



Morphological and Morphometrical Characteristics of Lacrimal Apparatus in Adult Iraqi Local Breed Goat (*Caprus hircus*)

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ABSTRACT

In the present study used ten fresh heads of adult indigenous goat (*Caprus hircus*) to study the lacrimal apparatus. The lacrimal apparatus divided into glandular part & ducts system. The glandular part consist of right & left lacrimal glands that produce tear. Whilst duct system consists of excretory duct, dorsal & ventral puncta, dorsal & ventral lacrimal canaliculi & the nasolacrimal duct. The lacrimal gland was elongated, oval, flattened, smooth & light brown in color. Each gland consist of body & appendage. The excretory ducts not easily noticed but could be recognized by using magnified. The dorsal & ventral puncta show in the medial canthus of the eyeball. It has slit-like opening with grayish black in color. Lacrimal canaliculi is start from the lacrimal puncta in the medial canthus of the eyeball & lead into two conical dilatation, which ended by short narrowing canaliculi. The Lacrimal sac consist from joined two lacrimal canaliculi together in the distal end to formation it. The nasolacrimal duct divided into three regions according to course of ducts.

Keywords: goat, lacrimal apparatus, lacrimal gland, lacrimal sac, nasolacrimal duct.

INTRODUCTION

Goat is one types of ruminants, most important provide milk, meat, hair & leather. It spread in different region of the Iraq especially in north region(1). The eyes were the sensory organ responsible for eyesight. It is well protected from damage by the bone which formed the orbit. It has accessory structures important in the process of maintaining eye, including the lacrimal gland, 3rd eyelid gland (2). The lacrimal apparatus in mammalian consist of many structures can be classify into production tear (lacrimal gland) & drain away tears (lacrimal puncta, lacrimal duct, lacrimal sac, nasolacrimal duct & nasolacrimal puncta)(2&3). The lacrimal fluid is maintaining the cornea & kept clear by diffusion





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tear on the corneal surface which act as nutrients of cornea, moisture & lubricate inner surfaces conjunctiva in upper & lower eyelids. Also act as protection of the eye from pathogens (4&5). The lacrimal gland is brown to pink in colour. It is located on the dorsolateral side of the eyeball. The lacrimal fluid transport about duct system after washing the eye, into the nasal cavity & exit through the nasolacrimal punctum (2,3 &6). This study design to providing anatomical & morphometric information about the lacrimal apparatus in Iraqi local breed goat (*Caprus hircus*).

MATERIALS AND METHODS

Anatomical & morphometric Studies

In the present study used ten fresh heads of adult goat (*Caprus hircus*). It is collected immediately after slaughtering. The specimens inspected before & after slaughtering to insure the specimen healthy. After collection the specimen cleaned by washing in running tap water. It is kept in clean plastic containers & transported into the research laboratory to record the required relationship & measurement of the lacrimal apparatus. Made dissections to easy exposure lacrimal gland & duct system. It is described & recorded appearance features of lacrimal apparatus including the relationship, location, shape & colour. The final step recorded the measurements by using electronic vernier, sensitive balance & snapshot the specimens by using Canon digital camera.

RESULTS

The lacrimal apparatus in the adult indigenous goat (*Caprus hircus*) consists of glandular part & ducts system. The glandular part consists of right & left lacrimal glands. Whilst duct system consists of excretory duct, dorsal & ventral puncta, dorsal & ventral lacrimal canaliculi & the nasolacrimal duct.

