DETALIED ANATOMY OF THE SUPERIOR ORBITAL FISSURE

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DETALIED ANATOMY OF THE SUPERIOR ORBITAL FISSURE (Abstract): The superior orbital fissure is a foramen https://en.wikipedia.org/wiki/Foramina_of_the_skull in the skull, lying between the lesser and greater wings of the sphenoidal bone, conecting the middle cranial fossa with the orbit. At the level of the superior orbital fissure pass abducens nerv, trohlear nerve, superior and inferior branches of the oculomotor, ophtalmic nerve with its branches (lacrimal, frontal, nasociliary), superior and inferior divisions of ophtalmic vein (1). Inferior division also passes through the inferior orbital fissure, sympatetic fibers from cavernous plexus. We removed the dura mater so we could identify the trigeminal ganglion with its 3 branches (ophtalmic, maxilar and mandibular nerve) on the anterior part of the petrous part of the temporal bone. Medial to this ganglion is located the cavernous sinus. In the nearby of the superior orbital fissure we disected the internal carotid artery in its pathway through the cavernous sinus and we highlighted its relations with the oculomotor nerves at the level of the sinus. Just after the exit from the wall of the cavernous sinus the oculomotor nerves go through the superior orbital fissure. This fissure appears like a free space between lesser and greater wings of the sphenoid and it's located inferior and lateral to the optic foramen. At the level of the superior orbital fissure we have the next closest relations: the most superior and central, in the long axis of the orbit is situated the oculomotor nerve; ophtalmic nerve enters the orbit inferior to the oculomotor nerve (at the origin is between the oculomotor and maxillar nerves); abducens nerve is practicaly the most lateral element which goes through the superior orbital fissure; the trochlear nerve enters the orbit across superior orbital fissure where its tapered and bulging portions come together. The relation between the vasculonervous elements and the bones are very closed inside of the superior orbitar fissure, so the content acts like a single bundle, also these close relations explain a several pathologies.
Key words: SUPERIOR ORBITAL FISSURE, OCULOMOTOR NERVES, INTERNAL CAROTID ARTERY, CAVERNOUS SINUS

INTRODUCTION

The superior orbital fissure is a foramen https://en.wikipedia.org/wiki/Foramina_of_the_skull in the skull, lying between the lesser and greater wings of the sphenoidal bone, conecting the middle cranial fossa with the orbit. The fissure can be divided into three anatomical regions by the ring of Zinn (common annular tendon): the lateral, central, and inferior regions. Defining these regions is useful in describing the course and placement of the nerves and vasculature in the superior orbital fissure.

At the level of the superior orbital fissure pass abducens nerv, trohlear nerve, superior and inferior branches of the oculomotor, ophtalmic nerve with its branches (lacrimal, frontal, nasociliary), superior and inferior divisions of ophtalmic vein. Inferior division also passes through the inferior orbital fissure, sympatetic fibers from cavernous plexus.

A very detalied knowledge of this important anatomical region with its relations is extremly important for a good understanding, diagnoses and treatment of posible local pathologies.

MATERIALS AND METHODS

Our study was performed with dedicated disection instruments on human formalinized cadavers in the Anatomy Hall of the Medicine Faculty of UMF Carol Davila University.

Fig. 1. 1-Lesser wing of the sphenoid ; 2-Nerve III ; 3-Ophtalmic nerve ; 4-Greater wing of the sphenoid ; 5-Maxillar nerve ; 6-Trigeminal ganglion ; 7-Nerve VI

Fig. 3. 1-Lesser wing of the sphenoid ; 2-Nerve VI ; 3-Frontal nerve ; 4-Lacrimal nerve ; 5-Maxillar nerve ; 6-Greater wing of the sphenoid ; 7-Nerve III

We realized disections on two cadavers. After the transversal opening of the skull, we carefully removed the brain and dura mater. The superior orbital fissure was identified and we started the disections of the content.

RESULTS AND DISCUSSIONS

After the removal of the dura mater, we identify the trigeminal ganglion with its 3 branches (ophtalmic, maxilar and mandibular nerve) on the anterior part of the petrous part of the temporal bone (fig. 1). Medial to this ganglion is located the cavernous sinus. Between dura mater and the bone, in the epidural space are located the oculomotor nerves in an adipos tissue atmosphere.

In the nearby of the superior orbital fissure we disected the internal carotid artery in its pathway through the cavernous sinus and we highlighted its relations with the oculomotor nerves at the level of the sinus. The artery exits the sinus between the anterior and the

Fig. 2. 1-Ophtalmic artery ; 2-Optic nerve ; 3-Internal carotid artery ; 4-Lesser wing of the sphenoid ; 5-Nerve VI ; 6-Nerve III ; 7-Ophtalmic nerve ; 8-Maxillar nerve ; 9-Mandibular nerve ; 10-Trigeminal nerve ; 11-Nerve IV ; 12-Internal carotid artery

midle clinoid processes. After the removal of the dura mater and the cut of the internal carotid artery we can see the elements situated in the apex of the orbit at the level of the orbit forasem and there is notable how closer are located on the each other. The optic nerve passes the most superior in the optic forasem in relation with the orbital floor (1). Inferior to the nerve enters the ophtalmic artery (2) whose origin is disected and can be seen in our image. (fig. 2). We can observe that the whole content of the formen is occupied by those two structures without excess space able to facilitate the comunications between the orbit and the middle fosa of the endobase. Here can be highlighted the closed relation of the optic pathway and the internal carotid artery which is located posterior and lateral.

