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Morphology of the extra-ocular muscles (*musculi bulbi*) of the American Staffordshire Terrier during the perinatal period

Joanna Klećkowska, Maciej Janeczek, Monika Wojnar, Norbert Pospieszny

Department of Anatomy and Histology, Veterinary Faculty, Agricultural University, Wrocław, Poland

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The study was carried out on 12 American Staffordshire Terriers (AST) each of 60 days' gestation. A morphological analysis of the extra-ocular muscles was performed. The location of the rectus and oblique muscles and the retractor bulbi muscle is described. The length and breadth of these muscles as well as of their tendons, the distance between the final insertions of the tendons and the corneal limbus and the line of insertions is also given.

key words: dogs, American Staffordshire Terrier, eyeball, accessory organs of the eyeball, extra-ocular muscles

INTRODUCTION

The extra-ocular muscles are accessory organs of the eye (*organa oculi accessoria*) located between the sclera and the wall of the orbit. They comprise the dorsal (*m. rectus dorsalis*), ventral (*m. rectus ventralis*), lateral (*m. rectus lateralis*), medial rectus muscles (*m. rectus medialis*), the dorsal oblique (*m. obliquus dorsalis*) and ventral oblique muscles (*m. obliquus ventralis*) and the retractor bulbi muscle (*m. retractor bulbi*) [7]. Szekely [8] reported that ''Three muscles (medial rectus, inferior rectus and inferior obliquus) derive from the prechordal mesoderm and the other three muscles develop from the most rostral third of the medial paraxial mesoderm. The external eye muscles and their neurons are not homologous to any other striated muscle and motoneurons.'' The development of the extra-ocular muscles in dogs has also been described by Aguirre et al. [1]. Hifny and Misk [5] have provided a description of the morphology of the final insertions of the tendons of the extra-ocular muscles in domestic animals, including dogs, in the postnatal period.

In previous study we observed the extra-ocular muscles in Persian cats in the perinatal period, giving the morphometry of these muscles, the line of the final insertions of the tendons of the extra-ocular muscles on the sclera, the location of the muscles and the distances between the final insertions of the tendons of the muscles and the corneal limbus [unpublished data]

The study was designed to perform a morphological analysis of the extra-ocular muscles of American Staffordshire Terriers in the perinatal period.

MATERIAL AND METHODS

The study was carried out on 12 dogs of the AST breed from 6 uteri and of 60 days' gestation. The foetuses were preserved in 4% formaldehyde, in which they were kept for 12 months. For preparation 0.5–1.5% acetic acid and 70% ethanol were used to make the anatomical structures more recognisable. The preparations were made with a magnifying glass (4.5×) and a stereoscopic microscope (6.5––22.5×). The measurements were taken with an electronic slide calliper to the nearest 0.1 mm. For descriptive purposes NAV and NEV nomenclature served as a reference book [7]. Data were statistically analy-

Address for correspondence: Prof. Norbert Pospieszny, Department Anatomy and Histology, Faculty of Veterinary Medicine, Agricultural University, ul. Kożuchowska 1/3, 51–631 Wrocław, Poland, tel: +48 71 320 57 48, e-mail: norpos@gen.ar.wroc.pl

sed using the Excel 2000 computer programme. The data and results are given in tables, figures and photographs.

RESULTS

Recti muscles

Dorsal rectus. The dorsal rectus continues rostrally over the eyeball, along with the levator of the upper eyelid (*m. levator palpebrae superioris*). It runs over the ligament of the dorsal oblique to attach to the sclera. The tendon of the dorsal rectus is long and its insertion line is broad and oblique (Fig. 1). The dorsal rectus was the longest muscle of all the extra-ocular recti (Table 1).

Ventral rectus. The ventral rectus passes rostrally underneath the eyeball, its tendon being hidden under the muscle belly of the ventral oblique. It is interposed between the lateral and medial recti (Fig. 2). The tendon is long with a broad straight insertion line (Fig. 1). The tendon of the ventral rectus was the furthest of all the extra-ocular recti tendons from the corneal limbus (Table 1).

Medial rectus. The medial rectus runs medially to the eyeball between the dorsal and ventral recti (Fig. 2). The muscle has a long tendon and the tendon insertion line is broad and convex (Fig. 1 and Table 1).

Lateral rectus. The lateral rectus passes laterally to the eyeball between the dorsal and ventral recti (Fig. 2). The tendon is long and its insertion line is broad and

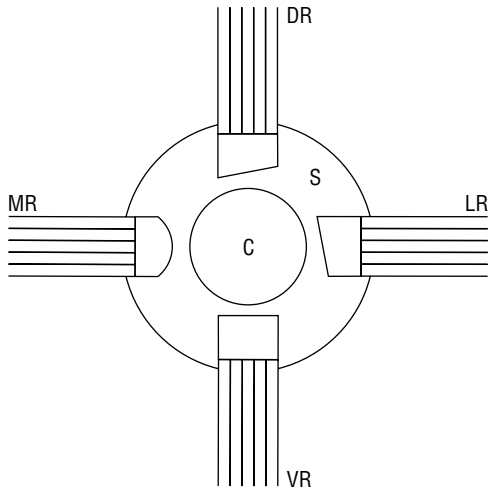

Figure 1. The rectus muscles position with respect to the eyeball. The left eye; C — cornea, S — sclera, DR — dorsal rectus, VR — ventral rectus, LR — lateral rectus, MR — medial rectus.