Lacrimal glands

The lacrimal glands located on the dorsolateral side of the eyeball. It extends above dorsal rectus muscle & lateral rectus muscle. The lacrimal gland was elongated, smooth (non-lobulated), flattened & light brown in color. Each gland consists of two parts body & appendage. It has dorsal & ventral surfaces, cranial & caudal extremities, medial & lateral borders. The dorsal surface was convex. It is opposite the inner surface of the orbit & it takes the shape of the inner surface of it. Whereas the ventral surface was concave. It is opposite the convexity of dorsal surface of the eyeball (Fig.1&2). The body of lacrimal gland was flattened, elongated oval in shape & the cranial end narrower than the caudal end (Fig.1&2). The mean weight, length, width, thickness & volume of body the right lacrimal gland was 1.121 ± 0.181 gm, 32.598 ± 1.777 mm, 17.015 ± 1.040 mm, 3.38 ± 0.303 mm & 1.5 ± 0.182 mm³ respectively, while the mean weight, length, width, thickness & volume of body the left lacrimal gland was 1.138 ± 0.140 gm, 32.047 ± 0.931 mm, 16.278 ± 0.869 mm, 3.283 ± 0.307 mm & 1.5 ± 0.182 mm³ respectively. The appendage of lacrimal gland was small rod elongated shape. It has dorsal & ventral surfaces, medial & lateral borders & cranial & caudal extremities (Fig.1&2). The mean weight, length, width, thickness & volume of appendage of the right lacrimal gland was 0.03 ± 0.007 gm, 11.738 ± 2.137 mm, 4.088 ± 0.975 mm, 1.704 ± 0.137 mm & 3 ± 0.158 mm³ respectively, while the mean weight, length, width, thickness & volume of appendage the left lacrimal gland was 0.026 ± 0.006 gm, 11.184 ± 1.602 mm, 3.018 ± 0.739 mm, 1.394 ± 0.245 mm & 3 ± 0.158 mm³ respectively.

excretory ducts

The excretory ducts not easily noticed but could be recognized by using magnified. It is origin from the lacrimal glands. It is open in the conjunctival mucous membrane of the upper eyelids in the lateral canthus of the eyeball. The



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ducts origin from the lateral border of the caudal part of the of body gland near from beginning of appendage part & the mean number of ducts were 1-2 ducts(Fig.3&4).

Lacrimal puncta

We observed dorsal & ventral puncta in the medial canthus of the eyeball. It has slit-like opening with grayish black in color(Fig.5).The diameter & distance of punctum from medial canthus of right & left dorsal puncta were 1.121 ± 0.071 mm, 1.16 ± 0.114 mm, 3.961 ± 0.177 mm, 4.086 ± 0.151 mm respectively, while the right & left ventral puncta were 1.16 ± 0.062 mm, 1.205 ± 0.093 mm, 4.053 ± 0.379 mm & 4.218 ± 0.361 mm respectively.

Lacrimal canaliculi

It is start from the lacrimal puncta in the medial canthus of the eyeball & lead into two conical dilatation, which ended by short narrowing canaliculi (dorsal & ventral) (Fig.6).The mean length of the right & left dorsal lacrimal canaliculi were 8.555 ± 0.481 mm & 8.361 ± 0.516 mm respectively, whereas the right & left ventral lacrimal canaliculi were 11.045 ± 0.438 mm & 11.48 ± 0.925 mm respectively.

Lacrimal sac

We observed the two lacrimal canaliculi in each side joined together in the distal end to formation the lacrimal sac. It was situated in the small depression the lacrimal fossa in lacrimal bone. The distal end continuous with nasolacrimal duct(Fig.6). The mean length of right & left lacrimal sac were 23.676 ± 1.436 mm & 19.645 ± 1.909 mm respectively.

Nasolacrimal ducts

The nasolacrimal ducts was beginning from the distal end of the lacrimal sac. It extend ventrally on the medial side of the lacrimal, maxillary & incisive bones. It pass on the medial side of the lateral wall of the nasal cavity. The mean total length of the right & left nasolacrimal duct in was 89.71 ± 3.260 mm & 91.953 ± 2.983 mm respectively. The nasolacrimal duct could be divided into three regions according to course of ducts(Fig.7).The proximal part run in osseous canal that formed by lacrimal & maxillary bone. The mean length of the right & left the proximal part was 26.178 ± 3.188 mm & 30.411 ± 2.182 mm respectively. The middle part was consist of mucous membrane. It extend after the duct leave the osseous region into the junction with the skin of the vestibule of the nasal cavity. The mean length of the right & left the middle part in goat was 40.553 ± 1.915 mm & 38.556 ± 1.813 mm respectively. The distal part was referred to cutaneous part supported by nasal cartilage. It was smaller part of the nasolacrimal duct ended by the external orifice of the nasolacrimal duct. The mean length of the right & left the distal part in goat was 22.941 ± 1.696 mm & 22.983 ± 2.481 mm respectively. The external orifice of the nasolacrimal duct has slit-like shape & located ventral to the alar fold of the ventral nasal concha. The mean diameter of right & left was 2.813 ± 0.225 mm & 2.876 ± 0.097 mm respectively.

