Questions
1. Blindness results in damage to the visual receptors and sensory pathways contained in which cranial nerve?
2. Diplopia does not affect the visual pathway but is due to the optokinetic dysfunction resulting in paralyzed or weakened eye muscles. Which cranial nerves when damaged could cause diplopia?
3. Which cranial nerve would be damaged in a patient with a drooping upper right eyelid and an unresponsive dilated right pupil when exposed to bright light?
4. Which cranial nerve would be damaged in a patient with a drooping lower eyelid on the right side?
5. How would damage to the two structures in the optic canal cause blindness?
6. How would damage of cranial nerve VII cause pain in the eye?
7. Is the optic disc in the center of the posterior pole of the eyeball? When the blood vessels in the center of the optic disc radiate onto the retina are they medial or lateral to the macula lutea?
8. Following an automobile accident, a patient was found to have an internal (medial) strabismus of the right eye. Which cranial nerve was damaged? Which muscle was paralyzed?
9. On examination, a patient is found to have a bitemporal hemianopia. An enlargement of which anatomical structure is likely to cause this condition?
10. A 25-year-old woman was found to be suffering from thyrotoxicosis. Not only was she complaining of nervousness, excessive sweating, and loss of weight, but also she had bilateral exophthalmos. What anatomical structures are believed to be responsible for the exophthalmos?
11. A patient complaining of a foreign body in the eye comes to you. The foreign body has been in the conjunctival sac for several hours, and the patient has failed to remove it. Where would you look for a foreign body that has been floating around the conjunctival sac?
12. A 49-year-old woman was found on ophthalmoscopic examination to have edema of both optic discs (bilateral papilledema) and congestion of the retinal veins. The cause of the condition was found to be a rapidly growing intracranial tumor. Using your knowledge of anatomy, explain the papilledema. Why does the patient exhibit bilateral papilledema?
13. A 29-year-old woman was struck in the face with a baseball while playing with her son. X-ray examination revealed multiple fractures of the bones around the orbit. Name the bones that form the orbital margin.
14. A steel-worker was taken to the hospital after a fragment of metal flew into his eye. The eye was painful and watery. Following the administration of a topical anesthetic, removal of the foreign body was attempted using a small needle. During the procedure, however, the doctor suspected that she had perforated the cornea. Why
was the anesthetic required and what sign might help the doctor assess the possibility of a perforated cornea?

15. A teenager, known to suffer from chronic sinusitis, visited her doctor complaining of a four-week history of gradual deterioration in the sight of her right eye. During the past week she had suffered with headaches, malaise, and a purulent discharge from her right nostril. Although the visual field in her right eye was not grossly altered, there was a marked decrease in central visual acuity. Radiographs revealed a thickening of the mucosa of the right ethmoidal air sinuses resulting from inflammation, and erosion of the posteromedial aspect of the orbital wall caused by the presence of a mucocele (a cyst containing mucus) in the right sphenoidal sinus. How might this cyst be responsible for the symptoms reported?

16. A man was hit in the face by a baseball. On the right side of his face he developed a black eye with swollen eyelids, and had a tingling sensation over his cheek, the side of his nose, and his upper lip. The doctor noted that the patient's right eye had sunk inwards (enophthalmos), and that he had double vision (diplopia) when looking upwards. What has happened to cause these symptoms?

17. A mother visited her doctor with her baby who had a wet, sticky right eye. The doctor noted that there was a stagnant pool of tears in the affected eye and infection of the conjunctiva (conjunctivitis). When the doctor pressed just below the medial canthus of the eye, purulent material was expelled from the lacrimal punctum. The doctor suspected that the baby had a blocked nasolacrimal duct because of a developmental abnormality.

**Answers**

1. CN II (Optic)
2. CN III, IV or VI (Oculomotor, Trochlear or Abducent)
3. Right CN III (Oculomotor Nerve) (Preganglionic or postganglionic fibers or neurons)
4. Right CN VII (Facial)
5. (a) By preventing impulses from traveling to the brain through the optic (II) nerve. (b) By preventing the blood supply to the retina via the ophthalmic and central retinal arteries
6. If the lacrimal gland were denervated and corneal desiccation occurred. V¹ is intact and would transmit the pain sensation from the “dried” cornea.
7. No, the optic disc and its blood vessels are medial to the macula lutea, which is in the central portion of the posterior pole of the eyeball.
8. Right abducent nerve and right lateral rectus muscle.
9. Bitemporal hemianopia is a loss of both temporal fields of vision and is due to the interruption of the optic nerve fibers derived from the medial halves of both retinae. Pressure on the optic chiasma by a tumor of the pituitary gland is the cause of the condition.
10. The ocular manifestations of hyperthyroidism are proptosis, retraction of the upper lid, and lid-lag (the upper lid fails to move with the eye as the patient is asked to look downward). Exophthalmos was originally believed to be due to the excessive contraction of smooth muscle present in the back of the orbital cavity forcing the
orbital contents forward. Now it is believed to be due to a general weakness of the recti muscles resulting from infiltration with fat and lymphoid tissue. Retraction of the upper lid and lid-lag may be due to increased tone of the smooth muscle component of the levator palpebrae superioris. It is more likely to be a secondary mechanical defect associated with the exophthalmos.

11. Foreign bodies in the conjunctival sac tend to lodge in the subtarsal sulcus. The eyelid should be everted and the foreign body wiped off with a piece of moist cotton.

