



Lacrimal Apparatus System in One-humped Camel of Iran (*Camelus dromedarius*): Anatomical and Radiological Study

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Abstract

Objective- Radiological and anatomical study of the Lacrimal apparatus system in one-humped camel of Iran (*Camelus Dromedarius*)

Design- Prospective study

Animals- Five heads (cut above the third cervical vertebra) of adult Dromedary camels' cadavers were collected from the slaughterhouse of the Najafabad area of Isfahan Province, Iran.

Procedures- The anatomy of the nasolacrimal duct of one- humped camels studied grossly and radiographically in 5 camels. Dacryocystorhinography was performed on cadaver heads, using a radiographic contrast media. Anatomic casts of the nasolacrimal apparatus were obtained by cannulation of the duct and use of Rodopas cast material.

Results- The lacrimal puncta were not found within the mucocutaneous junction of the palpebral margin of medial canthus. The duct then traversed the nasal cavity in an S- shape fashion, covered only by nasal mucosa and a thin connective tissue membrane. The opening of the nasolacrimal duct was on the lateral wall of the dorsal angle of the nostril.

Conclusion and Clinical Relevance- Dacryocystorhinography accurately revealed the nasolacrimal apparatus and compared favorably with gross dissection and Rodopas casts. Since the puncta lacrimalis have not been formed in camels, tears can not drain with it and naturally flow over the lower eyelid.

Key words: Dacryocystorhinography, nasolacrimal duct, casting, camel

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Introduction

One-humped camel (*Camelus Dromedarius*) is found in Iran, Iraq, Arabia, Egypt, Sudan, North Africa, Somaliland, India, and many other countries. This animal adapted to the rigorous climate of the desert where it is subjected to high temperature, fierce gale, and the scorching sun rays. The lacrimal apparatus system provides a passage for tear drainage from the eye to the nasal cavity. The system for each eye in most species consists of dorsal and ventral lacrimal puncta, paired canaliculi, lacrimal sac, and the nasolacrimal duct.¹ The nasolacrimal system of one-humped camel has been briefly, but accurately, reviewed by Abdalla et al (1970) and Shokry et al (1987). There are no reports on the lacrimal apparatus system in the *Iranian Camelus Dromedarius*. Dacryocystorhinography, the radiographic visualization of the lacrimal apparatus using radiographic contrast media, has been used to study normal anatomy^{2,3} as well as pathologic conditions of the nasolacrimal duct in human beings⁴, dogs⁵, horses⁶, sheep⁷, cattle^{8,9}, camels³, cats² and llamas.¹⁰ The present study on the lacrimal apparatus of the *Iranian Camelus Dromedarius* might be useful for differentiation of congenital or clinical cases affecting the lacrimal system area.

Materials and Methods

Five heads (cut above the third cervical vertebra) of adult Dromedary camels' cadavers were collected from the slaughterhouse of the Najafabad area of Isfahan Province, Iran. In gross observation the dorsal and ventral puncta were not found in the medial canthus of eyelids, therefore the distal opening of nasolacrimal duct was found in nasal cavity and was cannulated with a 6-French feeding tube. Five milliliters of a sodium and meglumine diatrizoate mixture (Urographin 76%, Schering Company, Germany) were injected into the lacrimal duct in retrograde fashion. Lateral and dorsoventral oblique radiographic views were taken (90 KV and 10 mAs) (Fig 1). For gross anatomic studies, casting materials was also introduced in retrograde fashion from distal opening of lacrimal duct. Approximately 5-6 milliliter of casting material (Rodopas, Merck Company, Germany) was needed to fill the entire length of the nasolacrimal duct. When the casting materials had solidified, the lacrimal apparatus was examined grossly via exposure of the lateral aspects of nasal cavity. Medial dissection was facilitated by removal of the ethmoturbinates, ventral conchae and lacrimal bone.

Results

Anatomic studies- In gross anatomical studies, the lacrimal puncta were not found within the mucocutaneous junction of the palpebral margin of medial canthus. The paired ventral and dorsal canaliculi were 10.5 ± 0.5 mm (mean \pm SD) long and converged into a small dilatation, the lacrimal sac, which was located in the orbit on the fossa of the lacrimal bone outside the periorbita. The nasolacrimal duct extended from the lacrimal sac to the nostril in the wall of the nasal cavity (fig 2). The proximal portion of the lacrimal duct was in the osseous lacrimal canal and was

