INTRODUCTION

The great variety of tumors and other mass lesions that occur behind the eye and cause proptosis are of interest to several surgical disciplines, and access to a multidisciplinary team can be valuable when contemplating surgical management. Ophthalmic surgeons can deal with many of these problems by one of a number of direct orbital approaches. The otolaryngologist can gain access to pathologic conditions arising within sinuses bordering the superior, medial, and inferior margins of the orbit. The neurologic surgeon has access to those tumors that involve both the intracranial and the intraorbital space **(Bruce et al., 2006).**

Orbital tumors comprise a wide variety of lesions that often share the same cardinal clinical finding, (exophthalmos) and clinical history. Age at presentation, associated ophthalmological findings, and radiological features however, provide invaluable information as to the possible histological type of tumor **(Darsaut et al., 2001).**

The difficulties of surgery in the region between the cranial and orbital cavities have been a matter of discussion for a long time. Cushing and Eisenhardt in their classic monograph "Meningioma" emphasized the importance of trespassing in the optic canal for the radical surgery of lesions of the anterior cranial base with intracanalicular and intraorbital extensions. Modern microsurgical techniques make it possible to remove cranial base lesions extending into the cavernous sinus and the optic canal after preparation of the petrous carotid artery and its branches by an extended frontotemporal approach. Access to the superior orbital fissure is possible through a pterional approach **(Morard et al., 1994).**

A clear understanding of orbital anatomy will assist the neurosurgeon in selecting those patients with unilateral exophthalmos who can be treated best by a transcranial approach, these who require the co-operation of more than one surgical discipline, and those who do not require operation at all **(Housepian et al., 1990)**.

Only a portion of lesions occurring in the orbit and responsible for the production of unilateral exophthalmos may be of interest to neurosurgeon. Preselection of cases will increase the incidence of optic nerve glioma, meningioma, neurofibroma and encephalocele seen in a neurosurgical practice. Currently available clinical studies, including computed tomography scanning and magnetic resonance imaging, pleuridirectional tomography and angiography, are important supplements to the clinical diagnosis of conditions producing proptosis.

With these improvements in methods for preoperative diagnosis of orbital lesions, transcranial procedures can be selected as primary treatment only when warranted **(Housepian et al., 1990).**

Orbital skeletal injuries are frequently associated with other significant injuries and require a substantial surgical effort to correct **(Manolidis et al., 2002).**

Orbital and ocular injuries are common in association with orbital roof fractures. A multidisciplinary approach to management is required because facial and cerebral injuries are also common. Most patients can be managed conservatively **(Fulcher et al., 2003).**

In most countries, traffic accidents are the leading cause of orbital fractures. CT scanning remains the gold standard for assessing orbital fractures, especially with the new technology (multislice CT), which has improved the acquisition of coronal images of the orbit without need for hyperextension of the neck. Orbital fractures are usually part of more complex midfacial trauma **(Cruz et al., 2004).**

The orbit is particularly susceptible to fractures because of its exposed position and thin bones. External impact to this area can cause a blowout fracture or non-blowout fracture, both of which could be accompanied by orbital floor defects. The main treatment of orbital defects is surgical orbital reconstruction **(Wang et al., 2008).**

Aim of the Work

The aim of this study is to evaluate the different methods of diagnosis and treatment of orbital tumors and fractures as well as to evaluate surgical approaches as regards indication and extent of view.

Chapter (1):

ANATOMY OF THE ORBIT

The orbit is a bony cavity shaped like a four-sided pyramid lying on its side, with the apex at the back and the base forming the orbital margin on the front of the facial skeleton. The roof of the orbit is the orbital part of the frontal bone, with the lesser wing of the sphenoid at the most posterior part. The frontal sinus frequently extends into its anteromedial part **(Last's, 2006).**

