**Applied Ophthalmic Anatomy and How to Describe Ocular Lesions**

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I. **INTRODUCTION**

Both normal and abnormal anatomy play important roles in ophthalmic diagnoses. Unlike those of many medical disciplines, however, most ophthalmic diagnoses are made on the basis of anatomical observations. In this lecture, the anatomy of the equine eye and associated structures will be reviewed with emphasis on clinically relevant elements.

II. **MATERIALS AND METHODS**

**Ocular Adnexa**

The adnexa of the eye include the bony orbit, eyelids, extraocular muscles, conjunctivae, lacrimal glands, and nasolacrimal duct system. In various ways these structures protect the globe and provide a first line of defense to the horse’s environment. These are the ocular structures that a veterinarian first appreciates when meeting a horse, even prior to pursuing a complete ophthalmic examination.

The equine orbit is made up of six bones (lacrimal, zygomatic, frontal, sphenoid, palatine, and temporal) and is completely enclosed. Specifically relevant to the ophthalmic examination is the supraorbital fossa or foramen in the frontal bone, where the supraorbital nerve emerges. This nerve provides sensation to the upper eyelid and it is often helpful to anesthetize the nerve at this location to facilitate manipulation of the eyelid or place a subpalpebral lavage (SPL) catheter in the upper eyelid.

The prominent bony rim of the orbit is formed by the frontal process of the zygomatic bone, and the zygomatic processes of the frontal and temporal bones. It is important to pay particular attention to this area when evaluating a horse following trauma to the head as the dorsal orbital rim and zygomatic arch are at greatest risk of fracture. Even if the hair and dermis overlying these structures appear intact, careful palpation and sonographic examination may reveal a fracture. Subtle fractures are most easily diagnosed using ultrasonography as the anatomy and complicated structures of the skull preclude identification of non-displaced fractures with no associated external trauma.

Globe movement results from the action of six extraocular muscles (medial rectus, lateral rectus, dorsal rectus, ventral rectus, and dorsal and ventral oblique). The retractor bulbii muscle is a muscular cone with multiple, large muscle bellies that attach to the posterior half of the globe. Additional ocular muscles control the movement of the eyelid, most relevant to the equine clinician being the large orbicularis oculi muscle. The orbicularis oculi muscle is the major muscle that closes the eyelids and akinesthesia (cessation of voluntary movement following peripheral anesthesia) of this muscle is critical when evaluating an injured eye where the integrity of the globe is compromised, performing diagnostic procedures, placing a SPL catheter, and during standing surgery of the globe. Depositing a small volume of an anesthetic solution subcutaneously using a small gauge (26- or 25-gauge) needle as the nerve passes over the zygomatic arch, caudal to the bone process of the frontal bone, will anesthetize the palpebral branch of the auriculopalpebral nerve and facilitate opening of the upper eyelid. While the auriculopalpebral nerve can be anesthetized at multiple sites as it courses from the base of the ear towards the dorsal (superior) palpebral, the location where the nerve lies perpendicular to the zygomatic arch is the easiest to palpate and horses typically do not resist if placement of the needle is swift. Using a slip-tip syringe and placing the needle prior to attaching the syringe facilitates injection.

The eyelids are important not only as they serve a protective function to the globe, but also as an indicator of discomfort in the horse. The upper eyelid is more mobile than the lower eyelid, and thus injury to the upper eyelid can present a greater risk to proper function of the eyelids. Eyelashes or cilia are present in greatest number on the lateral two thirds of the upper eyelid. Vibrissae (long, tactile hairs) are located dorsonasal to the upper lid and ventral to the lower lid. The horse has a large nictitating membrane or third eyelid, situated at the medial canthus. The third eyelid moves laterally in a horizontal and slightly dorsal action across the globe.

**Lacrimal and Nasolacrimal System**

The horse’s major lacrimal gland lies beneath the dorsolateral orbital rim and is innervated by a combination of sympathetic and parasymathetic nerve fibers from the lacrimal branch of cranial nerve (CN) VII. At the base of the third eyelid, the horse...
has a serous nictitans gland, which is innervated by parasympathetic nerve fibers of CN IX. Two lacrimal puncta are located 8-9 mm from the medial canthus on the upper and lower eyelids. A canaliculus from each punctum joins to form the lacrimal sac, which is the proximal dilation leading into the long nasolacrimal duct. The nasolacrimal duct terminates in the lower punctum in the ventromedial aspect of the nostril, near the mucocutaneous junction. Multiple nasal puncta are common findings in the horse. Often a single punctum lead to the nasolacrimal duct, while the others are blind pouches not connected to the nasolacrimal duct. This is important to keep in mind when diagnosing and/or treating a blocked nasolacrimal duct as the clinician may have to flush each punctum in order to determine which one connects to the nasolacrimal duct.

Globe

Anterior Segment

The cornea is the transparent anterior portion of the fibrous tunic of the globe. Due to its avascular nature, the cornea relies on the aqueous humor and tear film for nourishment and immune surveillance. The thickness of the equine cornea ranges from 770 μm peripherally to 793 μm centrally. Histologically, the cornea has three primary layers: epithelium (lipophilic), stroma (hydrophilic), and endothelium (lipophilic). The alternating lipophilicity of the corneal layers is useful in identifying corneal ulcers and has implications for drug penetration into the cornea. The conjunctiva is continuous with the corneal epithelium and consists of three primary regions: palpebral conjunctiva, bulbar conjunctiva, and fornix. The conjunctiva is highly vascular and variably pigmented. The conjunctiva functions primarily to prevent desiccation of the cornea and to provide a barrier against microorganisms and foreign bodies.

Posterior to the cornea is the anterior chamber, which is filled with aqueous humor produced by the ciliary body. The visible part of the uveal tract is the iris. Most horses have a dark brown to golden color, while blue, white, and heterochromia iridis are more common in certain breeds and coat colors. The ventral fundus is the non-tapetal area and is usually dark green to blue in color. Small dark dots throughout the tapetal fundus are end-on choroidal capillaries called stars of Winslow. The optic disc is oval, salmon pink, and located in the non-tapetal fundus. Radiating from the periphery of the optic disc are 30-60 small arterioles and venules. The horse has a paupangiogenic retina meaning that it is partially vascularized by the vessel radiating from the optic nerve disc. The remainder of the retina is avascular and obtains nourishment from the underlying choroid.

III. DISCUSSION

Ocular Lesions

Ophthalmology is a visual science that demands a detail-oriented approach. The correct diagnosis often relies entirely on abnormalities from the clinical examination. Ruling out possibilities on the clinician’s differential diagnosis list often depend solely on the clinician appreciating the differences between deep and superficial corneal vasculature, buphthalmia and exophthalmia, or corneal cellular infiltrate and fibrosis. The clinician must not only understand the difference between these abnormalities and the significance of them, but possibly more necessary is the clinician’s ability to “see” them. Critically thinking about every structure while scanning the eye and conducting the ophthalmic examination by evaluating the “layers” of the eye is a good start to avoid missing key abnormalities. Once a lesion is identified, noting the shape, surface, margins, color, distribution/location, and size will help guide the clinician towards a morphologic diagnosis.

REFERENCES