Assessment of orbital volume changes in different age groups using CT orbital volumetry

Thesis

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In Radiodiagnosis

By

Huda Yossry Abdelhamid Abdelmageed

Supervised by

Professor Dr/ Ayman Ismail kamel
Professor of Radiodiagnosis
Faculty of Medicine, Cairo University

Dr/ Nagy Nabil Youssif Khatar
Lecturer of Radiodiagnosis
Faculty of Medicine, Cairo University

Dr/ Mohamed Hazem Abd Elazim
Lecturer of Plastic Surgery
Faculty of Medicine, Cairo University

Faculty of Medicine

Cairo University

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بسم الله الرحمن الرحيم

﴿ رب اوزعنى ان اشكر نعمتك التى انعمت علي

و على والدى و أن أعمل صالحا ترضاه و ادخلنى برحمتك

فى عبادك الصالحين ﴾

صدق الله العظيم

الآية (١٩) سورة النمل

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HU	Hounsfield units.
OV	Orbital volume.
FV	Fat volume.
MV	Muscle volume.
SD	Standard deviation.
TOFE	Total orbital fat expansion.

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Aim of work

This study was conducted to assess orbital volume changes in different age groups using CT orbital volumetry and its role in assessment of orbital volume changes to morphological changes and way of correlation according to age.

Orbital Anatomy

Size, Shape, and Purpose

The orbits are conical structures dividing the upper facial skeleton from the middle face and surround the organs of vision. Although the orbit is commonly described as pyramidal in shape, it is not an angular structure, and the walls are not regular. Rather, its walls, apex, and base are curvilinear and are perforated by foramina and fissures, and they have several irregularities where ligaments, muscles, and capsules attach. The apex is located proximally, whereas the base opens onto the facial skeleton. The apex and base of the orbit are composed of thick bone, whereas the walls are thinner. The height of the orbit is usually 35 mm, whereas the width is approximately 40 mm as measured at the rims. The child's orbit is rounded, but with age the width increases. (***Hayreh SS et al 2006).***

The widest circumference of the orbit is inside the orbital rim at the lacrimal recess. From the medial orbital rim to apex, the orbit measures approximately 45 mm in length, whereas from the lateral orbital rim to the apex, the measurement is approximately 1 cm shorter. When considering the size and shape of the orbit, it is a well-designed and protective structure, which shields the ocular globes (extensions of the brain). The thickened rim is able to resist fracture forces more than the weaker walls, especially the medial wall and floor. Similarly, the thicker bone at the apex shields the brain and the optic nerve from direct force. Pressure to the eye is dispersed to the walls, which absorb the forces and fracture easily. This structural feature reduces the force dispersed to the deeper orbital contents***.(Ochs MW and Buckley 1993).***

The medial walls of the orbits are parallel to the sagittal plane and extend forward on the facial skeleton. The lateral walls are shorter, convergent, and more recessed, which facilitate peripheral vision (a greater projection of the orbit toward the midline of the face with gentle loss of projection laterally).The conical design of the orbit maintains the position of the globe with acceleration; however, this design is not protective of deceleration injuries. Although the widest diameter of the orbit is inside the rim, which helps maintain ocular position during deceleration, it isnot always preventative of injury, especially with high-speed injuries (Fig1.1).(***Takahashi Y et al 2014).***

OSTEOLOGY

The orbit is composed of 7 bones. The lateral wall is formed by the greater wing of the sphenoid apically and the frontal and zygomatic bones facially. The floor is formed from the sphenoid, the orbital process of the palatine bone, and the orbital process of the maxillary bone. The medial wall is formed from the lesser wing of the sphenoid, the ethmoid bone, the lacrimal bone, and the frontal process of the maxilla. The roof of the orbit is derived from the sphenoid and the frontal bones (Fig1. 2).

