Diplopia

Essay
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By

Ahmad Salah Dewedar

M.B., B.Ch., Faculty of Medicine, Ain Shams University

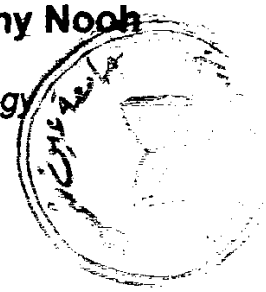
Supervised By

Prof. Dr. Golzamin Ragheb Elhawary

Prof. Of ophthalmology
Faculty of Medicine Ain Shams University

Assistant Prof. Dr. Hazem Hosny Nooh

Assistant Prof. of Ophthalmology
Faculty of Medicine
Ain Shams University



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Ain Shams University
Department Of Ophthalmology
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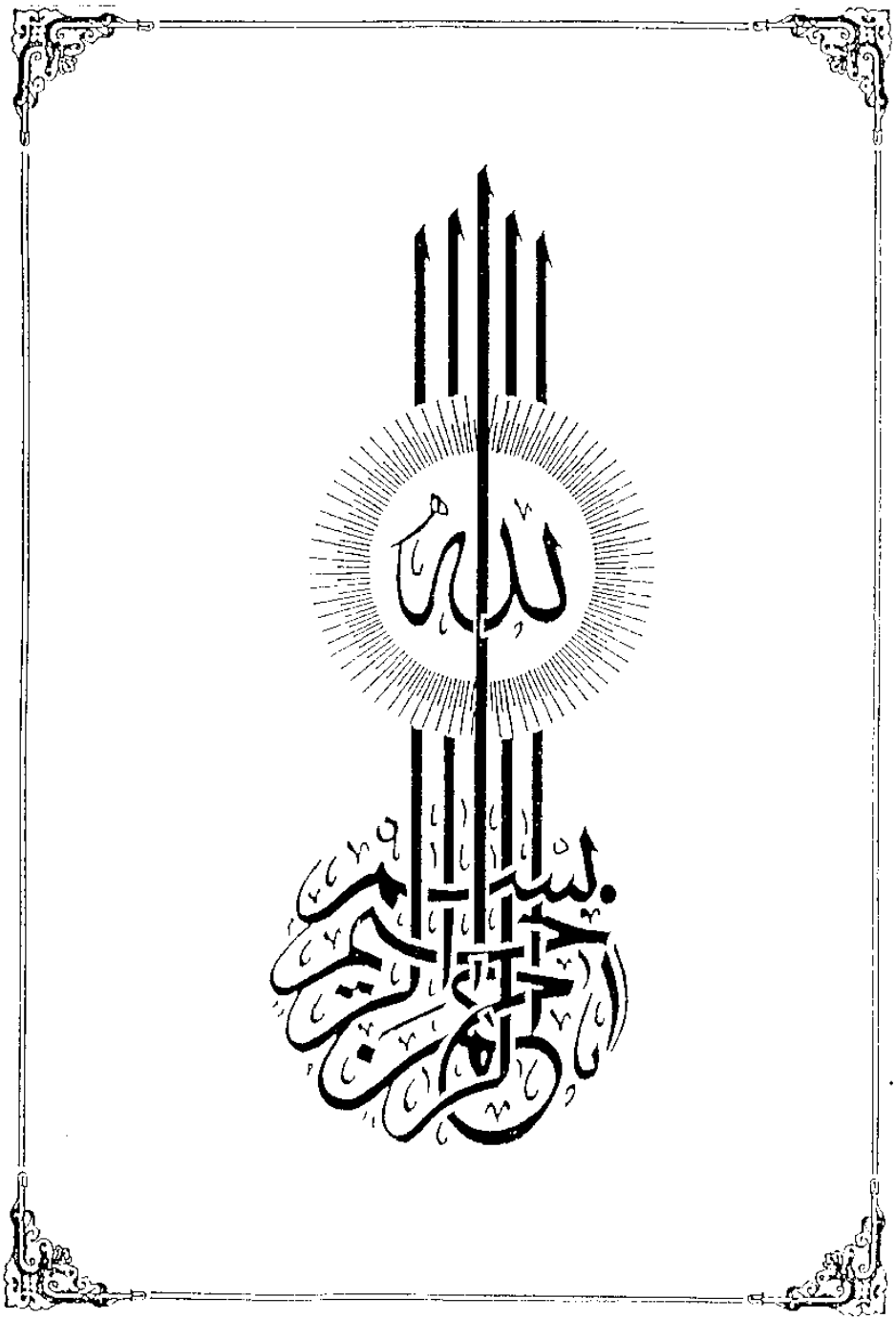

بسم الله الرحمن الرحيم

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سورة البقرة ـ الآية ٣٢

List of Contents

Introduction

Single binocular vision is a unique function of the eyes that is achieved by using both eyes together so that separate and slightly dissimilar images arising in each eye are appreciated as single image by process of fusion. When this system breaks down and the two images that are different for the brain to fuse, double vision or diplopia occurs ***(Kanski, 1999).***

