CHAPTER 8 THE ORBIT

A. ANATOMY

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The orbit has the configuration of a four walled pyramid with the apex toward the interior of the skull. The base is formed by the circular orbital rim which overhangs the walls. The rim, along with the brow and malar prominence, serves to protect the eye from blunt trauma. The medical walls of the orbits are parallel to the median sagittal plane and the central axis of each orbit diverges 23° from it. The eyes themselves do not diverge but are situated facing straight ahead in the orbits. The vessels and nerves to the eyes thus enter the globes medial to their posterior poles.

The four walls of the orbits have important relations. The medial wall consists of four bones: maxillary, lacrimal, ethmoid and sphenoid. The anterior portion of the medial wall contains the lacrimal fossa, the lacrimal sac and the nasolacrimal duct. Posteriorly, the medial wall is very thin and related to the ethmoidal and sphenoidal sinuses and the nasal cavity. Severe sinusitis may result in an orbital cellulitis.

The roof is formed from the lesser wing of sphenoid and the frontal bone. Above the roof of the orbit is the anterior cranial fossa and the frontal lobe of the brain. Sharp instrument injuries to the orbit, e.g. from pencil or umbrella tip, can pass through the roof of the orbit into the frontal lobe resulting in meningitis or a brain abscess. Laterally the roof contains the fossa for the lacrimal gland.

The floor is formed from three bones: zygomatic, maxillary and palatine. The floor of the orbit is horizontal and covers the maxillary sinus. Blunt trauma to the eye may cause a 'blow-out' fracture of the floor with herniation of orbital contents into the maxillary sinus. Trapping and incarceration of the inferior rectus and inferior oblique muscles may occur with impairment of vertical eye movement. X-rays, particularly tomograms, demonstrate a floor fracture with soft tissue extension into the maxillary antrum. Repair of blow-out fractures is sometimes necessary to relieve the diplopia and enophthalmos.

The lateral wall consists of two bones: the greater wing of sphenoid and the zygomatic and slopes at 45° to the sagittal plane. The lateral wall of the orbit is the thickest and usually not of clinical importance except that it provides the most suitable and safest route for orbital exploration.

At the apex of the orbit are the superior and inferior orbital fissures and the optic foramen which transmit the

vessels and nerves to the eye. The optic foramen transmits the optic nerve and ophthalmic artery. Total uniocular loss of vision may be due to a blow on the brow which causes a shearing injury of the optic nerve within the optic canal or mechanical compression of the nerve by a fracture involving the canal.

B. THE ORBITAL CONTENTS

The eyeball takes up about twenty per cent of the volume of the orbit. The remainder is muscle, fascia, fat, vessels, nerve and the lacrimal gland.

There are six extraocular muscles: the superior, inferior, medial and lateral recti and superior and inferior oblique. Most are innervated by the IIIrd (oculomotor) cranial nerve. The exceptions are the lateral rectus (VIth - abducens) and superior oblique (IVth - trochlear).

All of the extraocular muscles except the inferior oblique originate from a fibrous ring around the optic nerve (annulus of Zinn). As the muscles fan out from their origin at the apex of the orbit toward the eye they form the 'muscle cone'. The optic nerve, ophthalmic artery and vein and the nerves to the extraocular muscles (with the exception of the IVth cranial nerve to the superior oblique) are contained within this cone. For this reason, the muscle cone is the ideal place to inject local anaesthetics for ophthalmic surgery. An injection here causes paralysis of all the extraocular muscles except the superior oblique. It also causes anaesthesia of the eye due to its effect on the fifth nerve.

The superior oblique passes from the annulus of Zinn to a pulley (the trochlea on the medial side of the roof of the orbit near the orbital rim). From here it passes laterally and posteriorly to insert into the sclera beneath the lateral border of the superior rectus. Contraction of the superior oblique causes depression of the eye with abduction and intorsion. The inferior oblique passes from its origin on the medical aspect of the inferior orbital rim underneath the eye and inserts into the sclera posterior to the lateral rectus insertion. It elevates the eye and also abducts and extorts it.

The unique functional abilities (constant activity, smooth, fine and rapid movements) of the extraocular muscles stem from several unusual structural characteristics. The striated muscle fibres have a high degree of differentiation and are smaller than usual for skeletal muscle. In addition, the degree of innervation is very high, approaching a 1:1 ratio of nerve fibres to muscle fibres. The elastic fibre content is also large, and ensures smooth contraction.