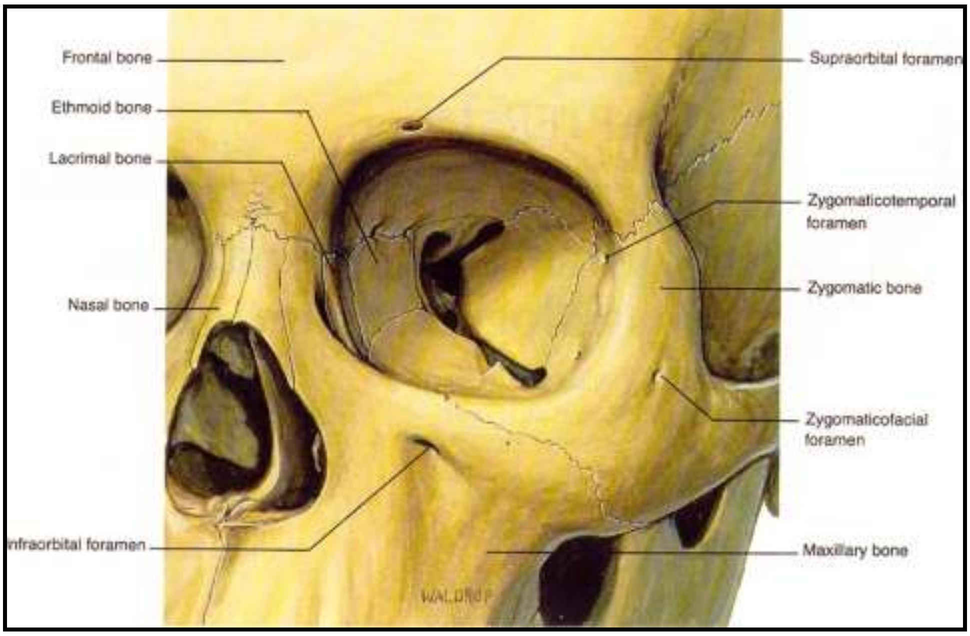

Fig. (1): Orbital bones, frontal view *(from Dutton JJ: Atlas of Clinical and Surgical Anatomy. Philadelphia: WB, Saunders, 1994, p8.).*

Bony orbit:

The orbit is formed of four bony walls having the shape of quadrilateral pyramid:

The apex is at the optic foramen and its base is directed forwards, outwards and slightly downwards.

The bones forming the walls of the orbit are:

The roof: The thin orbital plate of the frontal bone and the lesser wing of the sphenoid bone.

The lateral wall: The frontal process of the zygomatic bone anteriorly and the greater wing of the sphenoid posteriorly.

The floor: The orbital plate of the maxilla articulates with the zygomatic bone anteromedially and the small triangular orbital process of the palatine bone posteromedially.

The medial wall: The frontal process of the maxilla, the lacrimal bone, the orbital plate (lamina papyracea) of the ethmoid bone and a small part of the body of sphenoid bone **(Gray's, 2008).**