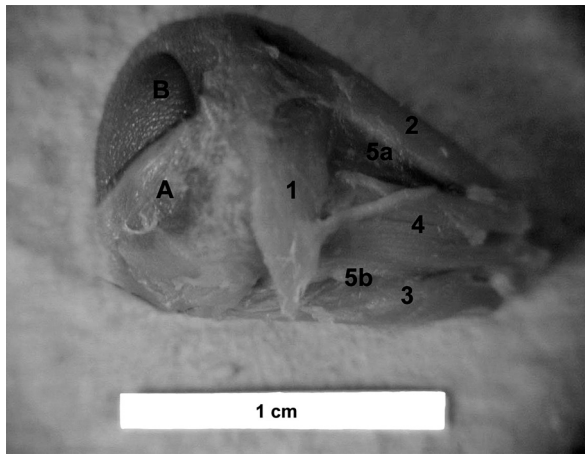

Figure 2. Extra-ocular muscles of the dog. The right eye; A — third eyelid, B — cornea, 1 — ventral oblique, 2 — lateral rectus, 3 — medial rectus, 4 — ventral rectus, 5a — retractor of eyeball (ventrolateral funicle), 5b — retractor of eyeball (ventromedial funicle).

Table 1. Morphometry of the rectus muscles of the American Staffordshire Terrier

		Length of the muscle [mm]	Length of the tendon [mm]	Width of the tendon [mm]	Distance insertion — cornea limbus [mm]
Lateral rectus	X	7.47	2.06	2.27	2.50
	SD	1.00	0.69	0.34	0.64
Medial rectus	X	8.00	2.04	3.37	2.83
	SD	0.80	0.61	0.31	0.37
Dorsal rectus	X	8.14	2.01	2.95	3.05
	SD	1.00	0.67	0.29	0.24
Ventral rectus	X	7.46	2.13	3.66	3.44
	SD	0.90	0.68	0.37	0.63

X — mean, SD — standard deviation

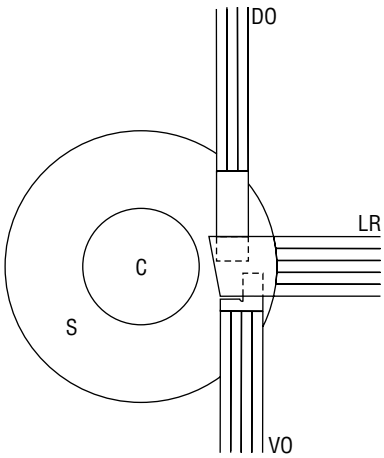

Figure 3. The oblique muscles position with respect to the eyeball. The left eye; C — cornea, S — sclera, LR — lateral rectus, VO — ventral oblique, DO — dorsal oblique.

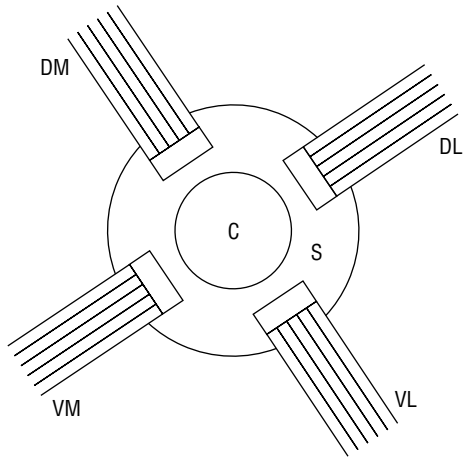

Figure 4. The retractor bulbi muscle position with respect to the eyeball. The left eye; C — cornea, S — sclera, DM — funiculus dorsomedial, DL — funiculus dorsolateral, VM — funiculus ventromedial, VL — funiculus ventrolateral.

oblique (Fig. 1). The lateral rectus tendon was the closest of all the extra-ocular recti to the corneal limbus (Table 1).

Oblique muscles

Dorsal oblique. The dorsal oblique derives from the margin of the dorsomedial optic canal and continues inside the periorbit between the dorsal and medial recti. In the upper part of the orbit it forms a thin tendon that passes through a trochlea and beneath the final tendon of the dorsal rectus. It then goes across the eyeball and under the final tendon of the lateral rectus. The dorsal oblique has a narrow tendon insertion line and the longest tendon of all the extra-ocular muscles. The tendon of the dorsal oblique is entirely underneath the tendon of the lateral rectus (Fig. 3). The dorsal oblique was the longest and narrowest muscle of all the extra-ocular rectus and oblique muscles (Table 2).