Closely associated with the superior tsrectus muscle is the levator muscle of the upper lid. It arises just above the annulus of Zinn, runs along the roof of the orbit overlying the superior rectus and inserts into the skin of the upper lid and the anterior surface of the tarsal plate (IIIrd nerve). A thin sheet of smooth muscle fibres arises from the under side of the levator and inserts into the upper edge of the tarsus (superior palpebral muscle of Muller - sympathetic innervation.

Continuous with the fascia of the muscles is a connective tissue covering which surrounds the eye called Tenon's capsule. It fuses with the conjunctiva and sclera at the limbus and with the optic nerve behind. Along with the fascial coverings of the inferior oblique and inferior rectus muscles it forms a suspensory ligament under the eye. The external fascial coverings of the muscles also extend outward at the muscle insertions to the orbital wall forming check ligaments which limit the action of the associated muscle.

The orbital fat fills the remaining space in the orbit and is quite loose within the muscle cone but considerably denser outside. Atrophy of the orbital fat causes the enophthalmos so often seen in the elderly.

The periosteum lining the orbit reflects inward at the orbital margin across the orbital opening to fuse with the tarsal plates as the orbital septum. With age it weakens allowing orbital fat to herniate through it. The nasal quarter of the upper lid and the lower lids are most commonly involved, the latter causing the 'bags' under the eyes of older persons.

The lacrimal gland, lacrimal sac and nasolacrimal duct are also contained within the orbit.

C. DISEASE INVOLVING THE ORBIT

Expanding lesions in the orbit characteristically displace the eye forward. This is called proptosis or exophthalmos. Depending upon the location of the lesion, the eye may be displaced up, down or to one side. Inflammatory, neoplastic and endocrine lesions can all cause proptosis. The Hertel exophthalmometer is used to measure the degree of proptosis and serial measurements are valuable. Investigation of proptosis may involve X-rays, CT scans, ultrasound scans, MRI scans and fine needle biopsy.

1. INFLAMMATION

Inflammatory causes of proptosis are usually unilateral and may be the result of:

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a) Orbital cellulitis from extension of an ethmoidal or maxillary sinusitis or development of a chronic mucocele of a sinus.

The condition usually occurs in a child or young adult and presents with relatively sudden onset of unilateral chemosis, lid oedema, pain and proptosis. There is reduction of external ocular movements and disc swelling may be present. Potentially lethal complications include meningitis, brain abscess and cavernous sinus thrombosis. Blindness may result from occlusion of the central retinal artery and inflammation of the optic nerve. Treatment of this serious condition involves hospital admission and the administration of intravenous antibiotics. Surgical drainage of the orbit and infected sinuses is sometimes necessary. This condition must be differentiated from preseptal cellulitis in which the infection does not extend behind the orbital septum. The patient presents with unilateral periorbital swelling and tenderness, but there is no proptosis and external ocular movements are normal. Treatment is with oral antibiotics as an out-patient.

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b) Inflammation of the lacrimal gland.

c) 'Pseudotumour', a granulomatous inflammatory reaction of unknown aetiology which resembles a neoplasm. (Epithelioid and giant cells are the typical histological findings).

d) Cavernous sinus thrombosis, a grave condition usually due to infection spreading along the emissary venous channels which drain the skin of the nose and central facial region. Blood from the orbit largely drains to the cavernous sinus via the ophthalmic venous plexuses.

2. NEOPLASTIC

Primary neoplasms of the orbit usually produce unilateral proptosis. The commonest cause if a benign haemangioma of the orbit usually occurring in children or young adults.

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Rhabdomyosarcoma, a highly malignant embryonal tumour arising from the extraocular muscles, occurs in children. Tumours of the optic nerve (glioma) and metastatic tumours also cause unilateral proptosis.

3. ENDOCRINE

Endocrine exophthalmos is usually bilateral but is also the most common cause of unilateral exophthalmos in adults. Thyrotoxicosis is frequently accompanied by a benign mild exophthalmos, usually more apparent than real, the illusion of proptosis being caused by a widening of the palpebral fissure secondary to increased sympathetic tone in Muller's muscle (lid retraction).

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A more severe form of endocrine exophthalmos designated malignant exophthalmos may also develop in euthyroid, hyperthyroid or hypothyroid patients. This condition seems to be associated with excessive secretion of thyroid stimulating hormone by the pituitary gland. The orbital tissues show increased amounts of mucopolysaccharides, oedema and infiltration by lymphocytes. The extraocular muscles are initially markedly swollen but later become fibrotic. Extraocular movements, especially elevation and convergence frequently become restricted with subsequent diplopia. Vision may be impaired by optic nerve compression. Large daily doses of systemic steroids is the treatment of choice although surgical decompression of the orbit may be required if steroids fail to resolve the optic nerve compression.