DISCUSSION

In the current study the lacrimal glands in goat located on the dorsolateral aspect of the eyeball. The lacrimal gland limited between the two bones of the orbit & the eyeball. This results agree with the findings (3;7;8;9;10 & 11) that found the lacrimal gland situated in the dorsolateral area eye ball. The lacrimal glands in goat take light brown in color. This results accordance with (12;13;14;15 & 16) in camel, goat, sheep & donkey the lacrimal gland has brown in color. But differ with (17; Diesem, (1968)& Elmahadi, (2017) show the color of lacrimal gland in camel, horse & dog was light red. Whilst Maala, et al., (2007) reported the lacrimal gland of the buffalo was red to pink in colour.





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This difference in the color of the lacrimal glands among the animals because of differ the species of animals. Also the amount of blood remaining in the blood vessels that supply the gland effect on the colour of gland. We observed the lacrimal gland consist of two parts body&appendage. This results accordance with (3;7;11;12;13;15;19;20 &21) show the lacrimal glands in goat, cattle, buffalo, camel & dog were divided into two parts main body& accessory appendage. While differ with (22)reported the lacrimal gland in sheep & goat undivided. It was consist of one compact part. Also (23 & 24)explain the lacrimal gland inEuropean bison & alpaca was undivided & uniform in shape.This alterationmay be because ofdiffer species of animal.

Our results in goat reported thatthe mean weight, length, width, thickness & volume of body the left lacrimal gland was 1.138±0.140gm, 32.047±0.931mm, 16.278±0.869mm, 3.283±0.307mm & 1.5±0.182mm³ respectively. Whilst the mean weight, length, width, thickness & volume of body the right lacrimal gland was 1.121±0.181gm, 32.598±1.777mm, 17.015±1.040mm, 3.38±0.303mm & 1.5±0.182mm³ respectively,This results agreement with (16) show the lacrimal gland in sheep has 3.58mmthickness, while (15) explain the length of lacrimal gland in donkey was 32 mm. But differ with While (15) show the lacrimal gland in goat has mean width & length 20mm & 26.5mm respectively. Whilst (25)reported that the mean weight, width, length, thickness & volume of the lacrimal gland in goat was about 1.63 gm, 25mm, 20 mm. 4 mm& 22 mm³ respectively.Also dispute with (16) reported the lacrimal gland in sheep the mean of weight 1.48gm, length 26.98mm& width20.11mm.

Dispute with (11 & 26) reported that the lacrimal gland in dog the mean weight 1.4-1.2 gm. The mean length, width, thickness of lacrimal gland was 14 mm, 2.42mm, & 0.49 mm respectively. Whilst (27) described the lacrimal gland in dog had mean length15.2mm & width 13.8mm.This alteration may becaused by species, genus & age of the animals. We observed the appendage of lacrimal gland in a goat have mean 0.03±0.007gm weight, 11.738±2.137mm length, 4.088±0.975mm width, 1.704±0.137mm thickness &3±0.158mm³volume.This results differ with (15)show the appendage of lacrimal gland in goathas10mm length &7mm width. The presentstudy find the excretory ducts of lacrimal gland in goat had a slit-like opening & take the same color of the conjunctival mucosa of upper eyelids. This results agreement with (16)show the excretory duct of the lacrimal gland in sheep opens in mucous membrane of conjunctiva on the internal surface of the upper eyelid. (28)reported in camel the main lacrimal ducts were small & open into the superior conjunctiva. But differ with (29)in camelseem the excretory ducts of lacrimal gland difficult to find but were noticed by black color. The current study finds that the puncta in goat had slit-like opening & take grayish black in color. This result was accordance with (10;16;22 & 30)explain most mammalshave two lacrimal puncta in the medial canthus of eyes & the colour of puncta differs. But differ with (28;31 & 32)showthe lacrimal puncta in camel was absent & the lacrimal ducts start blindly.