Diplopia can be classified into physiological or pathological diplopia. Physiological diplopia is a normal phenomenon occurring with objects lying outside of the Panum's area and the horopter due to falling of light rays emerging from an object on non corresponding points on the retinas of both eyes ***(Hart, 1992).***

Pathological diplopia can be also classified into monocular and binocular. Monocular diplopia is mostly optic in nature (e.g. cataract, irregular cornea or another opening in the iris rather than the pupil as iridectomy), while binocular diplopia is either caused by anisokonia or more commonly by misalignment of the visual axes ***(Larson, 1992).***

The common types of binocular diplopia are horizontal, vertical and torsional, and the common causes are traumatic, neoplastic as brain tumors, systemic diseases as diabetes and hypertension, inflammatory as seen with infections in the eye socket, intoxication with alcohol or botulism toxin, or progressive disorders such as myasthenia gravis and ocular myopathies. Cranial nerve paralysis is one of the common causes affecting third, fourth and sixth nerve ***(Dulayajinda et al., 1991).***

Double vision (diplopia) is a distressing condition that occurs due to pathology affecting the complex system of all

An Overview on the anatomy of Extraocular Muscles and Cranial Nerves III, IV, and VI.

I-Extraocular Muscles

The eye is a specialized sensory organ housing an outpouching of the forebrain and endowed with an active motility system that provides precise guidance around a center of rotation. Of the body's sense organs, the eye is unique in its capability for independent movement. These features afford three obvious advantages:

1) Greater field of vision. 2) Foveal vision for larger portion of the visual field. 3) Binocular vision for both near and far.

In a manner benefiting a jewel, the eye is encased within the orbital bones, cushioned with a layer of fat and covered with two vertically sliding lids ***(Apt, 1980)***.

The extraocular muscles are six in number, four recti (superior, inferior, medial and lateral) and two obliques (superior and inferior).

1] The four recti muscles.

Recti muscles all originate in the orbital apex from annulus of Zinn and course forwards around the surface of the globe to insert in the sclera anterior to rotation center of the globe. The motor nerve to each muscle enters the internal surface of the muscle at the junction of its posterior one third and anterior two thirds.

The average length of the recti muscles is 40mm the superior being the longest followed by medial, lateral and inferior

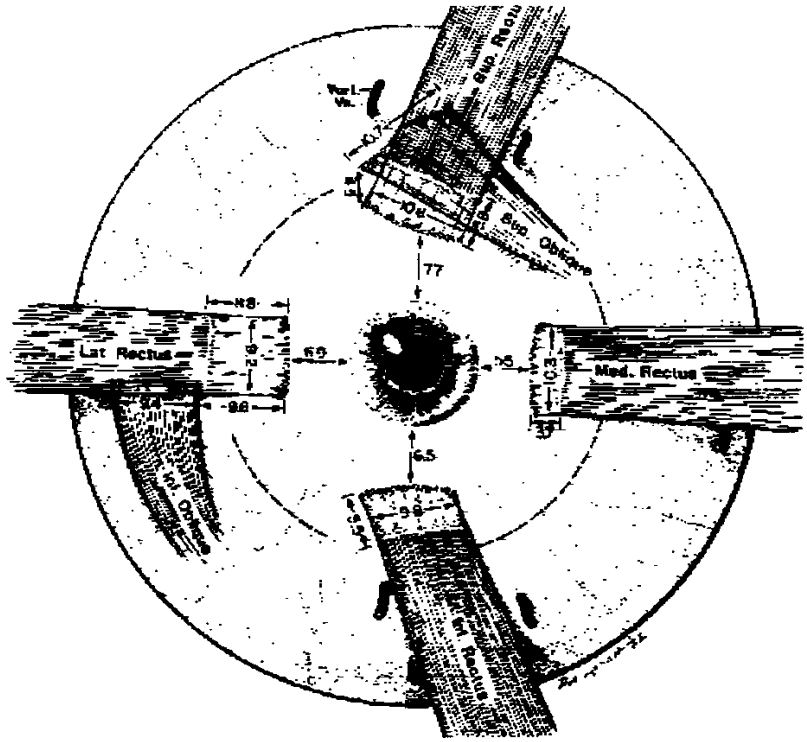

Fig 1: Anatomy of extraocular muscles

The superior and lateral recti have posterior ends that are U shaped, the inferior and medial have linear and dentate osseous attachments ***(Snell and Lemp, 1989)***.

Scleral insertions are by tendons which fibers are almost parallel to longitudinal axis of the muscle. These fibers consist of collagen supported by thick elastic fibers.

These fibers resemble scleral fibers being of the same tissue yet differ in size and direction.

The tendon fibers enter superficial sclera and quickly merges into it. Only cessation of elastic fibers marks the junction of the tendons with sclera. Occasionally, slips leave the main tendon near scleral attachments to be attached further back. These recurrent slips may be missed during squint surgery ***(Bron et al., 1997)***

a) Superior rectus.

