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Macroscopic and microscopic structure of the infraorbital sinus gland in Tuj Sheep

Estudio de la estructura macroscópica y microscópica glándula del seno infraorbitario en la oveja Tuj

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ABSTRACT

The infraorbital sinus (infraorbital gland-preorbital gland) is located in the lateral aspect of the skull, rostroventral to the eye, within the infraorbital fossa. Some skin glands are differentiated and specialized. In the present study, it was aimed to examine the macroscopic and microscopic structure of the infraorbital sinus, which is one of these skin glands. The distance between the infraorbital foramen and infraorbital sinus was 47.35± 0.57mm on the right and 53.80±1.27 mm on the left. The left side length of the infraorbital sinus in Tuj sheep was measured as 25.32±2.21 mm, width 16.21±2.83 mm, and depth 1.23±1.80 mm. The Tuj sheep infraorbital sinus was composed of the epidermis and dermis. The epidermis was consist of keratinized stratified squamous epithelium. There were many sebaceous glands, some apocrine glands, muscle fibers, and also hair follicles in the dermis. The sebaceous glands were located in the superficial region and the apocrine glands were deeper in the dermis. It was seen lots of lipid droplets inside the sebaceous gland cells. The myoepithelial cells and the basal membrane of the apocrine glands and muscle fibers were PAS-positive reaction. In conclusion, in the presented study, the macroscopic and microscopic structure of the infraorbital sinus was determined in Tuj sheep. This region is also clinically important because it is close to the infraorbital nerve passing through the infraorbital foramen (anesthesia area) and the infraorbital sinus is topographically located in this region. It is thought that it will support scientific studies related to the skin and its appendages.

Keywords: Macroscopic; microscopic; infraorbital sinus gland; Tuj sheep.

RESUMEN

El seno infraorbitario (glándula infraorbitaria-glándula preorbitaria) está ubicado en el aspecto lateral del cráneo, rostroventral al ojo, dentro de la fosa infraorbitaria. Algunas glándulas cutáneas están diferenciadas y especializadas. En el presente estudio, se buscó examinar la estructura macroscópica y microscópica del glándula seno infraorbitario, una de estas glándulas. La distancia entre el foramen infraorbitario y el seno infraorbitario fue de 47.35±0.57 mm en el lado derecho y de 53.80±1.27 mm en el izquierdo. La longitud del lado izquierdo del seno infraorbitario en la oveja Tuj fue de 25.32±2.21 mm, la anchura de 16.21±2.83 mm y la profundidad de 1.23±1.80 mm. El seno infraorbitario de la oveja Tuj estaba compuesto por la epidermis y la dermis. La epidermis estaba compuesta por epitelio escamoso estratificado queratinizado. Se observaron numerosas glándulas sebáceas, algunas glándulas apocrinas, fibras musculares y folículos pilosos en la dermis. Las glándulas sebáceas se ubicaban en la región superficial y las apocrinas en la profundidad de la dermis. Se observaron numerosas gotitas de lípidos dentro de las células de las glándulas sebáceas. Las células mioepiteliales y la membrana basal de las glándulas apocrinas y las fibras musculares dieron positivo a PAS. En conclusión, en el estudio presentado, se determinó la estructura macroscópica y microscópica del seno infraorbitario en ovejas Tuj. Esta región también es clínicamente importante porque está cerca del nervio infraorbitario que pasa por el agujero infraorbitario (área de anestesia) y el seno infraorbitario está ubicado topográficamente en esta región. Se cree que este estudio respaldará los estudios científicos relacionados con la piel y sus apéndices.

Palabras clave: Macroscópica; microscópica; glándula del seno infraorbitario; oveja Tuj.

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INTRODUCTION

In addition to being a sense organ, the skin also has duties such as protecting the body, providing temperature regulation, and removing toxic substances. Integumentum communae is a comprehensive organ that covers structures such as subcutaneous connective tissue, dermis, epidermis, hairs, nails, horns, mammary glands, and skin glands [1 , 2].