In the present study observed the mean diameter & distance of puncta from medial canthus of right & left dorsal puncta were 1.121±0.071mm, 1.16±0.114mm, 3.961±0.177mm & 4.086±0.151mm respectively, while the right & left ventral puncta were 1.16±0.062mm, 1.205±0.093mm, 4.053±0.379mm & 4.218±0.361mm respectively.This result agreement in some measurements & differ in other with (22)show that in goat the diameter & distance of punctum from medial canthus of right & left dorsal puncta were 1.21±0.13mm, 1.08±0.06mm, 4.94±0.22mm & 4.81±0.27mm respectively, while the right & left ventral puncta were 1.54±0.15mm, 1.50±0.14mm, 3.63±0.16mm & 3.75±0.16mm respectively. In the present study seen the lacrimal ducts in goat, the lacrimal ducts were started from the lacrimal puncta in the medial canthus of the eyeball & reached into the lacrimal sac. This resultsaccordance with(16) in sheep reported that there were two lacrimal canals begin from ventral & dorsal lacrimal puncta. Whiledispute with (16 & 31) showin goat, sheep &donkey have two lacrimal ducts starts by a small dorsal & ventral openings, but in camel, the lacrimal ducts start blindly. We observed the dorsal canaliculi were similar to that explained by (30) in goat explain that the dorsal & ventral canaliculi were 8 mm in length. But disagreement with (22) reported that in goat & sheep the mean length of right & left ducts (dorsal & ventral) were 13.64mm, 13.71mm, 10mm & 10.07respectively. Whereas(33) in catshow the length of dorsal 2.5mm &4.5mm ventral lacrimal ducts.





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The lacrimal sac was situated in the small depression of lacrimal fossa of the lacrimal bone. This resultssimilar with (22) explain that in goat the two lacrimal canaliculi merged together during course to formation the lacrimal sac. (10;22;30 &34) explain that in sheep, goat & buffalo the dorsal & ventral canaliculi were join into formation a small dilatation lacrimal sac. It was situated in the orbit on the fossa of the lacrimal bone in the medial angle of the eyeball. The nasolacrimal duct was divided into three parts proximal, middle & distal. This resultsaccordance with(30;35;36 & 37)in goat & horse show the nasolacrimal duct extended from the lacrimal sac into the nasal cavity & divided into three parts, while dispute with(10) show the nasolacrimal duct divided into two parts inside & outside osseous canals. Whilst (38) explain the nasolacrimal duct in dog divided in four regions. The current study see that the mean total length of the right & left nasolacrimal duct in goat was 89.71±3.260mm & 91.953±2.983mm respectively. This finding disagreement with (10) in buffalo show the total length left & right nasolacrimal duct was about 232 mm and 235 mm, whilst (16) in sheep explain the mean length of duct was 125.7mm, (28) in camel reported mean length of nasolacrimal duct was 210-230 mm.

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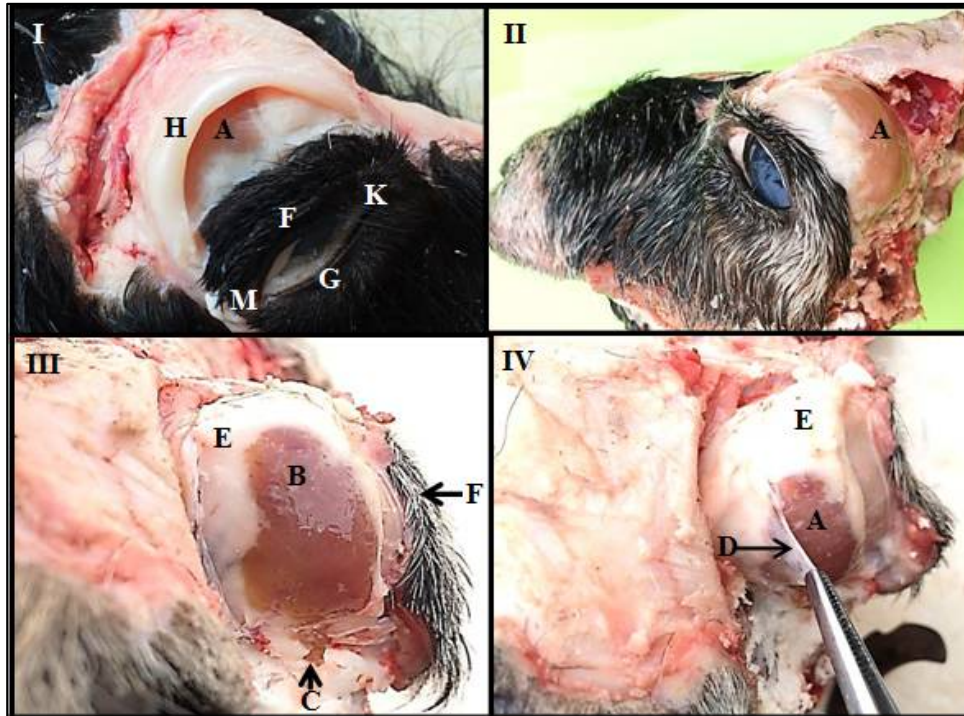