The superior rectus muscle arises from the fibrous ring above the optic foramen and its origin is attached to the dural sheath of the optic nerve. The muscle passes forward and somewhat laterally and pierces the fascial sheath of the eyeball. It is inserted into the sclera about 7.7mm posterior to the limbus by means of tendon 5.8mm long along an oblique line that is slightly curved and oblique and 10.8mm long, the muscle is about 42mm long and 9mm in width ***(Bron et al., 1997)***. Innervation is by the superior division of third cranial nerve.

It is related superiorly to the levator palpebrae superioris muscle, the frontal nerve and the roof of the orbit. Inferiorly are, the optic nerve, the ophthalmic artery, and nasocilliary nerve embedded in orbital fat ***(Snell and Lemp, 1989)***.

Action of the muscle:

Primary action: is elevation that increases with abduction and becomes nil with adduction. It is the only elevator in full abduction.

Therefore when the superior rectus is paralyzed, the abducted eye cannot be elevated.

Subsidiary action: is adduction and intorsion ***(Bron et al., 1997)***.

b) Inferior rectus.

Inferior rectus is the shortest of the recti, it is attached below the optic foramen by the middle part of the lower common tendon.

Passing anterolaterally along the floor of the orbit at an angle of 23-25 degrees, it is attached to the sclera 6.5mm from the

cornea by a tendon 5.5mm long. The muscle is about 40mm long and 9mm wide. Its line of attachment, 9.8mm long and is oblique and markedly convex forwards. It is also attached to lower lid by its fascial sheath. Innervation is by inferior division of oculomotor nerve ***(Bron et al., 1997)***.

It is related superiorly to the oculomotor nerve, optic nerve, and the eyeball. Inferiorly there is the floor of the orbit, the infraorbital vessels and nerves in their canal, and the underlying maxillary sinus ***(Snell and Lemp, 1989)***.

Actions:

Primary action: is depression, which increases in abduction and becomes nil in full adduction.

Subsidiary actions: are adduction and extorsion, which increases in adduction.

c) Medial rectus

Medial rectus is the largest ocular muscle. It is attached medial and inferior to the optic foramen by both parts of the common tendon and the sheath of the optic nerve. It is 40mm long and thicker than the other extraocular muscles, although similar in width and length.

Passing along the medial wall of the orbit, medial rectus inserts into the sclera 5.5mm from the cornea by a tendon 3.7mm in length. The line of insertion is 10.3mm, straight and symmetrical across the horizontal meridian. Innervation is by the inferior division of oculomotor nerve.

It is related superiorly to the superior oblique muscle, the ophthalmic artery and its branches, and nasociliary nerve. Inferiorly lies the floor of the orbit ***(Snell and Lemp, 1989)***,

Action:

Primary action: it is a pure adductor.

Subsidiary action: exerts slight elevator or depressor movement if the axis is elevated or depressed.

d) Lateral rectus

Lateral rectus is attached to both parts of the annular tendon where they cross the superior orbital fissure. It is about 48mm in length, which is longer than the medial rectus, but only two third of its cross sectional area. The attachment is continuos including the spina recti lateralis on the greater wing of sphenoid, and is U shaped and concave towards the optic foramen, the limbs of the U forming the outer and lower heads of the muscle.

The muscle at first adjoins the lateral orbital wall separated by a small amount of fat. More anteriorly it passes medially, pierces tenons capsule and reaches the sclera 6.9mm from the cornea by a tendon 8.8mm long, at a line of attachment 9.2mm in length, vertical or slightly convex forwards, and usually symmetrical. Innervation is by the abducent nerve ***(Bron et al., 1997)***.

It is related superiorly to the lacrimal nerve and artery. Inferiorly lies the floor of the orbit. Medially lies the abducent nerve.

Action:

It abducts the eye in the horizontal plane.

2] Two oblique muscles

a) Superior oblique

Superior oblique is the longest and thinnest extraocular muscle. It is attached superomedially to the optic foramen by a narrow tendon partially overlapping the levator muscle. Its length is due to that of its deflected tendon as much to its belly.

The muscle is fusiform in shape and becomes a rounded tendon 1cm posterior to the trochlea, beyond which it turns posterolateraly at an angle of about 55 degrees, pierces Tenon's capsule, descends slightly inferior to superior rectus, and spreads out into a fan shaped attachment in the posterosuperior quadrant along a line of insertion about 10.7mm long and convex posteriorly. Innervation is by the trochlear nerve ***(Parks, 1985)***.

It is related to the roof of the orbit superiorly. Inferiorly lie the ophthalmic artery and its branches and the nasocilliary nerve. The supratrochlear nerve lies above and lateral to the muscle and lateral to the trochlea.

Actions:

Primary action: is depression, which increases with adduction, it is the only depressor in adduction.

Subsidiary action: Are abduction and intorsion ***(Burde and Feldon, 1992)***

b) Inferior oblique

It is the only extraocular muscle attached near the front of the orbit and also has the shortest tendon of insertion. Its