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# List of Abbreviations

**AION ... A**nterior ischemic optic neuropathy

**CBV ..... C**horiodal blood volume

**CHF..... C**ongestive heart failure

**CRAO... C**entral retinal artery occlusion,

**BRAO... B**ranch retinal artery occlusion

**CSF ..... C**erebro-spinal fluid

**CT ..... C**omputerized tomography

**ERG ..... E**lectroretinography

**ION..... I**schemic optic neuropathy

**IOP ..... I**ntraocular pressure

**LGN ..... L**ateral geneculate nucleus

**MAC .... M**inimum alveolar concentration

**MRI ..... M**agnetic resonance imaging

**ON..... O**ptic nerve

**ONH…..O**ptic nerve head

**PCA ..... P**osterior cerebral arteries

**PION.... P**osterior ischemic optic neuropathy

**RAO..... R**etinal artery occlusion

**CRA ..... C**entral retinal artery

**CRV ..... C**entral retinal vien

**TURP .. T**ransurethral resection of the prostate

**VEP..... V**isiual evoked potential

# Introduction

The eye is very different from other organs in its blood supply, nerve supply and other anatomical and physiological considerations. It is supplied by four out of ten cranial nerves and its representation and relation to many cerebral areas along with its delicate and unique structure makes us appreciate its importance in supplying one of the special senses.

Although in its creation it is well protected anatomically and physiologically, but this essay will try to shed more light on the hazards and risks the eye is subjected to under anesthesia and recommendations to prevent them through detailed information and recent studies. Hoping in this way to help prevent harm such an important organ during performance of any type of surgery.

# Chapter (1)

## ➢ Anatomical and Physiological Protection of the Eye:

**The cornea:**

As light enters the eye, it first passes through a lubricating tear film that coats the cornea. The clear cornea covers the front of the eye and helps to focus incoming light.

**The aqueous:**

After light passes through the cornea it travels through a clear, watery fluid called the aqueous humor. The aqueous humor circulates throughout the front part of the eye, maintaining a constant pressure inside the eye.

**The iris:**

The iris is the colored part of the eye. As light conditions change, the iris may dilate to make the pupil bigger or constrict to make the pupil smaller. This allows more or less light into the eye.

**The lens:**

After light travels through the pupil, it must pass through the lens. The human lens, much like the lens of a camera, is responsible for focusing light. The lens can change its shape to focus on nearby and distant objects.

**The vitreous:**

After being focused by the lens, light passes through the center of the eye on its way to the retina. The eye is filled with a clear, jelly-like substance called the vitreous.

**The retina:**

The retina is a thin, light-sensitive tissue lining the back of the eye that acts much like film in a camera. Light must be properly focused onto the retina, and the surface of the retina must be flat, smooth, and in good working order to produce a clear image.

**The retinal vessels:**

The retinal blood vessels nourish the inner layers of the retina.

**The macula:**

The center of the retina is called the macula. The macula contains a high concentration of photoreceptor cells which convert light into nerve signals. Because of the high concentration of photoreceptors, we are able to see fine details such as newsprint with the macula. At the very center of the macula is the fovea, the site of our sharpest vision.

**The choroid:**

Behind the retina, a layer of blood vessels called the choroid supplies oxygen and nutrients to the outer layers of the retina.

**The sclera:**

The white part of the eye is called the sclera. The sclera is composed of tough, fibrous tissue that protects the inner workings of the eye.

**The optic nerve:**

It is unique anatomically as it is the only tract in the CNS to leave the cranial cavity. Furthermore, it is subdivided into fascicles by connective tissue and glial septae and is surrounded by cerebrospinal fluid. Also it is the only tract to be visualized clinically.

***Anatomy for regional ophthalmic anaesthesia:***

Detailed study of the orbit, its contents and surrounding structures allows the anaesthetist to understand how to insert needles within the orbit.

Local anaesthetics may thereby deposited in site where they may spread to block sensory and motor nerves to provide anaesthesia and akinesia without damaging the globle, blood vessels, lacrimal apparatus,muscles or the optic nerve and its coverings.***(Johnson, 1995)***.

**The bony orbit:**

Direct observation of the human skull provides the most valiable information on the pathway that a straight needle must follow, and the depth to which it may be inserted, to achieve a desired result. Each subject differs and observation of

individual soft tissue and bony characteristics is essential. The diamensions of the globe also varies (e.g a large, shortsighted eye) and ultrasound biometry, performed routinely before cataract surgery, provides this dimension. The axial length (usually marked AL) is the dimention from the external corneal surface to the retina. Axial length of 26 mm or more denote a large eye, dictating that caution should be exercised to avoid globe puncture ***(Atkenhead et al., 2007)***.

Each orbit is an irregular pyramid in shape with its base forming the orbital opening. Its axis is directed posteriomedialy towards the apex. The triangular roof is composed of the orbital plate of the frontal bone with a small portion of the lesser wing the sphenoid bone posteriorly. At the posterior end is the optic foramen, which is the orbital opening of the optic canal.