In general, the bone is thickest at the apex, thins as the walls diverge anteriorly, and then thickens again at the rims on the surface of the face. Although the bone of the medial orbital wall is thinnest, followed by the bone of the floor of the orbit, in actuality the medial wall is strengthened by the perpendicular septa of the ethmoid sinuses. The floor of the orbit is most vulnerable to fracture when there is direct force exerted on the ocular globe because it is thin and unsupported.(***Michalek P et al 2013***)

Fig1.1. Avulsion of the eye occurred as a result of a deceleration injury in which the patient also sustained severe mid-facial fractures. This is an example of deceleration forces exceeding the strength of the lid retractors, suspensory and check ligaments, and the natural shape of the orbit where the internal diameter exceeds the diameter of the orbital rims. (Patient treated at Parkland Memorial Hospital, Dallas, TX, under the direction of Dr R.V. Walker.) (**Timothy A. *et al.,* 2012**)

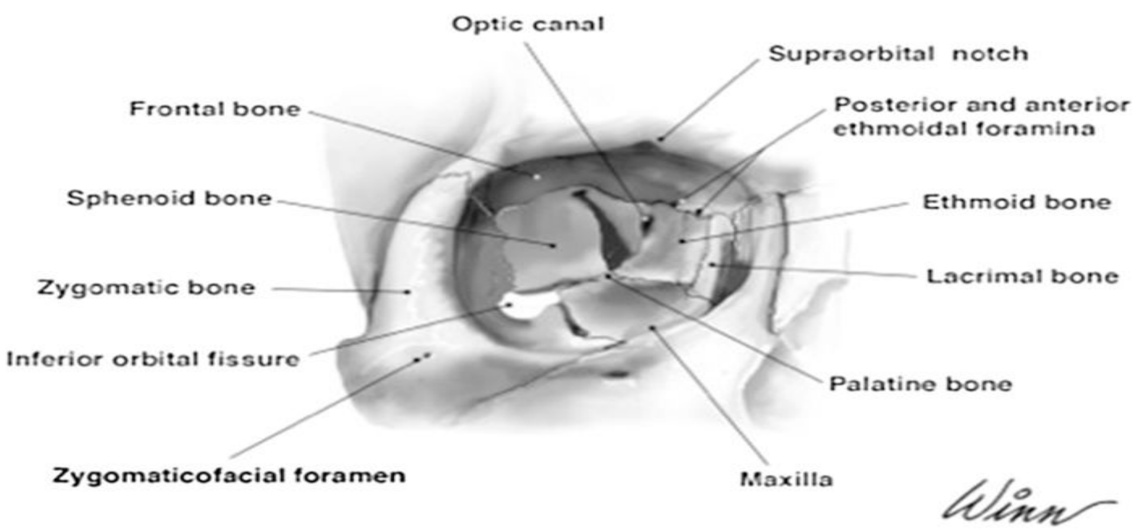

Fig1.2. The 7 bones of the orbit. (**Rougier J *et al.,* 1977**)

The floor of the orbit is thicker and offers more resistance to maxillary sinus abnormality. None of the walls of the orbit are flat; they are curvilinear in shape, and their purpose is to maintain the projection of the ocular globe and to cushion it when subjected to blunt force***.(Putterman, AM 1999)***

FLOOR OF THE ORBIT

From the inferior orbital rim, the floor dips inferiorly while maintaining the same cephalocaudal position for approximately 15 mm, past the inferior orbital fissure. It then gently curves cephalically to the superior orbital fissure. This anatomic subtlety is important when repairing orbital floor fractures because re-creating this gentle curvature will restore normal anatomy and will help prevent enophthalmos (***Heufelder AE et al 1999.)***

MEDIAL ORBITAL WALL

The medial orbital walls are parallel to the sagittal plane and have the greatest degree of superioinferior curvature. The medial orbital rim is less defined than the other rims. The entire wall is thin from the base to the apex, but it is strengthened by the perpendicular septa of the ethmoid sinus. The wall separates the ethmoid sinuses and nose from the orbit. The superior aspect of the medial rim is the most prominent and blends into the forehead, curving anteriorly toward the midline (***Fattahi T , Dipasquale 2009.)***

ROOF AND LATERAL ORBITAL WALL

The roof of the orbit curves cephalically in the lateral aspect to accommodate the lacrimal gland. The bone of this wall separates the anterior cranial fossa from the orbit. It is generally thin and becomes thinner with age. The superior orbital rim has a notch on the medial third through which the supraorbital nerve runs and supplies sensation to the forehead. Sometimes this notch is calcified and forms a distinct foramen.