The skin glands differ between species in size, shape, and location. Some are differentiated and specialized and are associated with sacs in the skin [3]. One of these glands, the infraorbital sinus (infraorbital gland-preorbital gland), is located in a skin sac in the rostral of the eye. In sheep (*Ovis aries*), they open to the ventrolateral of the face. The wall of the gland contains sebaceous and serous glands that stain the skin when secretions come out of the gland. These glands, which are responsible for marking their habitat, are larger in rams [4].

Reproductive communication in ungulates is thought to be via the infraorbital sinus, interdigital sinus, and tarsal glands, which are skin glands associated with many scents [5]. The presence of infraorbital sinus gland has been reported in sheep, goats, deer, and antelopes [6 , 7].

This gland and the external lacrimal fossa in which the gland is located varies according to the animal species. External lacrimal fossa is an important anatomical structure to distinguish sheep and goat heads. This structure is found in sheep but not in goats [8].

The region where the infraorbital sinus gland is located is also important because it is close to the infraorbital foramen. The infraorbital nerve, which is the continuation of the maxillar nerve from the infraorbital foramen, leaves the head [3]

After exiting the infraorbital nerve infraorbital foramen; it ends by dividing into three branches that disperse on the lateral surface of the nose, the dorsal surface of the nose, and the upper lip skin [8]. The infraorbital sinus is lined by thin skin and is composed of modified sebaceous and apocrine glands. The secretions of these glands are responsible for the sticky, yellow fatty substance on the skin [9].

There are studies on infraorbital sinus gland in some animal species [10 , 11 , 12]. However, in the literature review, no study was found on the infraorbital sinus gland in Tuj sheep. In the presented study, information was given about the macroscopic and microscopic structure of the infraorital sinus gland in Tuj sheep.

MATERIAL AND METHODS

Anatomical procedures

In the presented study, skulls of 5 male and 5 female Tuj sheep around 2 years old were used. Tuj sheep heads supplied as slaughterhouse material were preserved in 10% formaldehyde solution. Infraorbital sinus was exposed by dissectionand with a digital calliper the morphometric measurements were made (Stainless 0-150 mm, 0.00, BTS, UK). Materials were photographed with Canon digital camera zoom lens 5X. 17. The measured morphometric values were evaluated in the SPSS 20 program. For the use of scientific terms N.A.V. [12] was applied. After the anatomical findings were obtained, the histological procedure was performed.

Histological procedures

The infraorbital sinus gland was fixed in 10% formalin for 24 h, dehydrated, cleared, and embedded in paraffin. The 5 µm thick serial sections were cut and stained with Mallory's modified triple stain to demonstrate general structure of the infraorbital sinus. For glycogen demonstration Periodic Acid Schiff (PAS) stain was applied to the sections. The sections were examined under light microscope (Zeiss Primostar 3, Germany).

RESULTS AND DISCUSSION

Anatomical results and discussion

In Tuj sheep, it was observed that the infraorbital sinus gland was located in the external lacrimal fossa on the lacrimal bone, just adjacent to the ocular angular vein, above the initial tendon of the malar muscle (FIG. 1). It was determined that the infraorbital sinus was in the form of a plump circle. After removing this gland, the external lacrimal fossa was found to be clearly identifiable (FIG. 2). It was determined that the distance between the infraorbital sinus gland and the infraorbital foramen in one animal material was greater than in other substances. The distance between the infraorbital foramen and infraorbital sinus was taken as shown in FIG. 3.