The lateral wall is formed from the zygomatic bone and the greater wing of the sphenoid. The sphenoid portion of the lateral wall is separated from the roof by superior orbital fissure and from the floor by the inferior orbital fissure. The thin floor is composed mainly of the orbital plate of the maxilla, the zygomatic bone anteriorlly and the palatine bone posteriorly. The medial wall is quadrangular in shape and is compesed of the ethmoid centrally, surrounded by the frontal bone superiorly and anteriorly, the lacrimal bone inferiorly and anteriorly, and the sphenoind bone posteriorly. Of particular importance from the point of view of injection into the medial compartement are

the positions of the anterior and posterior lacrimal crests between which lies the fossa containing the lacrimal sac.

The average adult orbital height messured at the enterrance is 35 mm and the width 40 mm. the orbital depth messured from the hind surface of the eye ball to the apex is approximately 25 mm (range 12-35 mm). When considering the position of the needle point in relation to the apex, the relative angulations of the medial and lateral walls must be taken into account. If the length of the needle and axial length of the eye ball are known, and accepting that orbital wall angles are reasonably constant, accuracy of needle placement is achievable (fig.2).

The angle between the lateral wall of both orbits is approximately 90 degrees and the angle between the lateral and medial walls of one side is approximately 45 degrees. It follows that the medial walls of the orbit are nearly perpendicular to the frontal plane. The orbital axis and visual axis (the position of the eye when in straight or primary gaze) do not coincide and the anaesthetist must be quiet clear as to which one he or she referring to when describing angles for insertion of needles.

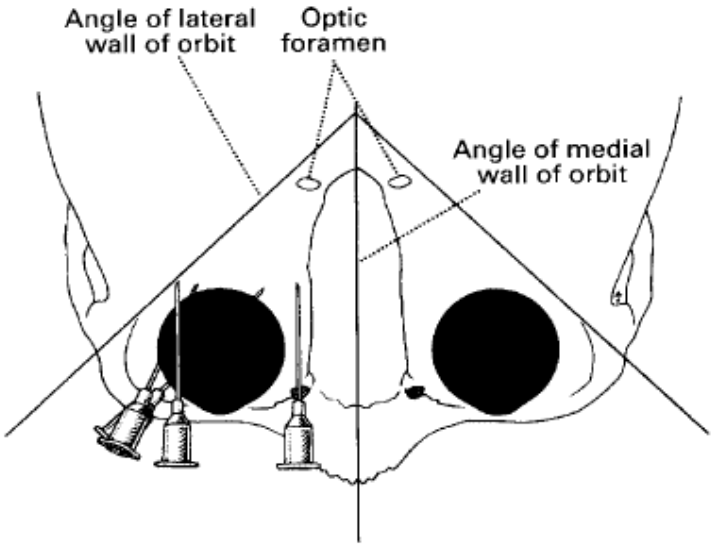



**Figure (2):** Diagrammatic representation of the angles of the lateral and medial walls of the orbits in transverse section. The needles are 2.5 cm from shoulder to point

Illustration drawn by Alexander James is from Johnson RW, Forest FC. Local and General Anaesthsia for Ophthalmic Surgery. Oxford: butterworth-Heinemann, 1994, with permission from the puplisher and authers.

## Orbital openings and there contents:

The optic canal transmits the optic nerve and the ophthalmic artery from the middle cranial fossa to the orbit. The superior orbital fissure carries the lacrimal, frontal, trochlear, occulomotor, nasociliary and abducent nerves, in addition to the superior ophthalmic vein. The annulus of Zinn divides the superior orbital fissure. The trochlear, frontal and lacrimal nerves enter the orbit above (outside) the muscle cone. The area within the annulus is termed the oculomotor foramen. The inferior orbital fissure contains the foramen rotundum

transmitting the maxillary branch of the trigeminal nerve from the middle cranial fossa to the pterygopalatine fossa ***(Snell R.S, Lemp MA Clinical Anatomy of the Eye. Boston: Blackwell, 1989)***.

