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Abnormality in the Growth of the Extraocular Muscles of the Zygomatic-Orbital Complex 3D Models

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Abstract: Nowadays, according to the world statistics on trauma of the facial area, particularly skull fracture injuries are becoming increasingly common. Especially, injuries of the zygomatic-orbital complex have their place to be, since the zygomatic-orbital complex has a complex structure, and is closely interconnected with the nervous system, namely with the human visual organ.

In this study, our goal is to determine the feature of zygomatic-orbital complex, since during the operation on this area of face, there is a huge demand for more detailed anatomical knowledge regarding anomalies of muscles, vessels and nerves. In this case, successful ending of the operation for the surgeon becomes a difficult task. For revealing the anatomical features of the zygomatic-orbital complex, we will conduct a literary review of online medical sources [1]

Purpose of the study: Based on numerous reviews that we have conducted through Internet resources, it can be said that our goals are :

- Clearly define and describe the disorder syndromes with abnormalities extraocular muscles;
- Based on the given data in the sources to create 3D models as close as possible to the anatomical structures of zygomatic-orbital complex, where the nature and type of anomaly of oculomotor muscles and their innervations will be described.

Materials and methods: Extraocular muscle anomalies are not as common as others anomalies of the bone structures of the facial area, but for the surgeon during operations in the area of the zygomatic-orbital complex knowledge of anomalies of extraocular muscles can become invaluable information for successful outcome of surgical intervention.

We believe that abnormalities of the extraocular muscles are not well studied, since there is an insufficient information on this topic [17,20]. For achievement of the set goal, we have conducted a retrospective analysis of medical articles from various sources, starting from ophthalmology ending with facial surgery.

And also, a range including 15 materials related to the pathological anatomy of anomalies of the oculomotor human muscles, was studied. In a number of Western medical articles, there is the data on syndromes which limit the functions of the extraocular muscles.

By studying various literature, we have created a 3D model of normal and abnormal anatomy of extraocular muscles. We describe each syndrome of limitations in the function of extraocular muscles:

Apert's syndrome is characterized by underdevelopment of the superior rectus and superior oblique muscle on both sides as well as hypotropia and esotropia of given muscles.

Brown's syndrome[8, 12] consists of symptoms such as limited lifting during adduction, sliding down the eyeball during adduction, [16] hyperactivity of the contralateral superior rectus muscle, abnormal head position when looking straight, proving that abnormal fibrosis of the orbital fascia.[4, 19]

Duane's syndrome - restrictive strabismus caused by innervation of lateral rectus muscle that pulls the eye in a certain direction and interferes with the normal movement of the eyeball. Different types of Duane's syndrome exist, which are classified depending on the direction of eye movement change: Altered eye movement outward. Inward eye movement is impaired. Eye movement is impaired both in outward and Inward directions.

3D models of extraocular muscle anomalies examples based on data obtained from various medical sources will be shown bellow.