Fig.1. I Lateral, II caudolateral, III caudal &caudodorsal views of the Head goat Show: A- Lacrimal gland. **B-** Body of lac. gland. **C-** Appendage of lac. gland. **D-**Periorbital connective tissue. **E-**Adipose tissue. **F-** Upper eyelid. **G-** Lower eyelid. **H-** Frontal cartilage. **K-** Medial canthus. **M-** Lateral canthus

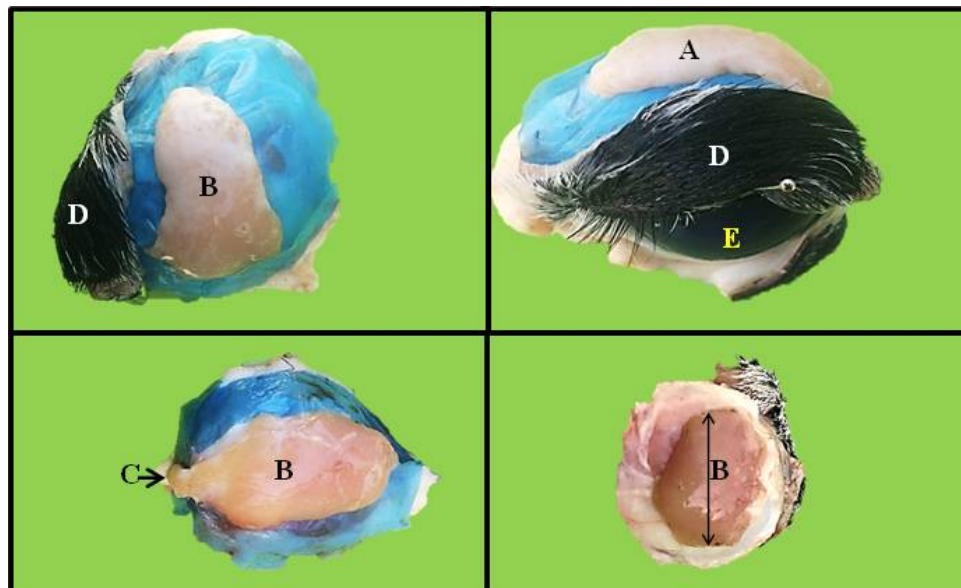


Fig .2. Lacrimal gland in goat Show:A-Lacrimal gland.**B-**Body of lacrimal gland. **C-** Appendage of lacrimal gland.**D-**Upper eyelid. **E-**Eyeball