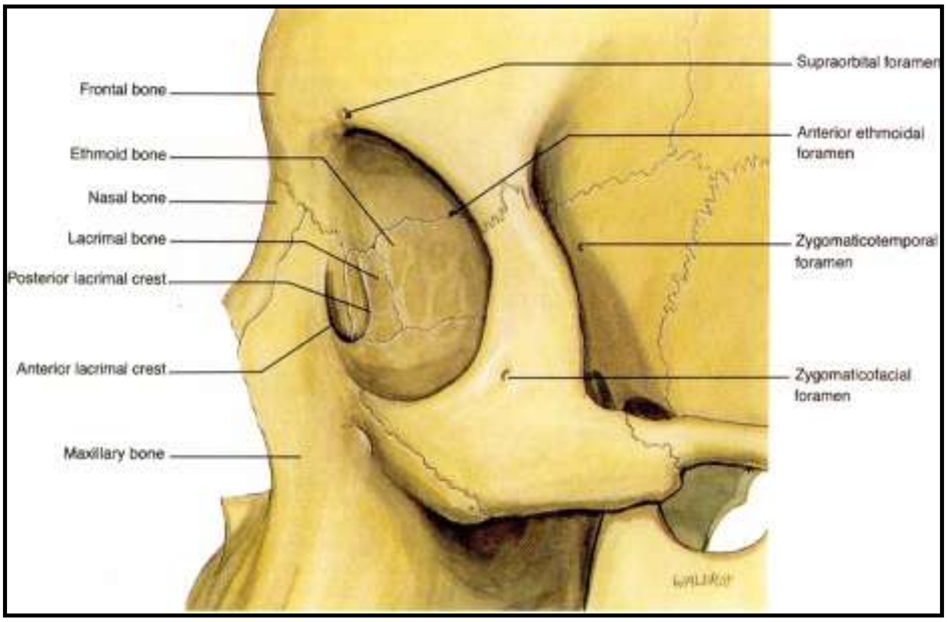

Fig. (2): Orbital bones, lateral view *(from Dutton JJ: Atlas of Clinical and Surgical Anatomy. Philadelphia: WB, Saunders, 1994,p9.).*

The orbital margin has four curved sides. The supraorbital margin (frontal bone) is notched or canalized a third of the way from its medial end for the passage of the supraorbital nerve and artery. The lateral margin is formed by corresponding processes of the frontal and zygomatic bones, which meet at a palpable suture line. The infraorbital margin is formed by the zygomatic bone and maxilla. The infraorbital foramen lies about 1 cm below the middle of this margin. The medial margin of the orbit is formed by the anterior lacrimal crest (maxilla) and the frontal bone **(Lasts's, 2006).**

The walls of the orbit are formed by seven bones: frontal, zygomatic, sphenoid, lacrimal, ethmoid, and palatine bones and the maxilla. The upper border of the orbital opening is formed by the frontal bone, which is notched or is the site of one or several small foramina that transmit the supraorbital and supratrochlear nerves and vessels. The lateral border of the orbital opening is formed by the frontal process of the zygomatic bone, except for the upper part, which is formed by the zygomatic process of the frontal bone. The lower margin of the orbital opening is formed laterally by the zygomatic bone and medially by the maxilla. The upper part of the medial border is formed by the frontal bone and the lower part is formed by the frontal process of the maxilla. The medial part of the upper border contains the frontal sinus **(Rhoton, 2003)**.

The orbital roof is triangular in shape and is formed by the frontal bone and lesser wing of the sphenoid bone. This orbital roof is thick posteriorly along the frontosphenoidal suture, but is frequently thin anteriorly. The thin region of the anterior orbital roof can be of assistance to the neurosurgeon in obtaining surgical access via the supraorbital craniotomy. On occasion, a portion of the anterior orbital roof may be absent in older individuals. The ridges and depressions along the cranial surface of the orbital roof, which conform to the frontal lobe gyri and sulci, are formed over time from cerebrospinal fluid pulsations. The supraorbital notch with the supraorbital nerve and artery is located along the nasal one-third of the superior orbital rim of the frontal bone. This notch is totally enclosed to create a foramen in 25% of adults. Medial to the supraorbital notch, a smaller groove is created by the supratrochlear nerve and artery. The roof of the orbit is joined to the medial wall by the frontoethmoid suture. Within this frontoethmoid suture are the anterior and posterior ethmoidal canals. The roof also is separated from the lateral orbital wall by the zygomaticofrontal suture anteriorly and the superior orbital fissure posteriorly **(Delashaw et al., 1995)**.

The floor of the orbit is formed by the orbital plate of the maxilla, the orbital surface of zygomatic bone, and the orbital process of the palatine bone. The orbital floor, which is very thin, forms the roof of the maxilla sinus. The floor is continuous with the medial wall, except in the most anterior part, where the floor is perforated by the nasolacrimal canal. The anterior part of the floor is continuous with the lateral wall, but posteriorly, the floor and lateral wall are separated by the inferior orbital fissure. The infraorbital groove, which transmits the infraorbital branch of the maxillary nerve, leads forward out of the inferior orbital fissure to cross the floor to reach the infraorbital canal, which ends below the lower orbital rim in the infraorbital foramen **(Rhoton, 2003)**.