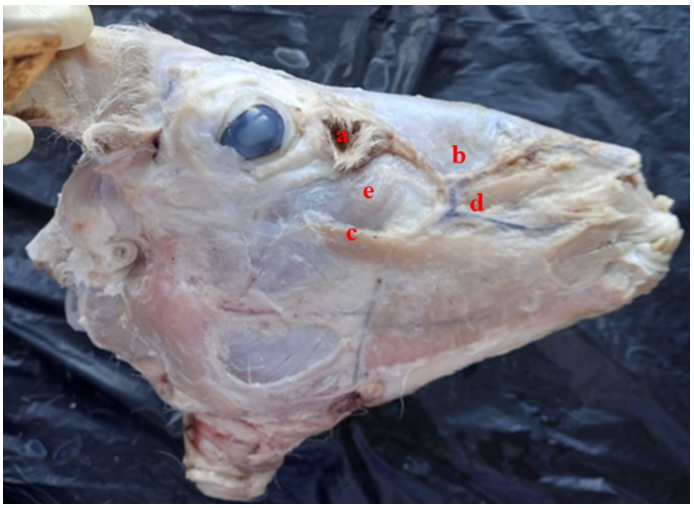

FIGURE 1. Infraorbital sinus gland and nearby anatomical structures in male Tuj sheep head (a: infraorbital sinus, b: nasal dorsal vein, c: zygomatic muscle, d: superior labial vein, e: malar muscle).

The distance between the infraorbital foramen and infraorbital sinus gland was 42.23±1.22 mm on the right side in females, 46.71±1.82 mm on the left in females, 47.35±0.57 mm on the right side in males and 53.80±1.27 mm on the left in males. The left side length of the infraorbital sinus gland in female Tuj sheep was measured as 25.32±2.21 mm, width 16.21 ± 2.83 mm, and depth 1.23±1.80 mm. The length of the

infraorbital sinus gland on the right side in female Tuj sheep was measured as 24.51±1.81 mm, width 14.52±1.33 mm, and depth 1.19±2.44 mm. The left side length of the infraorbital sinus gland in male Tuj sheep was 28.11±1.51 mm, width was 18.31±2.63 mm, and depth was 1.62±3.33 mm. In male Tuj sheep, the length of the infraorbital sinus gland on the right side was 27.01±2.33 mm, width was 17.22±1.62 mm, and depth was 1.29±2.13 mm. In general, looking at the measurement results, it can say that the left side parameters are higher than the right side in female and male Tuj sheep. The measured parameters are related to the size of the gland. An organ's growth may be related to the amount of oxygenated blood it receives, but it is not the sole criterion. The altitude at which the animal lives may also have an impact on the development of the organ. Normally, the anatomical structures on the right and left sides of the body are similar in size. However, the artery supplying one side may be larger than the other, or the increased blood volume may have caused the artery to receive more blood and enlarge. Therefore, it is thought that the artery supplying the left infraorbital sinus may be larger [13].

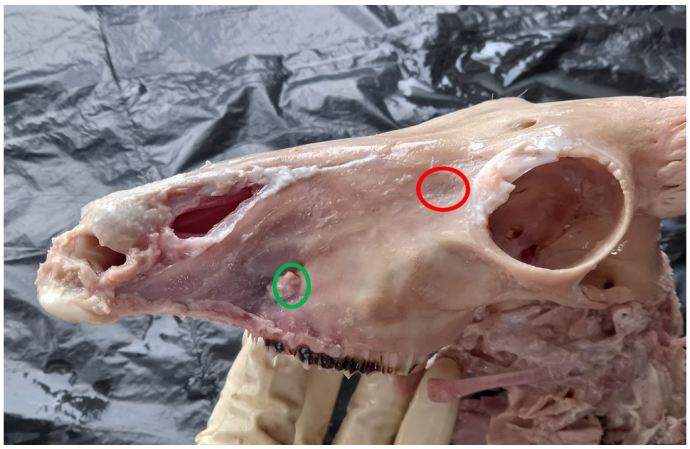

FIGURE 2. External lacrimal fossa and infraorbital nerve in head of Tuj sheep (red circle: external lacrimal fossa, green circle: infraorbital nerve).

FIGURE 3. Distance between infraorbital foramen and infraorbital sinus gland in female Tuj sheep.