Just after the exit from the wall of the cavernous sinus the oculomotor nerves go through the superior orbital fissure. This fissure appears like a free space between lesser and greater wings of the sphenoid and it's located inferior and lateral to the optic foramen.

At the level of the superior orbital fissure we have the next closest relations :

- The most superior and central, in the long axis of the orbit is situated the oculomotor nerve. The oculomotor nerve has relation

with the superior border of the fissure, represented by the lesser wing of the sphenoid. He enters in close relation with the superior wall of the orbit, the orbital roof. The oculomotor nerve supplies all the extraocular muscles apart from the superior oblique muscle and the lateral rectus muscle. Before entering the orbit, this nerve splits to form two terminal rami (superior and inferior) which penetrate the orbit across the bulging medial part of the superior orbital fissure inside the common tendinous ring. At this point, the nasociliary nerve is located between them on the inside with the abductor nerve on the outside. The two branches then enter the muscular cone and diverge away from one another. The superior, smaller-caliber branch climbs up the lateral side of the optic nerve and splits to form four or five rami that innervate the superior rectus muscle and, via a perforating ramus, the levator palpebrae superior.

- Ophtalmic nerve enters the orbit inferior to the oculomotor nerve. At the origin is between the oculomotor and maxillar nerves. We can clearly observe how the ophtalmic nerve splits into lacrimal nerve (lateral) and frontal nerve (medial) actually before entering the superior orbital fissure (3) (fig. 3). The ophthalmic nerve, a superior branch of the trigeminal nerve, is exclusively sensitive. It innervates the eyeball, the lacrimal gland, the conjunctiva, part of the mucosa of the nasal cavity, and the skin of the nose, forehead and scalp. This nerve is the smallest of the three branches of the trigeminal nerve. After its passage into the lateral wall of the cavernous sinus but before it enters the orbit, it splits to form three branches, namely (going from the outside to the inside) the lacrimal nerve, the frontal nerve and the nasociliary nerve. – The lacrimal nerve, the branch with the smallest caliber, enters the orbit via the lateral part of the superior orbital fissure and remains outside the cone (4).
- Abducens nerve is practicaly the most lateral element which goes through the superior orbital fissure. It comes from the cavenous sinus wall after passing between the maxillar and ophtalmic nerves. It will inervate the rectus medialis muscle (5).
- When the trohlear nerve exits the cavernous sinus is located between ophtalmic and maxillar nerves to lateral and the terminal part of the internal carotid artery to medial. The trochlear nerve enters the orbit across superior orbital fissure where its tapered and bulging portions come together. It passes outside the common tendinous ring above the orbital muscles and inside the frontal nerve. Inside the orbit, it carries on medially above the origin of the levator palpebrae superior, to reach the superior oblique muscle on its orbital side (6).

Even if we have described in detail the relations of this area we have to say that the surface of the superior orbital fissure is extended more than the space needed for the nerves to enter the orbit and the nerves form like a bundle, entering the orbit in very close contact one with each other. Also here at the level of superior orbital fissure enters the ophtalmic vein, but this is not seen in our pictures because it is located inferior, under the nerves.

Dura mater joins the edge of the fissure and is continued inside of the orbit with the orbital periostum.

Like in the optic foramen, here is no free space between the orbit and the endobase, so dura mater and the vascular and nervous elements close perfectly this comunication. This close relations between the nerves and vessels explain the nerve associated pathologies in vascular diseases like trombosis and aneurysms. Superior orbital fissure practicaly makes an inextendeble compartment where the vascular and nervous element are captive. A meningioma in the fissure or at the level of optic foramen will compress quickly and easily the vasculonervous structures. The associated inflamations of the trombosys or aneurysms will also affect the nerves. Another situation when the nerves can be affected very quickly are the bone tumors. The intraorbital pathological processes will have the same effects over the vasculonervous bundle which passes through the superior orbital fissure, due to the edema or the compression.

CONCLUSIONS

The relation between the vasculonervous elements and the bones are very closed inside of the superior orbitar fissure, so the content acts like a single bundle.

The inextendeble edges of the superior or-

bitar fissure offers the risk of developing a compartment syndrom in case of an extrinsec compresion.

The relation between internal carotid artery, ophtalmic vein and the nerves explains the clinical aspect with nerve damage in aneurysms and trombosys.

The pathway through the cavernous sinus explains the asociated nerves pathology in cavernous sinusal trombosys.

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