Ventral oblique. The ventral oblique tendon originates from the muscular fossa (*fossa muscularis*) of the lacrimal bone (*os lacrimale*), follows ventrally through the ventral rectus, ascends dorsally the temporal area of the eyeball and ends on the sclera close to the lateral rectus (Fig. 4). The tendon insertion line of the ventral oblique is broad. In dogs this tendon is divided into two sections: one faces the front of the tendon of the lateral rectus and the other is partly hidden beneath it (Fig. 3). The ventral oblique was the shortest muscle of all the extra-ocular muscles (Table 2).

Retractor bulbi muscle

The retractor bulbi muscle comprises four separate flat muscular funiculi: the dorsolateral, dorsomedial, ventrolateral and ventromedial. The funiculi lie among the extra-ocular recti. The final insertion of each funiculus is on the sclera at varying distances from the corneal limbus (Fig. 4). The retractor bulbi muscle had the

Table 2. Morphometry of the oblique muscles of the American Staffordshire Terrier

		Length of the muscle [mm]	Length of the tendon [mm]	Width of the muscle [mm]	Width of the tendon [mm]
Dorsal oblique	X	8.79	3.48	1.64	1.35
	SD	0.89	0.75	0.21	0.08
Ventral oblique	X	7.44	2.85	3.06	3.03
	SD	0.74	0.90	0.48	0.28

X — mean, SD — standard deviation

Table 3. Morphometry of the retractor bulbi muscle of the American Staffordshire Terrier

		Length of the muscle [mm]	Length of the tendon [mm]	Width of the tendon [mm]	Distance insertion — cornea limbus [mm]
Dorsomedial funiculus	X	9.58	2.11	2.37	1.82
	SD	0.95	0.35	0.51	0.44
Dorsolateral funiculus	X	9.80	2.06	2.71	1.96
	SD	0.52	0.22	0.41	0.21
Ventromedial funiculus	X	9.30	2.01	2.97	1.86
	SD	0.98	0.24	0.50	0.30
Ventrolateral funiculus	X	9.46	2.76	2.76	1.82
	SD	0.88	0.34	0.40	0.37

X — mean, SD — standard deviation

longest funiculi of all the extra-ocular muscles and the funiculi tendons were the closest of all the extra-ocular recti to the corneal limbus (Table 3).

DISCUSSION

The morphology and development of the extra-ocular muscles is inherently connected with the development of the head and its evolution in Vertebrata. The examinations proving that the extra-ocular muscles originate from the prechordal and paraxial mesoderm show their unique nature [8]. It is considered that the origin and development of the extra-ocular muscles as well as the propius lingual muscles may play a considerable role in tracing the evolution and the development of the head in Vertebrata. The accessible literature lacks information on the morphology of the extra-ocular muscles in dogs in the perinatal period. The course of the extra-ocular muscles in adult dogs has been described in the studies by Evans [3], Nickel et al. [6], Frewein and Vollmerhaus [4] and Dyce et al. [2]. The morphology of the tendons of the extra-ocular muscles in various species of domestic animals, including dogs, in the postnatal period was examined by Hifny and Misk [5]. They described the line of the final insertions of the tendons of the extra-ocular muscles and the tendon morphometry of dogs. Their studies comprised dogs whose breed, sex and age were not specified. Our studies have been carried out on specimens of one breed and from the same gestational period.

A comparison of the present results with those by Hifny and Misk [5] has shown no differences in the lines of the final insertions of the extra-ocular muscles. Differences did emerge, however, in the tendon morphometry of the examined muscles and in the distances between the final insertions of the muscle tendons and the corneal limbus.

CONCLUSIONS

The present study on the morphology of the extra-ocular muscles reveals the following:

1. The dog's sex, weight and length did not affect the muscle morphometry in this period of perinatal life.

2. The retractor bulbi muscle was closer to the corneal limbus than the extra-ocular recti.

3. The course of the line of the final insertions of the tendons on the sclera varied.

REFERENCES

1. Aguirre GD, Rubin LF, Bistner SI (1972) Development of the canine eye. Am J Vet Res, 12, 33: 2399–2414.
2. Dyce KM, Sack WO, Wensing CJG (1996) Textbook of veterinary anatomy. 2 Ed., WB Saunders Company.
3. Evans HH (1993) Millers anatomy of the dog. 3 Ed., WB Saunders Company.
4. Frewein J, Vollmerhaus B (1994) Anatomie von Hund und Katze. Balckwell Wissentschafts-Verlag, Berlin.
5. Hifny A, Misk NA (1982) A comparative study of the surgical anatomy of the Tendons of insertions of the extrinsic muscles of the eyeball in different domestic animals. Anat Histol Embryol, 11: 19–26.
6. Nickel R, Schummer A, Seiferle E (1999) Lehrbuch der Anatomie der Haustiere. Band II, Parey Buch Verlag.
7. Nomina Anatomica Veterinaria (NAV), Nomina Embryologica Veterinaria (NEV) (1994) New Jork, Ithaca, Zurich.
8. Szekely G (1994) Comparative anatomy of cranial nerve motor nuclei: with a comment on evolution of the craniofacial region. Europ J Morph, 32, 2–4: 217–224.