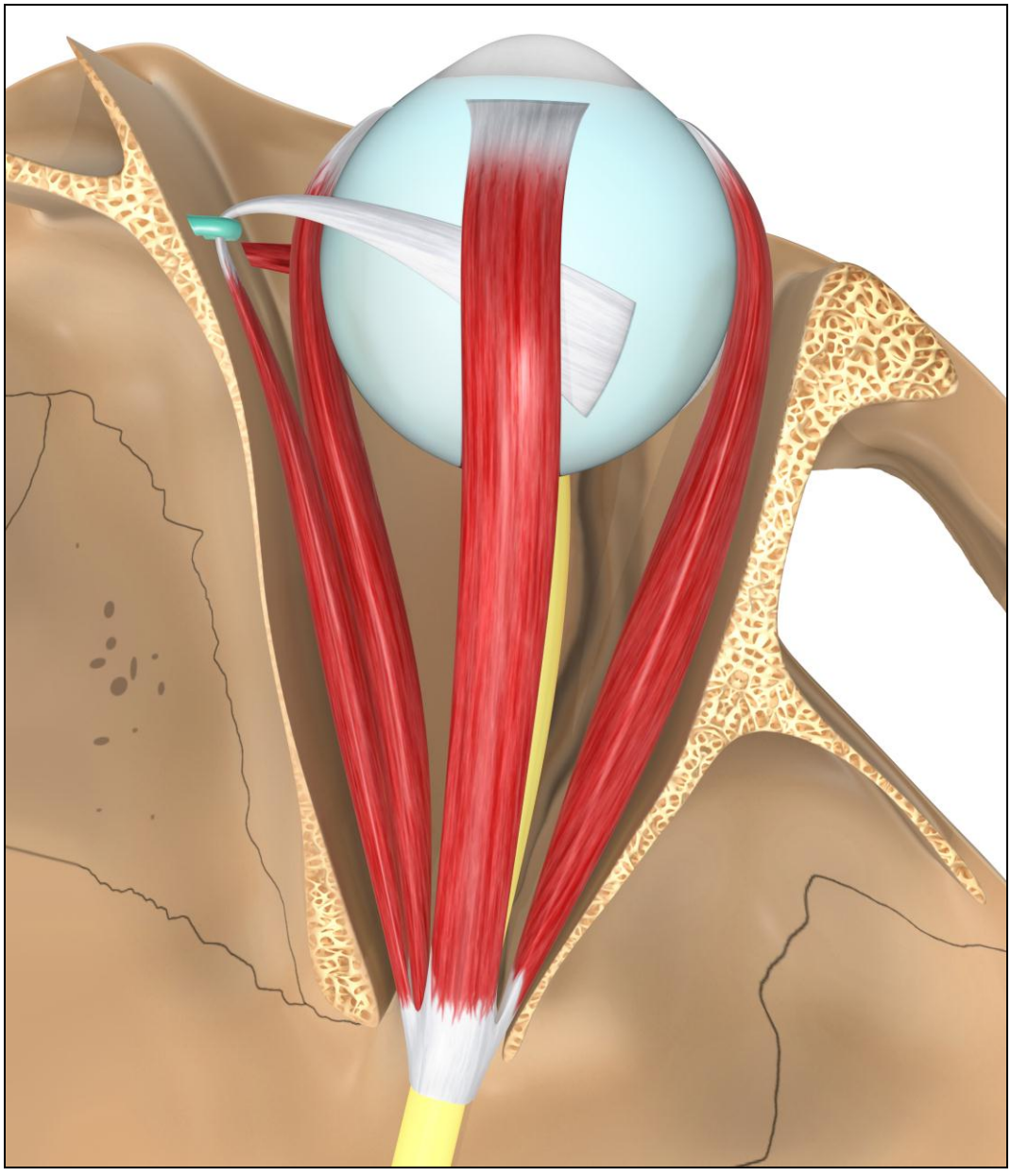

Figure 1. Normal anatomy of the extraocular muscles. (View from above)

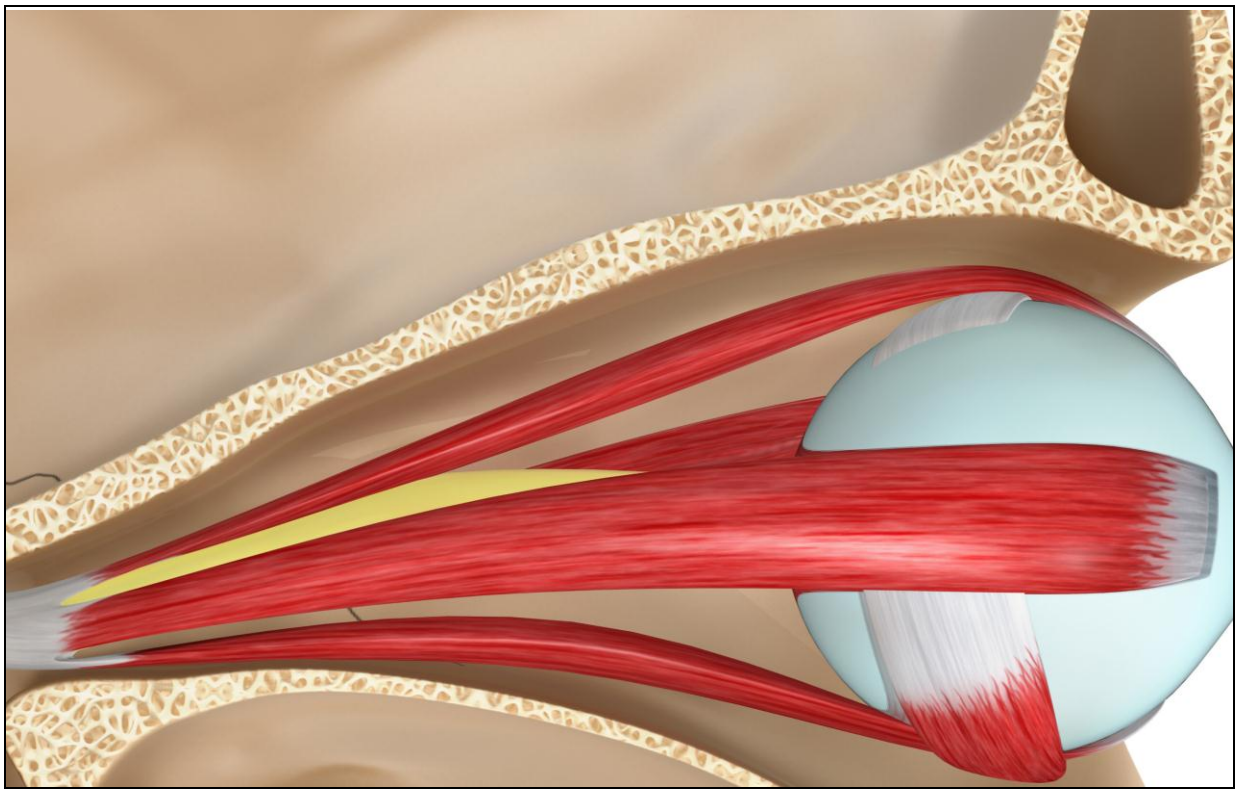

Figure 2. Normal anatomy of the extraocular muscles. (Side view)