The medial wall is formed, from anterior to posterior, by the frontal process of the maxilla, the lacrimal bone, the orbital plate of the ethmoid bone, and the body of the sphenoid bone. The medial wall is extremely thin, especially in the area of the orbital plate of the ethmoid bone, which separates the orbit and ethmoid air cells. The lacrimal sac, which sits in the lacrimal groove formed by the frontal process of the maxilla anteriorly and the lacrimal bone posteriorly, opens into the nasal cavity through the nasolacrimal canal. The anterior and posterior ethmoidal foramina, which transmit the anterior and posterior ethmoidal branches of the ophthalmic artery and the nasociliary nerve, are located at the junction of the roof and medial wall of the orbit and pass through the frontoethmoidal suture or the adjacent part of the frontal bone and open into the anterior cranial fossa along the lateral edge of the cribriform plate **(Rhoton, 2003).**

The lateral orbital wall is triangular in shape, and is composed of the zygoma and the greater wing of the sphenoid bone. The posterior margins of the lateral orbit are well-defined by the superior and inferior orbital fissures. The lateral orbital tubercle (Whitnall's tubercle) of the zygomatic bone is located anteriorly along the lateral orbital rim. This easily palpable tubercle marks the point of attachment of the lateral canthal tendon and is approximately 10 mm below the zygomaticofrontal suture **(Delashaw et al., 1995)**.

Orbital canals and fissures:

The orbit is transversed by a multitude of nerves, arteries, and veins extending to or from the middle cranial fossa, sinuses, and face. The structures enter the orbit via fissures or canals. The superior orbital fissure is located between the roof and lateral wall of the orbit. It is formed by the gap between the lesser and greater wings of the sphenoid bone. The apical portion of the superior orbital fissure is closed by the annulus of Zinn. This fibrous ring serves as the origin of the rectus muscles and levator palpebrae muscle. The opening created by the annulus of Zinn is called the oculomotor foramen. Nerves passing through the oculomotor foramen include the optic nerve, the superior and inferior divisions of the oculomotor nerve, the nasociliary nerve, and the abducens nerve. The frontal nerve, lacrimal nerve, and trochlear nerve enter the orbit through the superior orbital fissure above the annulus of Zinn and extraocular muscle cone **(Delashaw et al., 1995)**.

The optic canal lies between the two struts or roots of the lesser sphenoid wing. It is 5 to 10 mm long and 4.5 mm wide, and the average height is 5 mm. The roof of the canal is variably 1 to 3 mm thick. The proximal opening is formed dorsaly by the falciform process, a thin fold of dura which overlies the optic nerve, medially is the sphenoid sinus and laterally is the anterior clinoid process, which may be pneumatized and communicate with the sphenoid sinus. The optic canal is narrowed distally and the medial distal wall is quite dense relative to the more proximal segment **(Maroon and Kennerdell, 1984)**.

The superior and inferior orbital fissures bound the medial margin of the greater wing of the sphenoid. The superior orbital fissure, lying near the apex of the orbit, provides the passage for the oculomotor, trochlear and abducens nerves and the ophthalmic division of the trigeminal nerve from the cranial cavity to the orbit. Sympathetic branches from the cavernous plexus nerves also accompany the ophthalmic artery. Small orbital branches of the middle meningeal artery enter the orbit and recurrent branch of the lacrimal artery and the ophthalmic vein leave the orbit through this space. The recurrent meningeal arteries supply the dura covering the posterior aspect of the greater wing of the sphenoid. The inferior orbital fissure separates the floor and lateral wall of the orbit and transmits the maxillary nerve, the infraorbital vessels, and the ascending branches from the sphenopalatine ganglion, the medial wall of the orbit is formed by a number of fragile bones, including the lacrimal bone and the lamina papyracea of the ethmoid bone **(Almefty, 1989)**.

