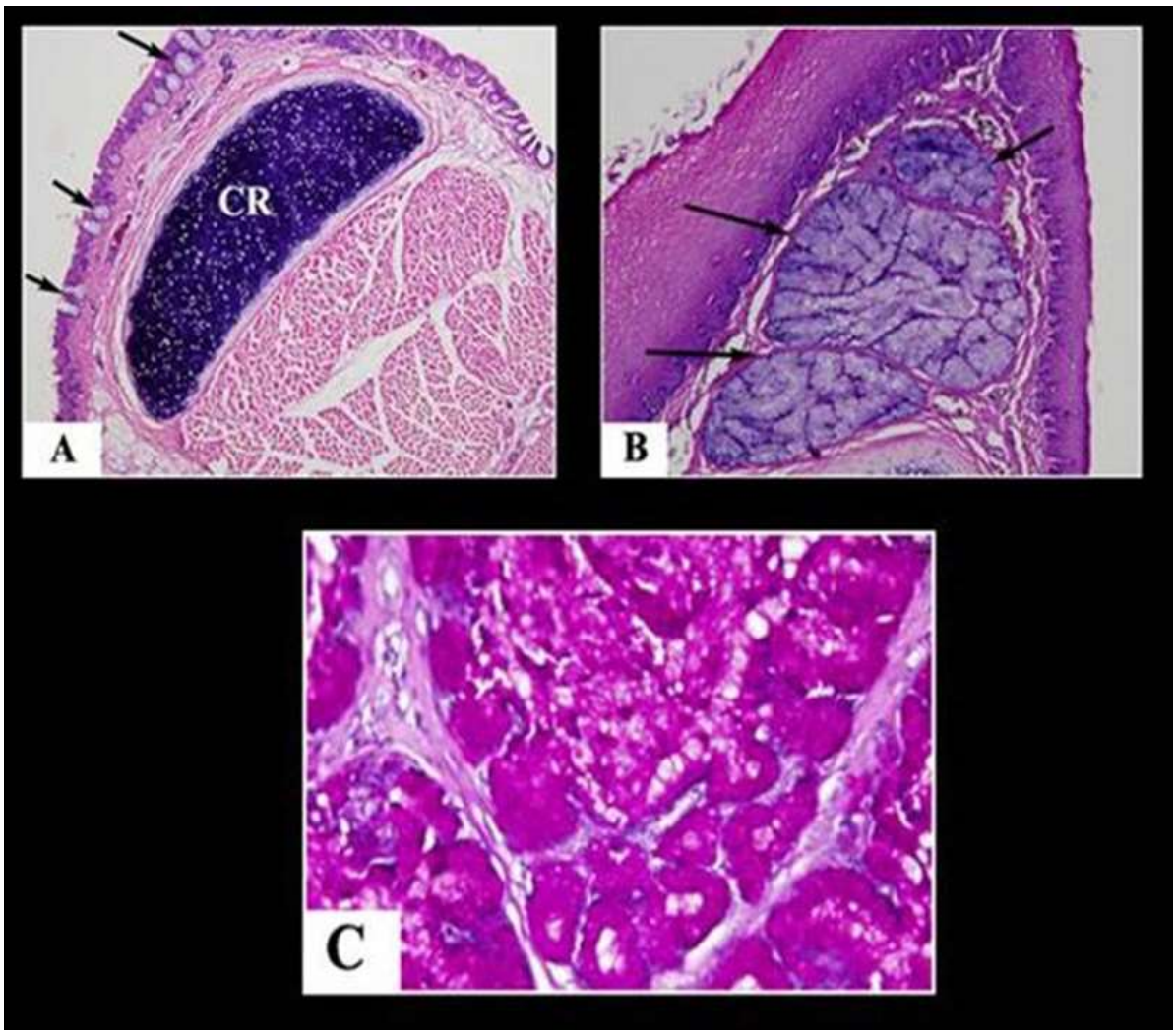

Figure: 2: 2A Photomicrograph of a transverse section of the laryngeal mound region of *Patagioenas livia* showing the Glandula laryngealis (arrows) , the Cricoids cartilage (CR.) (H.&E., x40). 2B. High magnification of a Photomicrograph of a transverse section of the laryngeal mound region of *Patagioenas livia* showing the Glandula laryngealis (arrows) (H.&E., 100) 2C. Photomicrograph of a transverse section through the Glandula laryngealis, gives a positive Periodic Acid Schiff's reaction (P.A.S.) which means it secretes mucopolysaccharides (P.A.S., 400x).