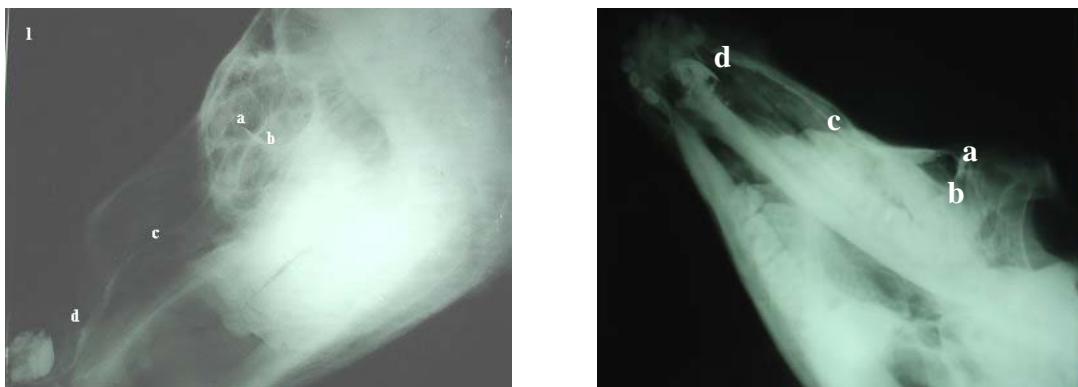


Figure 1. Lateral (left) and dorsoventral oblique (right) radiographic views of camel lacrimal duct. a) Dorsal canaliculi b) Ventral canaliculi c) Middle portion of lacrimal duct d) Distal opening of lacrimal duct



Figure 2. Rodopas injection from the distal opening of lacrimal duct (Red arrow is distal nasal lacrimal duct opening)

Figure 3. Gross anatomical dissection of lacrimal duct in camel (lateral aspect view) arrow shows lacrimal bone and lacrimal duct.

45.64 ± 0.41 mm (mean \pm SD) long. The medial wall of the nasolacrimal duct extended as a thin lamina of bone for 7.5 cm into the maxillary bone. The nasolacrimal duct did not pass through the maxillary bone. The duct then traversed the nasal cavity in an S- shape fashion, covered only by nasal mucosa and a thin connective tissue membrane (fig 2). The opening of the nasolacrimal duct was 2.6 ± 0.41 mm (mean \pm SD) in diameter and was on the lateral wall of the nostril about 11.5 ± 0.5 mm (mean \pm SD) from the dorsal angle of the nostril (fig 3). The opening, which was 2.6 ± 0.41 mm (mean \pm SD) in diameter, was easily identified. Gross dissection provided finely tailed casts of the nasolacrimal duct (Fig 2). Since the Rodopas was fragile, we cannot draw any finding with this technique.

Radiographic study- Positive contrast Dacryocystorhinography provided detailed visualization of the lacrimal apparatus. The nasolacrimal duct continue rostrally in a S- shape fashion from the orbit to the nasal cavity (fig 1) on leaving the orbit and lacrimal sac, the duct descended in a subtle, dorsal curve and then descended ventrally for 6 to 7.5 cm. The terminal portion of the

nasolacrimal duct tapered to a fine exit, rostral to the nasal processes of the incisive bone. The lateral dacryocystorhinographic view was better than ventrodorsal oblique view for detailed viewing of the course of the nasolacrimal duct.

Discussion

The nasolacrimal system of various domestic species has been previously described.^{2,3} Radiographic and gross anatomic description of the lacrimal apparatus in one-humped camels and llamas has been published^{3,10,12} but there are no reports on the lacrimal apparatus system in the *Iranian Camelus Dromedarius*. Anatomic and radiographic findings in dromedary camels of our study were similar to those reported by Abdalla et al (1970) and Shokry et al (1987).

The lacrimal apparatus consisted of an orbital part and a nasal cavity part. The orbital lacrimal apparatus consisted of a simple lacrimal sac, paired canaliculi without the dorsal and ventral puncta. Abdalla et al (1970) and Shokry et al (1987) reported that the puncta lacrimalis in dromedary camels were remarkably small or absent and could not be probed however in our study we observed the puncta lacrimalis have not been formed at all. The nasolacrimal duct coursed rostrally in a S- shape fashion, quite similar to that observed in dromedary camels and llamas.^{3,10} Primarily, the nasolacrimal duct coursed ventrally on coming out from the lacrimal bone and then gradually rose dorsally to a delicately tapered exit, embedded in the ventral lateral cartilage of the nostril. The nasolacrimal duct was regular in diameter throughout its entirety, unlike that in horses.⁶ Dacryocystorhinography accurately revealed the lacrimal apparatus and compared favorably with gross dissections and Rodopas casts. In the previous study by Sapienza et al (1992) the casts provided fine detail of the nasolacrimal duct, but were fragile and tended to break easily in situ.¹⁰ In our study, since the Rodopas was fragile, we cannot draw any finding with this technique.