The superior orbital fissure provides a communication between the orbit and the middle cranial fossa. The cavernous sinus is situated behind and fills the posterior margin, and the contents of the orbital apex are located in front of and fill the anterior margin of the fissure. The superior orbital fissure is situated between the greater and lesser wings and body of the sphenoid bone. It has a somewhat triangular shape, having a wide base medially on the sphenoid body and a narrow apex situated laterally between the lesser and greater wings. The frontal bone forms a small portion of the lateral apical margin of the fissure, because the greater and lesser wings approach, but do not meet at the narrow lateral apex. The fissure slopes gently downward from its lateral to medial border. The fissure is not oriented in a strictly coronal plane, but is directed forward so that the lateral apex is slightly forward of the medial margin. The lateral edge of the superior orbital fissure, formed by the thin edge of the greater wing, is the sharpest and best-defined border. The lateral border slopes downward from its lateral to medial end. The upper half of this border is located in a more horizontal plane, and the lower half has a more vertical orientation. The junction of the upper and lower segments of the lateral edge is the site of a bony prominence that serves as the site of attachment of the lateral edge of the annular tendon, from which the four rectus muscles arise. This bony prominence can vary from narrow and pointed to broad and flat. The superior wall of the fissure is formed by the lower surfaces of the lesser wing, the anterior clinoid process, and the adjacent part of the optic strut. The upper edge of the fissure is situated below the medial half of the sphenoid ridge. The anterior clinoid process projects backward above the junction of the narrow lateral and broader medial part of the fissure. The optic strut forms the upper medial border of the fissure. The strut forms the lateral edge of the optic foramen and the junction of the upper and medial walls of the superior orbital fissure.

The medial margin of the fissure is less sharply defined than the lateral margin. The upper part of the medial edge is formed by the lateral surface of the optic strut, and the lower part is formed by the body of the sphenoid bone. The anterior part of the carotid sulcus, the shallow groove marking the course of the intracavernous segment of the carotid artery, is situated just inside and behind the medial edge of the fissure and continues upward along the posterior margin of the optic strut and the medial side of the anterior clinoid process. The lower margin of the fissure is formed by the junction of the greater wing with the sphenoid body and is located at the level of the lower edge of the cavernous sinus and the floor of the middle fossa. The lower edge of the fissure is separated from the foramen rotundum by a narrow bridge of bone, referred to as the maxillary strut. The lower end of the superior orbital fissure is located above and blends into the medial end of the inferior orbital fissure **(Rhoton, 2003)**.

The inferior orbital fissure originates at the orbital apex and is approximately 20 mm in length. The posterior portion of the fissure is contiguous with the foramen rotundum and contains the maxillary division of the trigeminal nerve. The infra-orbital nerve (a branch of the maxillary nerve) and artery transverse the inferior orbital fissure and exit the orbit via the infraorbital canal. The inferior ophthalmic vein communicates with the pterygoid venous plexus through the inferior orbital fissure **(Delashaw et al., 1995)**.

The pterygomaxillary fissure is the narrow cleft between the posterior surface of the maxilla and the anterior surface of the pterygoid process of the sphenoid bone. The pterygomaxillary fissure opens into the pterygopalatine fossa, which is located below and communicates through the medial part of the inferior orbital fissure with orbital apex. The upper part of the pterygoid process is penetrated by the foramen rotundum, through which the maxillary nerve passes to reach the pterygopalatine fossa, where it gives rise to the infraorbital and zygomatic nerves, which course in the floor and lateral orbital wall (**Rhoton, 2003**).

