Eyelid and Orbital Fascial Attachments and their Clinical Significance

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Summary

Orbital connective tissue can be considered as an additional locomotory system of the eye. It is involved in orbital fractures, explaining the bizarre motility patterns in these patients. Various conditions, in patients with Graves' disease, are explained using the orbital connective tissue system as a key-stone. Avoidance of postoperative complications are discussed in eyelid lengthening and shortening procedures.

A new anatomical study of the human orbit was undertaken because of disappointing surgical results and poorly understood motility impairment following orbital fractures. Unknown connective tissue septa were found between the eye and the orbital walls.¹ These belong to a general intra-orbital connective tissue system which is best developed at the eyeball level.^{2,3} This connective tissue system is involved in normal eye movements and explains the bizarre eye movement limitations that can occur after orbital fractures.^{4,5}

Further clinical significances

The enhancement⁶ of the connective tissue system on coronal CT scans seen in patients with Graves' disease makes it probable that like eye muscles it is affected by inflammation (v.d. Gaag, this issue).

Inflammation characterised by extensive lymphocyte infiltration with mast cells and plasma cells causes oedema of the fibrous tissues.⁷ Mucopolysaccharides, which are products of fibroblast activation, are deposited. When the inflammation subsides a hypertrofied connective tissue system is left behind, which explains the enhancement seen on CT scanning. Eye movement limitation in

upwards gaze, most frequently seen in patients with Graves' disease, can be explained by the fact that the connective tissue system around the inferior oblique and inferior rectus muscles is best developed and thus most affected (Fig. 1).⁸ These eye muscles also have the greatest number of septal connections with the adjacent peri-orbit. Lesions in this system explain why patients, in which other muscles besides the inferior rectus muscle are enlarged on CT scan, still have limitations of upward gaze.

As we know from general surgery the quality of connective tissue between different individuals varies. In patients with a well developed connective tissue system, this can be further tightened by inflammation during Graves' disease. Because orbital connective tissue is best developed at eyeball level, the orbital contents cannot expand anteriorly. This causes a rise in intra orbital pressure and a decrease in vision explaining the mechanism of optic nerve compression in malignant Graves. Ophthalmopathy. The eyes in these patients are often scarcely proptotic and the eyelids relatively quiet. Additional support for this concept is lent by the fact that when coronal CT sections are made perpendicular

Fig. 1. Coronal histological section through the right orbit. On the right the nasolacrimal duct, on the left the lacrimal gland. The small arrows indicate the connective tissue systems of the inferior and medial rectus muscles which are best developed. The large arrows indicate the medial fat pad in the upper eyelid which should be excised in blepharoplasties. 1. levator muscle, 2. superior rectus muscle, 3. superior oblique muscle, 4. medial rectus muscle, 5. inferior rectus muscle, 6. lateral rectus muscle.

to the optic nerve some adipose tissue around the optic nerve in the orbital apex is always visible despite gross muscle enlargement.⁸

The quality of the intra orbital connective tissue system can also be held responsible for the differences in the clinical presentation of intra orbital haemorrhage in young adults and elderly patients.⁹ In young patients an orbital haemorrhage often leads to dramatic vision loss, because the blood cannot drain anteriorly. In elderly patients with an 'aged' and consequently less rigid connective tissue system anterior drainage can occur, resulting in a black eye with unaffected vision. These differences in connective tissue quality between the ages are readily recognised by surgeons performing squint surgery in children and adults.

In the management of patients with Graves' disease, the increase of motility impairment

and diplopia after cosmetic decompressions can be of major concern.¹⁰ I believe this problem can be circumvented if one looks at the architecture of the connective tissue again. Anteriorly in the orbit, at the level of the oblique muscles, the general structure of the connective tissue is circumferential. Posteriorly around the straight eye muscles the connective tissue has a more radial distribution. This should be borne in mind when making the relieving peri orbital incisions during a decompression procedure. We changed our incisions to 'circumferential' anteriorly and 'antero-posteriorly' posteriorly. Since then we have had less post-operative motility impairment and often even an improvement of motility. Another reason why we get less motility impairment after decompression is a well balanced incision of the *whole* periorbit.¹¹ One can imagine that in a fibrosed

connective tissue system the tension does not rise equally in different areas during inflammation resulting in motility imbalance. If one opens up the peri-orbit in only one quadrant, tension is relieved there, but not in the other areas, causing a greater imbalance of the whole system and consequently more diplopia. If the whole peri-orbit is incised however, the whole system can relax and the orbital contents together with the eye can re-adjust to accomplish binocular single vision. Undoubtedly the coronal approach¹² gives the best entrance to all peri-orbital quadrants. It is an invasive and rather difficult technique. Good results can however, also be obtained by a medial inferior anterior orbitotomy to reach the medial inferior peri-orbits. Consequently the best developed connective tissue system can thus be adequately decompressed.