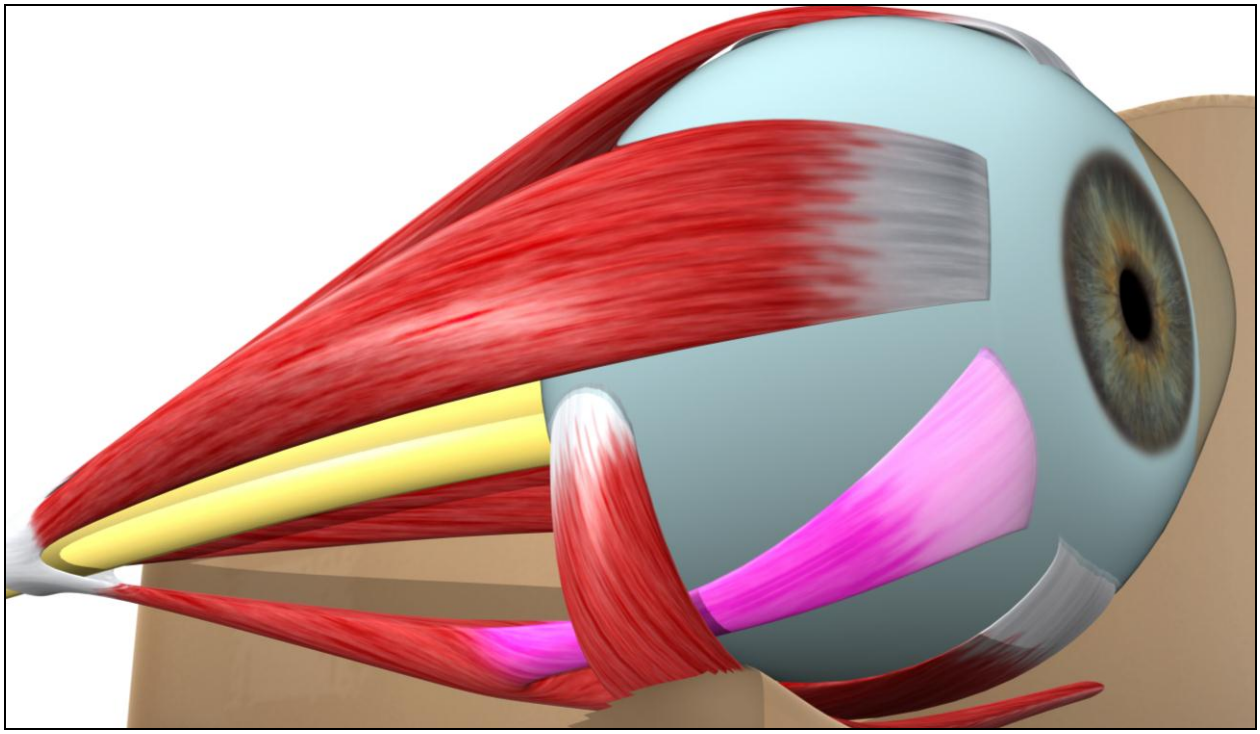

Figure 3. Model of the right eye, viewed from below, showing an abnormal muscle structure, which attaches laterally to the inferior rectus muscle.