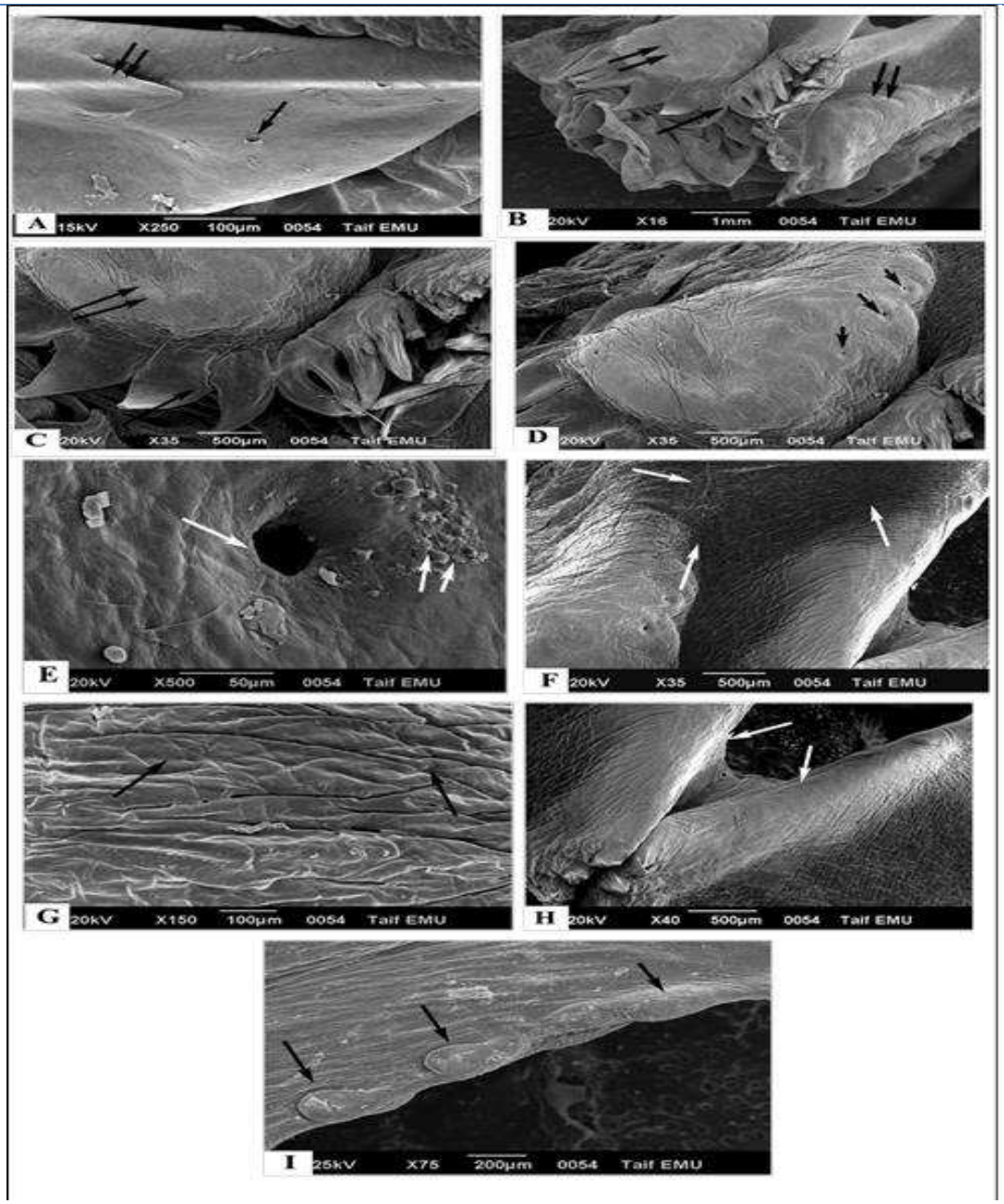

Figure 3: 3A. Scanning electromicrograph of the dorsal surface of the posterior part of the lingual wing (double arrows) of the tongue of *Patagioenas livia,* and pores of the posterior lingual salivary gland (arrow).3B. Scanning electromicrograph of the dorsal surface of the laryngeal mound of the tongue of *Patagioenas livia,* showing the surface of the laryngeal papillae (arrow) and the laryngeal salivary gland (double arrows).3C. High magnification of Fig. (2B), showing the surface of the laryngeal papillae (arrow), and the laryngeal salivary gland (double arrows).3D. Scanning electromicrograph of the dorsal surface of the laryngeal mound of the tongue of *Patagioenas livia,* showing the pores of the laryngeal salivary gland (arrows)3E. High magnification of Fig. (2D), showing the pores of the laryngeal salivary gland (arrow) and its secretion (double arrows).3F. Scanning electromicrograph of the dorsal surface of the laryngeal mound of the tongue of *Patagioenas livia,* just lateral to the glottis, showing its smooth surfaces (arrows)3G. High magnification of Fig. (2F), showing the smooth surface with detached keratin (arrows).3H. Scanning electromicrograph of the dorsal surface of the laryngeal mound of the tongue of *Patagioenas livia,* showing emergence on the edges of laryngeal mound (arrow). 3I. High magnification of (2H), showing emergence on the edges of laryngeal mound (arrows)

DISCUSSION

The present study revealed that the laryngeal mound of rock dove located is musculoskeletal structure caudal to the tongue with caudally directed papillae inside the floor of the pharyngeal cavity. This results are in agreements with Abumandour, (2014) in Eurasian Hobby; Jayachitra et al. 2015 in guinea fowl; Gupta et al. 2018 in turkey. The morphometrical study recorded that the laryngeal mound was 20.12mm long and 13.41 mm wide. Madkour (2018) stated that In laughing dove and Japanese quail, the length is 5.99, 6.40 mm, respectively. McLelland (1990) stated that the caudal part of the mound in adult chicken carried papillae which are used in swallowing and move the food to the oesophagus and might be helpful in the ingestion of solid food particles and pellets. Extrinsic laryngeal muscles play an important role during swallowing of food, they retract the larynx to help moving the food from the buccal cavity to the oesophagus. Results of gross anatomy in this study