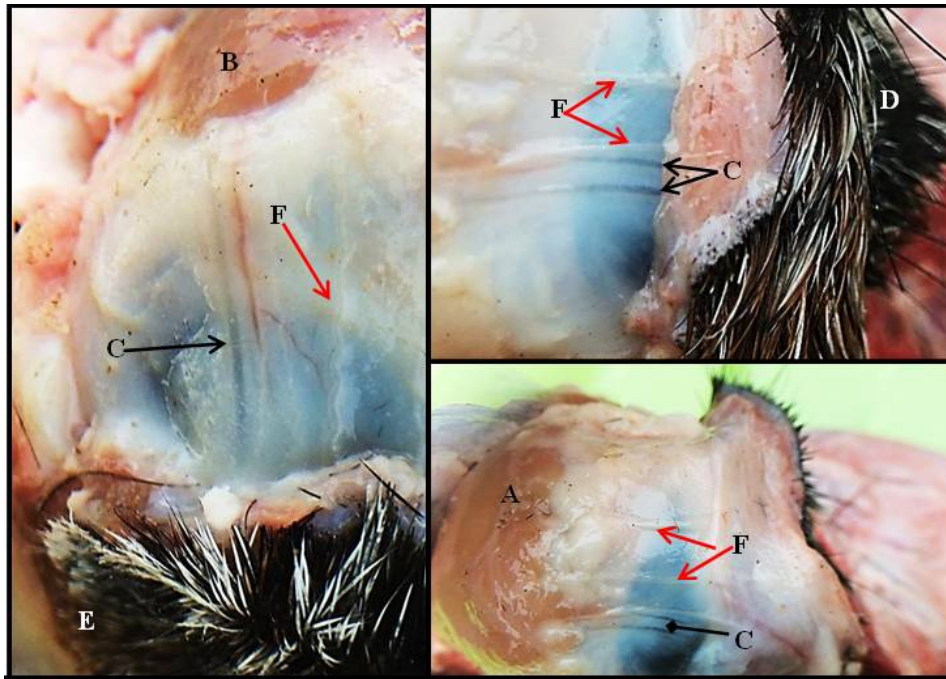
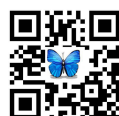


Fig.3. Major excretory ducts of lacrimal gland in goat Show: A-Lacrimal gland. B-Caudal part of body lacrimal gland. C-Major excretory duct of lac. gland. D-Upper eyelid. E- Lateral canthus. F- Nerve supply



Fig. 4. Conjunctival surface of the upper eyelid (Fornix) in goat Show: A-One opening of the major excretory duct of lacrimal gland. B-Conjunctival surface of upper eyelid (Fornix). C-Upper eyelid. D- Medial canthus. E- Lower eyelid. F- eyeball.



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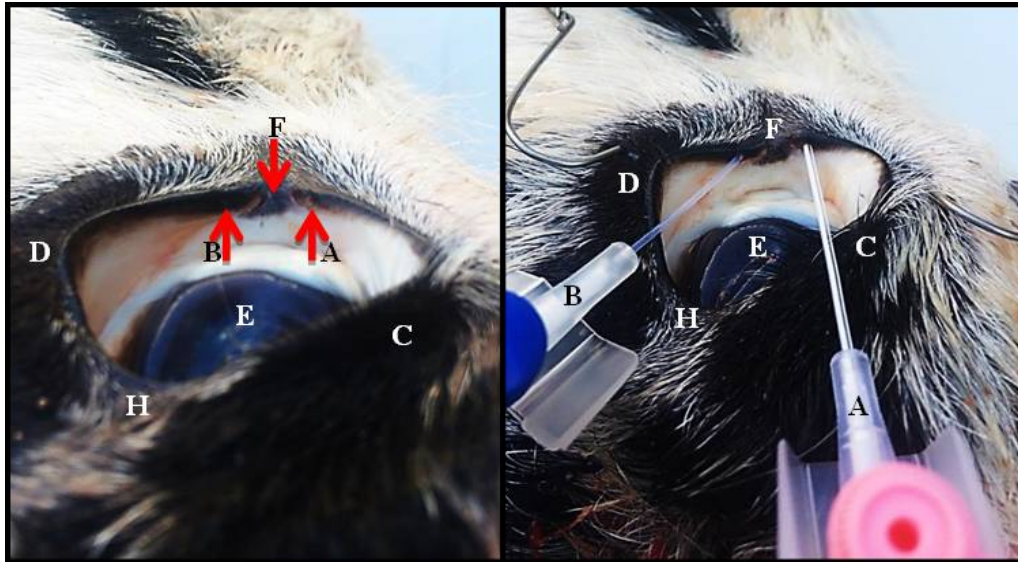


Fig.5. Lateral view of the eye goat Show: A- Dorsal punctum, B- Ventral punctum. C- Upper eyelid. D- Lower eyelid, E- Eyeball, F- Medial canthus, H- Lateral canthus.