12. The optic nerves are surrounded by sheaths derived from the pia mater, arachnoid mater, and dura mater. There is an extension of the intracranial subarachnoid space forward around the optic nerve to the back of the eyeball. A rise in cerebrospinal fluid pressure caused by an intracranial tumor will compress the thin walls of the retinal vein as it crosses the extension of the subarachnoid space. This will result in congestion of the retinal vein and bulging of the optic disc. Since both subarachnoid extensions are continuous with the intracranial subarachnoid space, both eyes will exhibit papilledema.

13. The bones that form the orbital margin are the frontal, zygomatic, and maxillary bones.

14. The cornea has a rich sensory nerve supply. The innervation is derived from the ciliary branches of the ophthalmic division of the trigeminal nerve, particularly the long ciliary nerves. It was therefore necessary to apply topical anesthetic to the cornea before attempting to remove the metal fragment. The reflex lacrimation that occurs following the introduction of a foreign body into the eye is mediated via parasympathetic fibers from the greater petrosal nerve, which relay in the pterygopalatine ganglion. The central portion of the cornea is only about 0.5mm thick and is therefore at risk of being perforated when a foreign body is removed. Small perforations are difficult to detect. As the anterior chamber of the eye is filled with aqueous humour at an intraocular pressure of 10 to 20mm Hg greater than atmospheric pressure, fluid will quickly seep through any breach in the cornea. If dye (e.g. fluorescein) is dropped over the suspected site of perforation, it will wash away and dilute in the aqueous flow. This test is called the Seidel test.

15. The optic nerve runs in the optic canal within the sphenoid bone. The canal is closely related to the sphenoidal sinus, lying at the junction between the roof and lateral wall of the sinus. A cyst within the sphenoidal sinus can therefore erode the bone and compress the optic nerve. Early compression of the optic nerve affects primarily the centrally placed fibers that subserve central vision. The sphenoidal sinus drains into the sphenethmoidal recess of the nose. A sphenoidal cyst may consequently discharge into the nasal cavity and from there infection may spread to the other sinuses (in the present case the ethmoidal sinuses). Pathologies can spread easily from the paranasal sinuses into the orbit. Infection spreading to the orbit may then pass to the cavernous sinus by means of the ophthalmic veins.

16. This is a classic description of a blowout fracture of the orbit. When the orbital rim is struck by an object of greater circumference, there is an explosive increase in intraorbital pressure. Although the bones comprising the lateral wall and roof of the orbit are usually able to withstand the increased pressure, the thin floor of the orbit is often fractured. In rare instances where the suspensory ligament is damaged, the eye
may sink into the maxillary antrum. Should the inferior oblique muscle be trapped in the fractured floor of the orbit, upward movement of the eye is affected and diplopia results. The infraorbital branch of the maxillary nerve is prone to injury because it lies in the floor of the orbit. This nerve supplies an extensive area of skin over the face. Should the nerve be damaged, therefore, paresthesia or anesthesia of the cheek, side of the nose, and upper lip will be expected. A black eye results when blood tracks into the soft tissues around the eye.

17. The nasolacrimal duct develops from the naso-optic furrow lying between the merging maxillary and medial nasal processes. From the furrow, a solid ectodermal rod of cells sinks below the surface and canalizes to form the nasolacrimal duct. The baby’s nasolacrimal duct had failed to canalize. Thus, tears were unable to drain from the eye and the resulting stagnant pool of tears became infected, with subsequent development of conjunctivitis. The infection tracked down to the lacrimal sac via the punctum. Pressure just below the medial canthus forced purulent material back up the canaliculus and into the eye. The baby would not develop symptoms before the age of four months because tear production does not start until the age of three months. Treatment is usually conservative as the nasolacrimal duct usually canalizes spontaneously by the age of six months.

**Cases without printed interpretations**

- **Patient Frank S.** This 63-year-old plumber with a 2-year history of intermittent headaches complained to his physician that he was experiencing “double vision.” The physician examined his eyes and noted that the right eye deviated laterally and inferiorly at rest. The patient was unable to move the right eye medially (adduction), and the pupil was dilated and unresponsive to light, but no visual impairment was noted in the retina. The left eye was completely normal in its motor and sensory function. Now he is an inpatient at the O’Bleness Memorial Hospital. Further tests reveal a meningioma (tumor of the dura) that is invading the upper aspects of the superior orbital fissure. At combined neurology-ophthalmology ward rounds, faculty and students discuss the alternatives for best treatment. You only have your anatomical knowledge to help you follow the debate.

- A female patient visited her doctor at Parks Hall complaining of constantly feeling tired, run-down, and chilled. Based on these and other symptoms, a diagnosis of pituitary tumor is advanced. What visual problems is the patient likely to be experiencing and why?

- A patient was admitted to the hospital complaining of double vision (diplopia), particularly when looking to the right. Her left eye was observed to move little and tended to be directed inferiorly and laterally wherever the patient was asked to look. On examination, her left pupil did not react directly to light nor did it react consensually (that is, the left pupil did not contract when light was shone into the right eye). Explain these symptoms.

- An older man complained of an inability to elevate his right upper eyelid (ptosis). He also noticed that the right side of his face felt flushed and warm, yet he never seemed to sweat on that side of the face (anhidrosis). The doctor observed that the pupil in the
patient's right eye was constricted (miosis) and did not dilate when exposed to light. On further questioning, the patient admitted to being a heavy smoker. A chest radiograph revealed an opacity at the apex of the right lung indicative of cancer. How can the carcinoma of the right lung explain the facial symptoms?