Because intra orbital connective tissue is a continuum and has relationships with the eyelids it is equally involved in eyelid problems. In the upper eyelid the connective tissue of the

levator muscle splits into two layers, the anterior and posterior levator lamella (Fig. 2). The anterior lamella has a relationship superiorly with a traverse connective tissue septum (Whitnall's ligament) running from the superior oblique muscle trochlea (medial horn) across the orbit to the lacrimal gland and finally attaching to Whitnall's tubercle (Lateral horn). Anteriorly the anterior lamella blends with the orbital septum and attaches to the eyelid skin forming the palpebral fold. The posterior lamella contains a lot of smooth muscle cells (Müller's muscle) and is continuous with the tarsal plate. More posteriorly in the orbit the levator muscle has an intimate relationship with the superior rectus muscle (rectus superior/levator muscle complex).

The architecture of the lower eyelid is comparable to that of the upper one (Fig. 3). From the connective tissue system of the inferior rectus muscle two lamellae split off anteriorly. The anterior lamella blends with a less developed orbital septum and attaches to

Fig. 2. Sagittal histological section through an orbit. 1. superior rectus muscle, 2. levator muscle, 3. posterior lamella, 4. anterior lamella, 5. orbital septum, 6. orbicularis muscle, 7. tarsal plate, 8. inferior oblique muscle, 9. inferior rectus muscle.

Fig. 3. Detail of a sagittally sectioned orbit showing the connective tissue between the inferior rectus muscle and the lower eyelid. 1. tarsal plate, 2. capsulo palpebral ligament anterior lamella, 3. posterior lamella with supporting ligament to lower fornix, 4. inferior oblique muscle.

the skin forming the lower eyelid palpebral fold. The posterior lamella again contains a lot of smooth muscle cells and attaches to the tarsal plate.

The relationships of orbital connective tissue with the eyelids have clinical consequences in lid lengthening procedures. In our experience it is rather difficult to predict the amount of sclera which should be used in these procedures.¹³ It appears to be highly dependent on the amount of scar tissue in the connective tissue. The postoperative result is also influenced by whether or not a decompression was performed previously. It appears that after a decompression the intra-orbital connective tissue system seems to be unbalanced causing unpredictable results in levator lengthening procedures. Finally if the adhesions of the lateral horn of the levator muscle with the lacrimal gland (Fig. 4) are not well enough dissected, persistent lateral upper eyelid retraction¹⁴ can occur in some patients.

Combining upperlid lengthening pro-

cedures with blepharoplasties is even more difficult in patients with Graves' disease. Special attention should be paid to the adipose tissue compartment between the superior oblique muscle tendon and the medial canthal tendon. If this is not resected during blepharoplasties unsatisfactory cosmetic results (medial fat pad bleb) are obtained.

Another interesting phenomenon highlighting the septal relationships between the inferior rectus muscle and the lower eyelid, is the complication of lower eyelid retraction after a recession of the inferior rectus muscle. To avoid this, the capsulo-palpebral ligament should always be dissected free from the inferior rectus muscle connective tissue.

Hylkema,¹⁵ reviewing the results of the intra-operatively monitored adjustable levator resection technique, showed that the amount of levator resection cannot be gathered from the amount of levator function only. Possibly differences in the quality of the connective tissue system between individuals can be held responsible. Support for this con-

Fig. 4. Sagittal section of the lateral half of an orbit showing the lacrimal gland area. 1. orbital septum, 2. lacrimal gland orbital part, 3. lateral horn of levator muscle, 4. palpebral part lacrimal gland, 5. inferior fornix, 6. Müller's muscle.

cept is given by his figures showing lower percentages of success in patients with congenital and iatrogenic ptosis. It is conceivable that in congenital ptosis the superior rectus muscle/levator complex is poorly developed, and that in iatrogenic cases adhesions are present between the complex and the orbital roof, explaining the poor post-operative results.

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