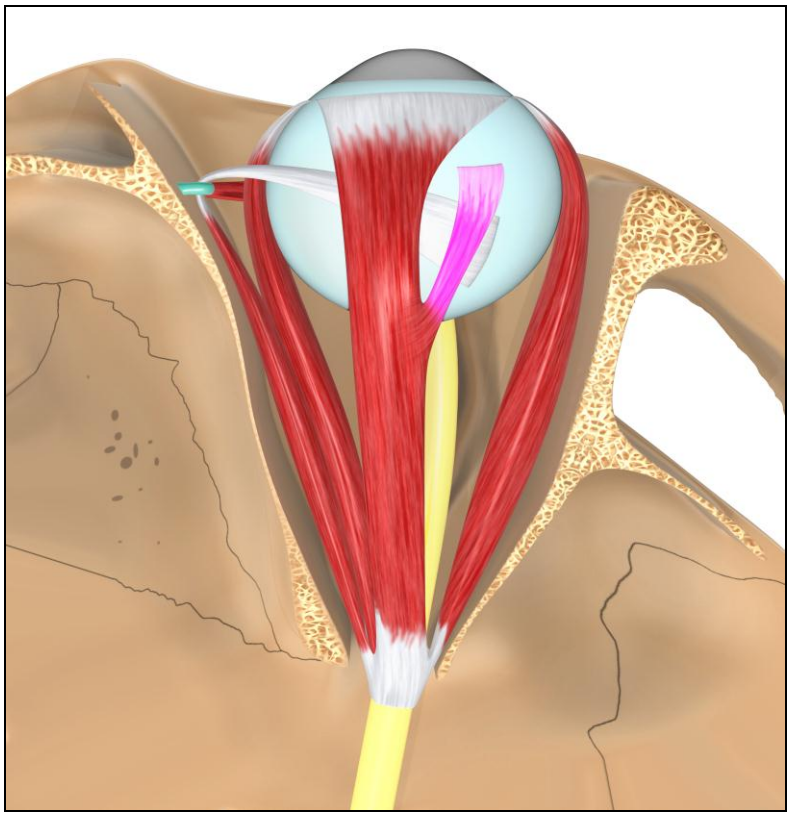

Figure 4. Model of the right eye, viewed from above, showing abnormal muscular structure that attaches laterally to the superior rectus muscle. With the misalignment of the eye (strabismus), as a result the visual axis of the eye directed above the fixation point.

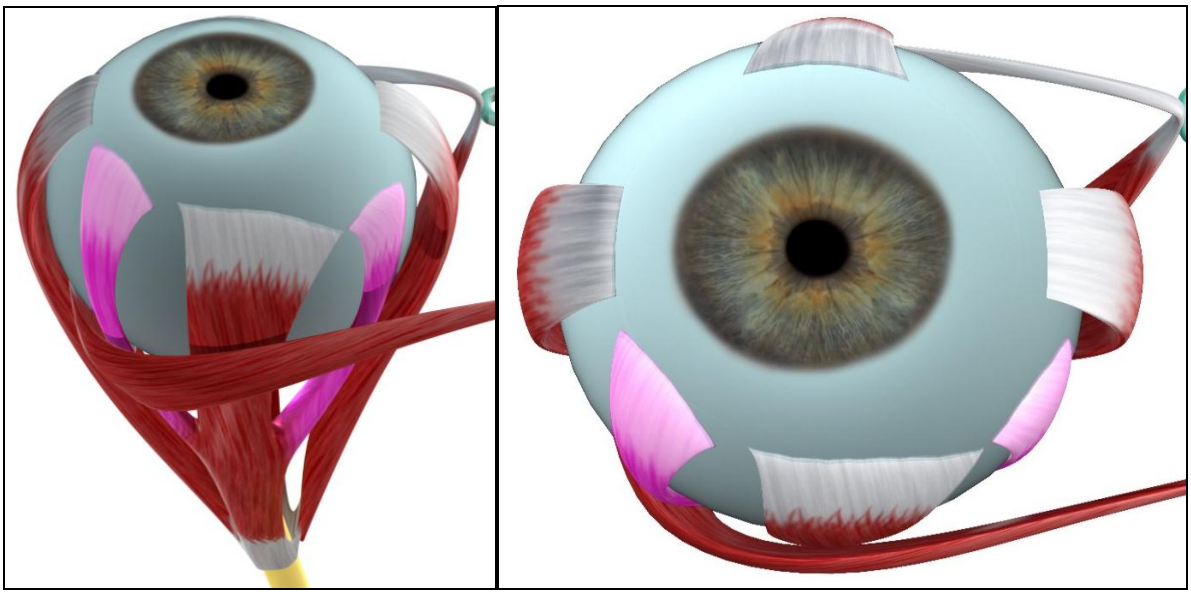

Figure 5. Models where the "triplication" of the lower line muscles can be seen. The term "triplication" indicates that in addition to the normal lower rectus muscle, there are medial and lateral muscle fibers. (View from the bottom and front) [5, 14]

Additional EOMs are rare chance finds during the surgeries on strabismus.[17] This case of accessory rectus muscle is an example of a rare anatomical anomalies. Awareness of such anomalies can help facial surgeons, ophthalmologists in assessing cases of unusual strabismus in postoperative period.

Output:

After the literature review regarding anomaly of extraocular muscles. We have determined that:

- Anomalies of the extraocular muscles are poorly studied however by their nature, clinical manifestations are aggravated factors after surgery on the zygomatic-orbital complex. Since the syndromes mentioned above can stay permanently even if the defect has been corrected.
- Based on the Internet data, as well as on the review of a number of medical articles, we have created 3D models of each defect and nearby structures.We can safely say that the created 3D models do not have any analogues in the electronic database of libraries.

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