are also agreed with Tadjalli et al. (2008) in the West African guinea fowl and ostriches. The present work indicated that the laryngeal papillae were arranged in one transverse row. These findings are in agreements with Abumandour and Gewaily, 2019 in hoopoe; Kadhim, 2011 in red jungle fowl and Al-Ahmady, 2016 in egret cattle. Otherwise, these findings are in disagreements with Kabak et al. (2007) who described two sagittal rows of small in chicken and long legged buzzard. Histologically, the present study showed that the laryngeal mound of the rock dove was covered with non-keratinized stratified squamous epithelium and its surface have laryngeal glands located within the lamina propria, strong PAS-positive reaction and their ducts penetrated the mucosa to open into the pharyngeal cavity. The mucous secretion lubricates the food items during its passage in the buccal cavity. This observations were in accordance with those reported in the lingual and laryngeal gland of quails (Liman et al. 2001), in the chicken (Gargiulo et al. 1991) and in laughing dove and Japanese quail (Madkour, 2020). The present work revealed that the length and width of the laryngeal mound of the rock is longer than that of the Broad Breasted White Turkey (*Meleagris gallopavo*, Madkour, 2022) but the Length of glottis is similar. Madkour and Khalaf (2022) stated that the edges of the laryngeal mound of Egyptian Cattle Egret (*Bubulcus ibis*) were smooth free from papillae and edges with mucosal lips which were slightly elevated above the surface. This is disagreements with this study in the rock dove.

CONCLUSIONS

In conclusion, this study described morphological features of laryngeal mound the rock dove especially gross anatomy, light microscopic examination, in addition to scanning electron microscopy.

Supplementary materials

The supplementary material / supporting for this article can be found online and downloaded at: https:// www.isisn.org/article/

Author contributions

The author, Fatma A. Al-Nefeiy contributed in all parts of this work.

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Not applicable.

Data Availability Statement

All the data included in this manuscript will be available on demand.

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Conflict of interest

The authors declared that present study was performed in absence of any conflict of interest.

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