Infraorbital sinus gland was found to be bean-shaped [7] in male antelopes and pear-shaped in Native Egyptian sheep [5]. It was in the shape of a plump circle in Tuj sheep. In antelopes, infraorbital sinus gland length has been reported to be 28-35 mm, wide 15-17 mm, deep 1-1.2 mm [7]. In male native Egyptian sheep, this gland is 28-33 mm length, 25-28 mm width, 3-5 mm depth. It has been reported that females are 24-27 mm in length, 20-22 mm in width, and 2-4 mm in depth [5]. In male Tuj sheep, this gland was 27-28 mm length, 17-18 mm width, 1-1.5 mm depth. It has been measured in male Munchaks (barking deer) 23-27 mm length and 20-30 mm width [14]. In general, the measurement results were found to be closer to the results of Rajagopal and Archunan [7] in terms of all parameters. In terms of length, it was close to the Munchaks [14]. It was 24-25 mm length, 14-16 mm width, 1-2.5 mm depth in female Tuj sheep. The length of the infraorbital sinus gland was close to Moawad [5] when compared in females, while other parameters differed.

The Tuj sheep infraorbital sinus gland was composed of the epidermis and dermis. The epidermis was consist of keratinized stratified squamous epithelium. There were many sebaceous glands, some apocrine glands, muscle fibers, and also hair follicles in the dermis. The sebaceous glands were located in the superficial region and the apocrine glands were deeper in the dermis. It was seen lots of lipid droplets inside the sebaceous gland cells (FIG. 4, 5, 6). The myoepithelial cells and the basal membrane of the apocrine glands and muscle fibers were PAS-positive reaction (FIGS. 7, 8, 9).

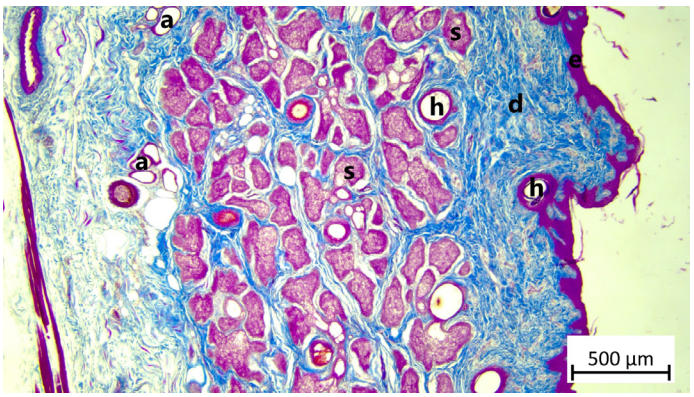

FIGURE 4. Male Tuj sheep infraorbital sinus gland. e: epidermis, d: dermis, s: sebaceous glands, a: apocrine glands, and h: hair follicles. Mallory's modified triple stain. Scale bar: 500 µm

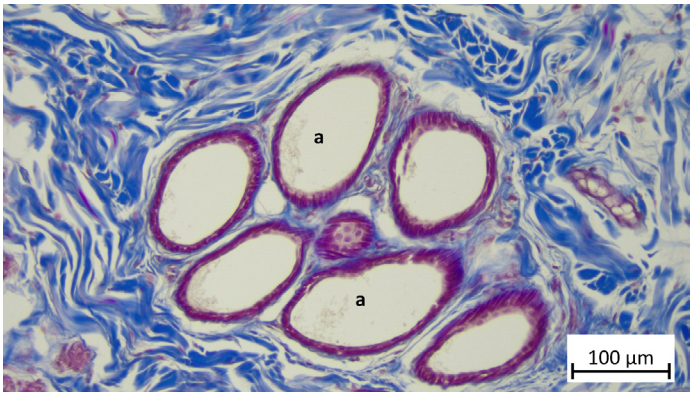

FIGURE 5. Male Tuj sheep infraorbital sinus gland. a: apocrine glands. Mallory's modified triple stain. Scale bar: 100 µm