The lateral dacryocystorhinographic view was better than the dorsoventral view for visualization of duct over its entirety.^{3,6} A dorsoventral oblique view has provided more detailed view than dorsoventral view.¹⁰ It seems that as the camel lives under adverse climatic conditions, its eye must be provided with a continuous lacrimal secretion to wash the eye surface free of irritant, particles and fums.^{12,13} We proposed that since the puncta lacrimalis have not been formed in camels, tears can not drain with it and flow over the lower eyelid; in addition if the puncta had been formed in camels, the lacrimal duct might be blocked by sand and small particles as soon as possible.

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References

1. Prince JH, Diesem CD, Eglitis I. *Anatomy and histology of the eye and orbit in domestic animals*: Springfield, III: Charles C Thomas, 1960.
2. Gelatt KN, Cure TH, Guffy MM. Dacryocystorhinography in the dog and cat. *J Small Anim Pract* 1972;13:381-397.

3. Shokry M, Abdel Hamid MA, Ahmed AS. Radiography of the nasolacrimal duct in the dromedary (*Camelus Dromedarius*). *J Zoo Anim Med* 1987;18:94-95.
4. Hurwitz JJ, Welham RAN. The role of Dacryocystorhinography in the management of congenital nasolacrimal duct obstruction. *Can J Ophthalmol* 1975;10:346-350.
5. Fowler ME. *Medicine and surgery of South American camelids*. Iowa: Iowa State University Press, 1989.
6. Latimer CA, Wyman M, Diesem CD, et al. Radiographic and gross anatomy of the nasolacrimal duct of the horse. *Am J Vet Res* 1984;45:451-458.
7. Gilanpour H. Anatomic and radiographic studies of the lacrimal drainage system in sheep (*Ovis aries*). *Am J Vet Res* 1979;40:1177-1179.
8. Heider L, Wyman M, Burt J, et al. Nasolacrimal duct anatomy in calves. *J Am Vet Med Assoc* 1975;167:145-147.
9. Wilkie DA, Rings DM. Repair of anomalous nasolacrimal duct in a bull by use of conjunctivorhinostomy. *J Am Vet Med Assoc* 1990;196:1647-1650.
10. Sapienza JS, Isaza R, Johnson RD, et al. Anatomic and radiographic study of the lacrimal apparatus of llamas. *J Am Vet Res* 1992;53:1007-1009.
11. Falah KA-a. *Camel management and disease*. 1 ed. Jordan National library: Al-Sharg Printing Press, 2004.
12. Abdalla O, A. FMF, Arnautovic I. Anatomical study of the lacrimal apparatus of the one- humped camel. *Acta Anat* 1970;75:638-650.
13. Awkati A, Bagdadi F. Lacrimal gland of the camel (*Camelus Dromedarius*). *Am J Vet Res* 1971;32:550-510.

مطالعه رادیوگرافیکی و آناتومیکی مجرای اشکی شتر یک کوهانه ایرانی

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هدف- مطالعه رادیوگرافیکی و آناتومیکی مجرای اشکی شتر یک کوهانه ایرانی.

طرح مطالعه - مطالعه آینده نگر

حیوانات- پنج سر شتر تهیه شده از کشتارگاه نجف آباد اصفهان.

روش کار- مجرای اشکی مسیری را برای زهکشی اشک از چشم به حفره بینی فراهم می کند. رادیوگرافی از مجرای اشکی با استفاده از ماده حاجب که برای مطالعه آناتومی طبیعی و نیز حالت پاتولوژیکی مجرای اشکی بینی استفاده می شود. آناتومی مجرای اشکی بینی، در سه شتر یک کوهانه ایرانی تهیه شده از کشتارگاه به صورت ماکروسکوپی و پرتو نگاری مورد مطالعه قرار گرفت. رادیو گراف مجرای اشکی بر روی لشه ها انجام شده و از پرتو نگاری ماده حاجب استفاده شد. قالب آناتومیکی از دستگاه اشکی بینی با لوله گذاری در مجا و با استفاده از ماده شیمیایی «رودو پاس» به دست آمد.

نتایج- سوراخ های مجرای اشکی در لبه پلکی شتر شکل نگرفته ولی مجرای اشکی در دیواره جانبی بینی در یک مسیر خمیده (S شکل) حرکت می کند و دهانه انتهایی آن در لبه پشتی دیواره جانبی سوراخ بینی شکل گرفته است.

نتیجه گیری و کاربرد بالینی- رادیوگرافی مجرای اشکی بینی دقیقاً، دستگاه اشکی بینی را اشکار می کند و در مقایسه با کالبد شکافی ماکروسکوپی و قالب رودوپاس روش مطلوبتری می باشد. از آنجایی که مجرای اشکی در شتر یک کوهانه ایران شکل نگرفته شتر مداوم و بطور طبیعی ریزش اشک دارد.

کلید واژگان- رادیوگرافی مجرای اشکی، شتر یک کوهانه.