**Relations:**

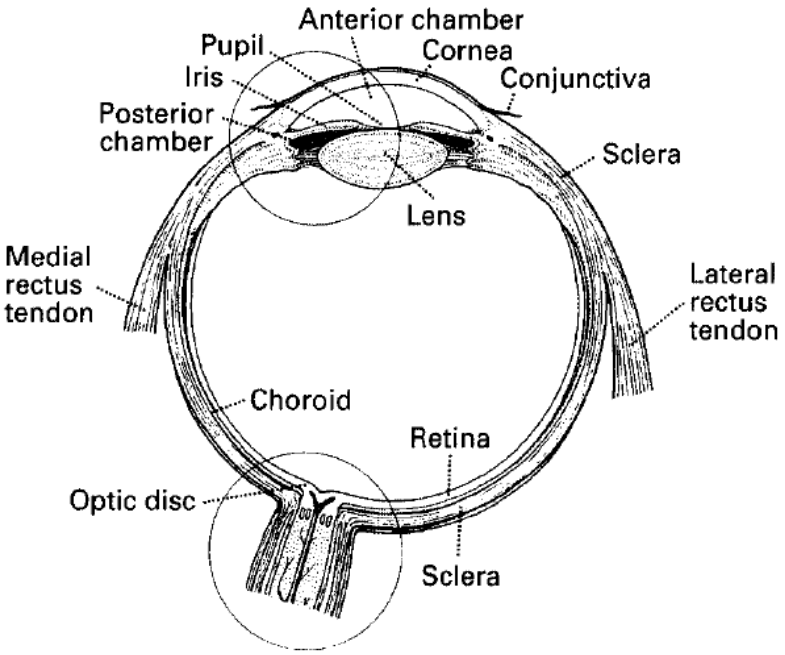
Above the roof are the frontal air sinuses anteriorly and the meninges and the frontal lobe of the cerebral hemisphere. Inferior to the floor is the maxillary air sinus. The infraorbital nerve and blood vessels lie within the infraorbital canal. Laterally the orbit is related to the temporal fossa in the anterior portion and the middle cranial fossa containing the temporal lobe of the cerebral hemisphere and its investing meninges posteriorly. Medially, the orbital wall is related to the nasal cavity anteriorly, the ethmoid sinuses in the middle part and the sphenoid sinus posteriorly. The bony walls may be very thin in some individuals and needle penetration is possible ***(Munich, 1987)***.

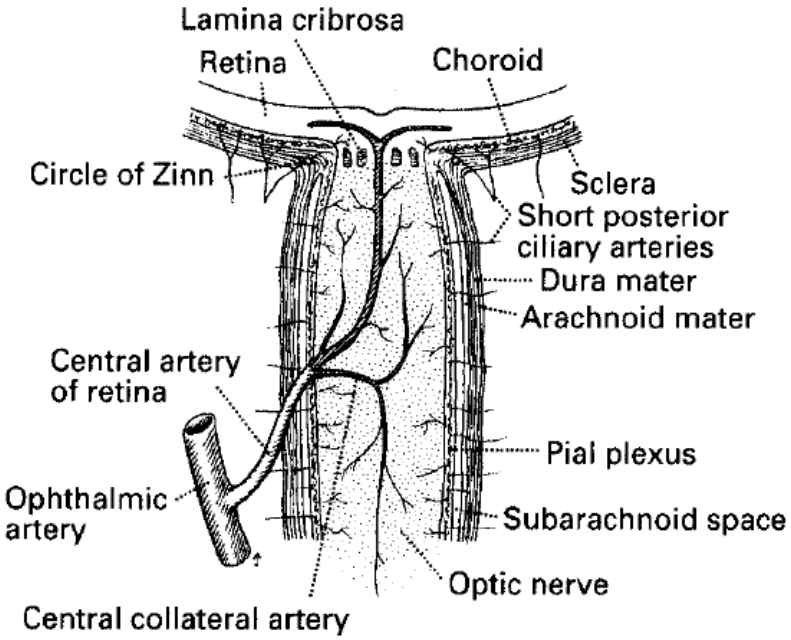
**The globe:**

The eyeball is situated in the anterior part of the orbital cavity closer to the roof than the floor and nearer the lateral than the medial wall. The position of the globe in relation to the orbital opening varies in normal individuals and with pathology (e.g tumours or thyroid disease). The cornea has a radius of curvature of approximatlly 8 mm. and the main portion of the globe has a radius of curvature of between 10 and 15 mm. the

myopic eye is longer. Highly myopic eyes may develop staphlomata when the posterior globe is enlarged with thinning of the sclera. Staphyloma is a bulge in the wall of the globe posteriorly which includes choroid tissue. Other types and positions of staphlomata may occur. Eyes with posterior staphylomata are more susceptible to needle trauma ***(Koornneef, 1982)***.

The sclera is the fibrous layer of the eyeball and is present everywhere except in the cornea. In the adult it's about 1 mm thick posteriorly and thins to 0.6 mm at the equator and 0.3 mm adjacent to the insertions of the rectii muscles. The optic nerve penetrates the sclera posteriorly 1 or 2 mm medial to and above the posterior pole. The centeral retinal artery and vein accompany the optic nerve. Anterior, middle and posterior apertures transmit the anterior ciliary arteries, the vortex veins and the long and short ciliary nerves and vesels respectively. The sclera is relatively tough but is pierced easily by sharp or blunt needles. The limbus forms the corneoscleral junction (fig. 4).


Anterior chamber
Pupil
Cornea
Iris
Conjunctiva
Posterior chamber
Sclera
Lens
Medial rectus tendon
Lateral rectus tendon
Choroid
Retina
Optic disc
Sclera


Lamina cribrosa
Retina
Choroid
Circle of Zinn
Sclera
Short posterior ciliary arteries
Dura mater
Arachnoid mater
Central artery of retina
Pial plexus
Ophthalmic artery
Subarachnoid space
Optic nerve
Central collateral artery