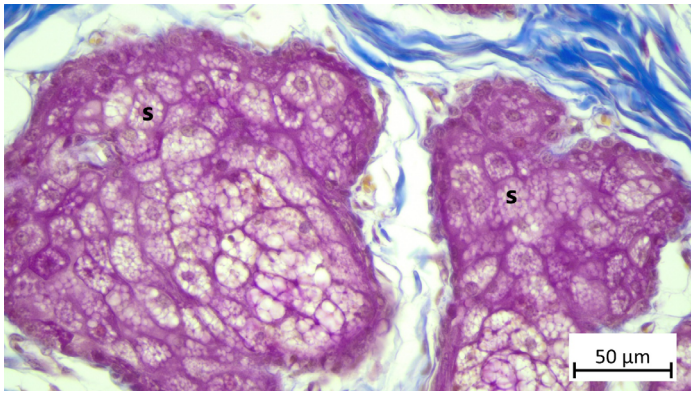

FIGURE 6. Male Tuj sheep infraorbital sinus gland. s: sebaceous glands. Mallory's modified triple stain. Scale bar: 50 µm

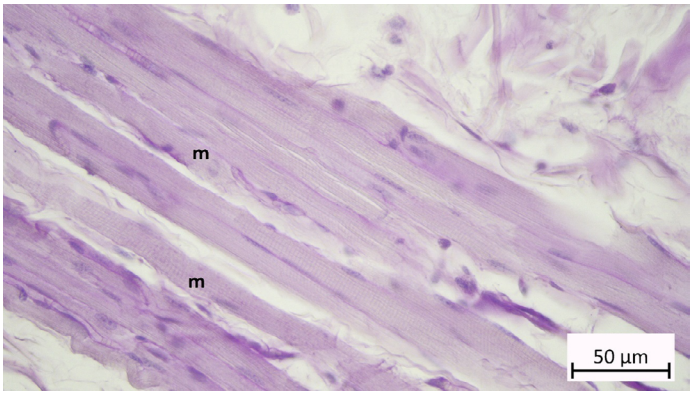

FIGURE 9. Male Tuj sheep infraorbital sinus gland. PAS (+) reaction. m: muscle fibers. PAS stain. Scale bar: 50 µm

Infraorbital sinus gland is thought to have other functions in addition to its role in marking [15]. It has been reported that deer open these infraorbital sinus gland while fighting [16]. Hatlapa [17] showed that preorbital secretions in red deer have a primary function in establishing mother-offspring bonds. It is also reported that the opening of the infraorbital sinus gland in fallow deer offspring is a signal to the mother that the calf is hungry [18 , 19]. When look at the results of the study, it is better understand the importance of infraorbital sinus gland in providing communication.

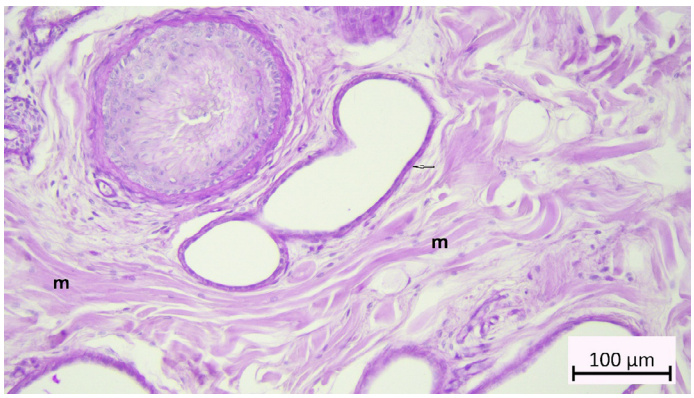

FIGURE 7. Male Tuj sheep infraorbital sinus gland. PAS (+) reaction. m: muscle fiber. PAS stain. Scale bar: 100 µm