Neural relationships:

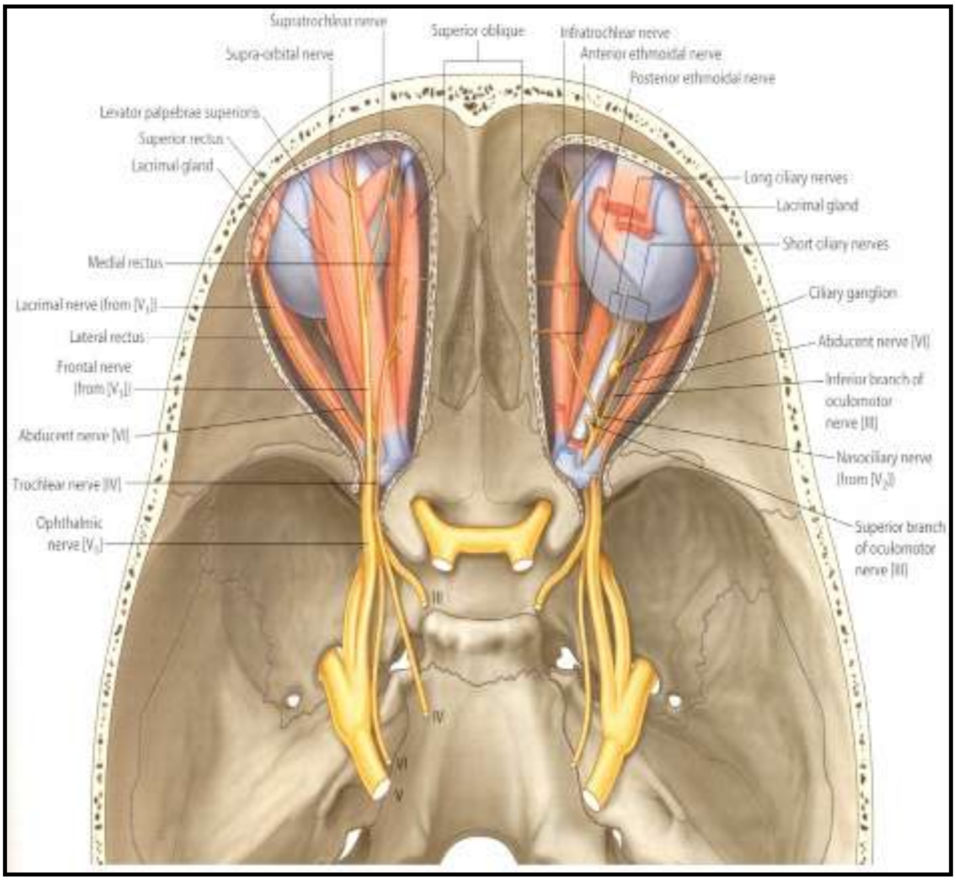

Fig. (3): Innervations of the orbit and eye ball, superior view
(From Gray's Atlas of Anatomy, 2008, p465.)

Optic nerve:

The optic nerve is divided into four parts: intraocular, intraorbital, intracanalicular, and intracranial. The intracanalicular part, located in the optic canal, and the intraorbital portions of the optic nerve are surrounded by dura and arachnoid. The subarachnoid space surrounding the intracranial part of the nerve extends forward from and communicates with the subarachnoid space around the intracanalicular and intraorbital portions of the nerve. The optic nerve passes through the medial part of the annular tendon and below the levator and superior rectus muscles. The dural sheath around the optic nerve blends smoothly into the periorbita at the anterior end of the optic canal. After passing through the optic canal, which forms a prominence in the upper part of the sphenoid sinus immediately in front of the sella turcica and along the medial aspect of the anterior clinoid process, the intracranial portion of the nerve is directed posterior, superiorly, and medially toward the optic chiasm.

The intraocular portion of the optic nerve, which includes the optic disc, lies within the sclera. The intraorbital portion of the optic nerve is surrounded by orbital fat and follows a slightly tortuous course. The ciliary nerves and arteries pierce the sclera in the area around the optic nerve. The ophthalmic artery enters the orbit on the lateral side of the nerve and passes above the nerve to reach the medial sides of the orbit. The superior ophthalmic vein arises in the anteromedial part of the orbit and crosses above the nerve to reach the orbital apex. Both the artery and vein course between the superior rectus muscle and the optic nerve. The branch of the inferior division of the oculomotor nerve to the medial rectus muscle passes below the optic nerve at about the same level that the ophthalmic artery