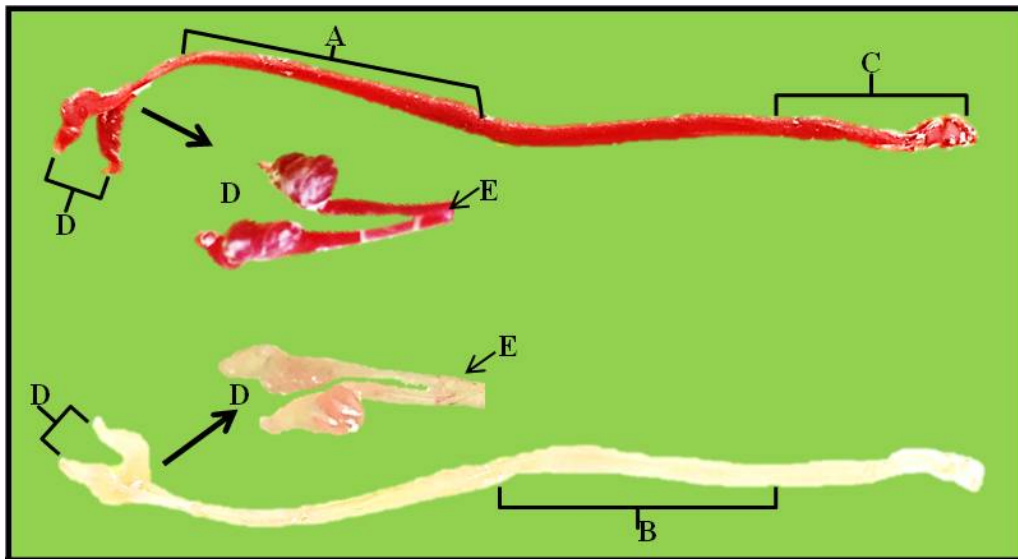


Fig.6. Resin cast of nasolacrimal duct in goat Show: A- Proximal part (bony part). B- Middle part (Mucous part). C- Distal part (Cutaneous part). D- Lacrimal canaliculi E- Lacrimal sac.





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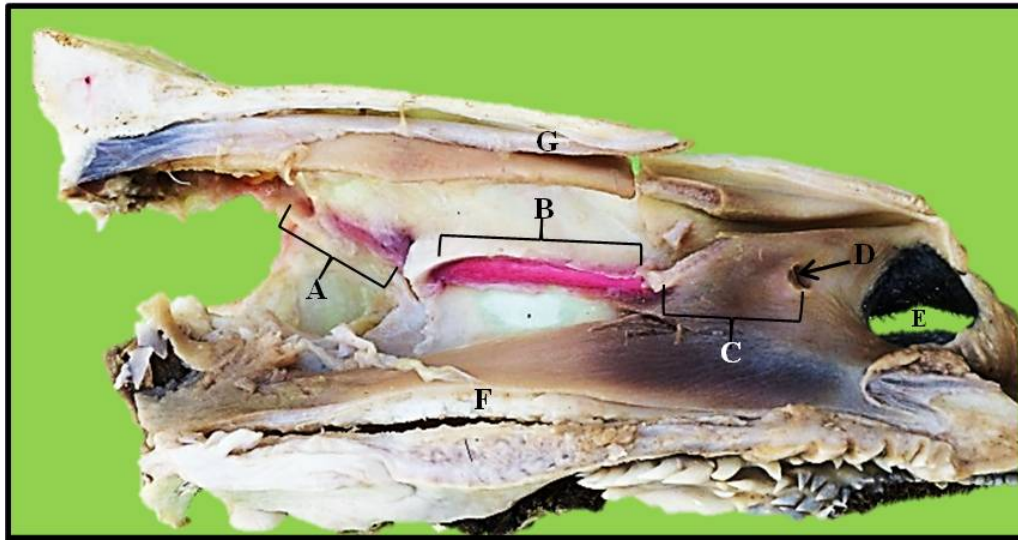


Fig.7. Course of nasolacrimal duct in goat Show:A-Proximal part(bony part).B-Middle part(Mucous part). C- Distal part(Cutaneous part).D-nasolacrimal opening. E-Nasal opening. F- Floor nasal cavity. G- Roof nasal cavity.