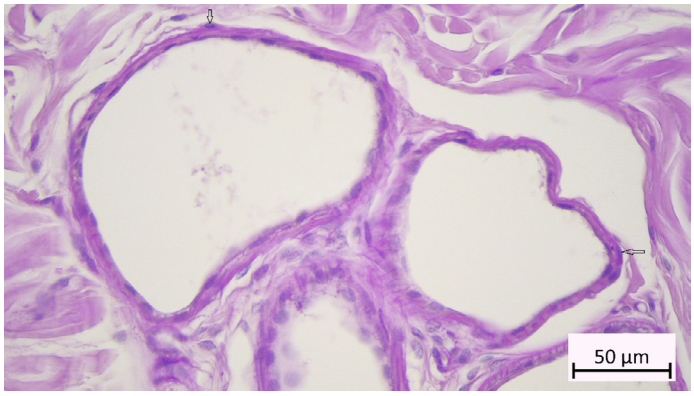

FIGURE 8. Male Tuj sheep infraorbital sinus gland. PAS (+) reaction. arrow: myoepithelial cells. PAS stain. Scale bar: 50 µm

The infraorbital sinus gland with large air spaces are in pairs, facing the nasal cavity, and lined with respiratory epithelium. It is located medial and rostal of the eye in sheep and covered with a thin skin with few hairs. It has sebaceous glands that form a continuous layer around it and several peripherally located apocrine sweat glands. The secretions of these glands are responsible for the formation of the sticky yellow oily substance in the skin [20]. There have been reports about the infraorbital sinus gland of Formosan serow [10], Steenbok [21], barking deer [14], blackbuck Antelope cervicapra [7] and Egyptian native breed sheeps [5] but not Tuj sheep. It was determined that the infraorbital sinus gland had two glandular components: one sebaceous secretory units and the other apocrine secretory units. These glands were surrounded by connective tissue and muscle fibers [7]. It has been suggested striated muscle fibers pass up between the sebaceous glands to the connective tissue of the stratum papillare and the contraction of these muscles should force the secretion out as small black granules in steenbok infraorbital sinus gland. It has also reported that these muscles could be strands from either the nasolabial levator muscle, malar muscle or both [21]. The Tuj sheep infraorbital sinus gland was composed of the epidermis and dermis. The epidermis was consist of keratinized stratified squamous epithelium. There were many sebaceous glands, some apocrine glands, muscle fibers, and also hair follicles in the dermis. It has stated that apocrine glands was larger than the sebaceous glands in infraorbital sinus gland of barking deer [14] but in the study it was seen that sebaceous glands are larger than apocrine glands. The sebaceous glands were located in the superficial region and the apocrine glands were deeper in the dermis. It was seen lots of lipid droplets inside the sebaceous gland cells in infraorbital sinus gland of Tuj sheep like steenbok infraorbital sinus gland [22]. Moawad [5] has suggested that the only apocrine acini reacted positively with the Periodic acid shiff stain in Egyptian native breed sheeps infraorbital sinus gland how ever in the study demonstrated that the myoepithelial cells and the basal membrane of the apocrine glands and muscle fibers were PAS-positive reaction in Tuj sheep infraorbital sinüs gland.

CONCLUSIONS

As a result, the infraorbital sinus gland is important because it is close to the infraorbital foramen apart from its role in communication between animals. Infraorbital nerve passes through this opening. The topographic location of the infraorbital sinus gland can assist in the selection of the

anesthesia site when performing regional anesthesia. In this sense, measurement values become even more important. It is thought that this study will contribute to the macroscopic, microscopic, and surgical operations to be performed in the infraorbital region.

Conflict of interest

The authors declared that there is no conflict of interest.

Data availability statement

The data supporting this study's findings are available from the corresponding author upon reasonable request.

Ethical statement

To conduct this study, necessary permissions were first obtained from Kafkas University Animal Experiments Local Ethics Committee (KAU-HADYEK/2023-082).

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