A Case Study: Management Options for a Patient with Congenital Fibrosis of the Extraocular Muscles

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ABSTRACT

Congenital fibrosis of the extraocular muscles is a relatively static congenital disorder leading to restrictive extraocular movements. The need for early intervention is vital to alleviate the development of an abnormal head posture and to lower the risk of amblyopia. A case of an 18-year-old male with congenital fibrosis, bilateral blepharoptosis, chin-up head posture, and external ophthalmoplegia is presented. His mother and older brother also exhibited similar clinical signs, thereby suggesting a familial pattern. Surgical management is discussed in light of the patient's presentation..

Keywords: congenital fibrosis of the extraocular muscles (CFEOM), bilateral ptosis, congenital external ophthalmoplegia, rotary nystagmus

INTRODUCTION

Congenital fibrosis of the extraocular muscles (CFEOM) is a rare non-progressive disorder characterised by ophthalmoplegia, bilateral blepharoptosis, abnormal head posture (AHP) and possible amblyopia.[1-9] CFEOM is broadly known as one of the congenital cranial dysinnervation disorders (CCDDs) due to its orbital innervational defects.[3,6,8,10] Muscle restriction is variable depending on the isolation or spread of fibrosis amongst healthy contractile muscle tissue. Earlier literature reported five clinical sub-classifications of CFEOM depending on the extent of fibrosis (Table 1).[11]

As the characteristics of the various forms of CFEOM may overlap, CFEOM is now categorised under three clinical phenotypes (Table 2).[3-4,7-9,12-14] The most common form of CFEOM is CFEOM1, with a 1/230,000 prevalence rate in the Western world.[3-4,14-15] CFEOM1 and CFEOM3 have been reported worldwide, however CFEOM2 has only been noted in people of Middle Eastern and Turkish descent.[3,14-16]

These genetic changes lead to an absence of the oculomotor and/or trochlear nucleus in the brainstem, agenesis of the superior division of the oculomotor nerve and motor neurons in the brainstem, a decrease in large motor axons and/or abnormal motor neurons, all of which result in atrophy and fibrosis of the extraocular muscles predominantly innervated by the oculomotor and trochlear nerves.[3-6,12-14,16-18]

Table 1. The five clinical sub-classifications of CFEOM[2,11]

General fibrosis syndrome (autosomal dominant > autosomal recessive > idiopathic)	Most severe form affecting all muscles bilaterally. Most severely the inferior recti and the levator palpebrae superioris.
Congenital fibrosis of inferior rectus with blepharoptosis (sporadic or familial)	Only the inferior rectus is affected. Mostly unilateral rather than bilateral. Ptosis, enophthalmos and unilateral fibrosis. Considered non-familial.
Strabismus fixus (sporadic)	Affects bilateral horizontal recti. Lateral rectus affected less than the medial rectus. Results in severe esotropia.
Vertical retraction syndrome	Bilateral vertical muscle restriction of superior and inferior recti. Most severely the superior recti, causing restriction of downgaze.
Congenital unilateral fibrosis with blepharoptosis and enophthalmos (sporadic)	All muscles are affected unilaterally, causing ptosis and enophthalmos.

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The levator palpebrae superioris and superior rectus muscles are particularly affected by atrophy due to agenesis of the superior division of the oculomotor nerve, thereby causing bilateral ptosis and hypotropia.[3,5-6,12,13,16,18]

Table 2. The three clinical phenotypes of CFEOM[2-4,6,10,12-16]	
CFEOM1	*Autosomal Dominant;* related to gene *KIF21A*/12q11-q12 of chromosome 12cen.
CFEOM2	*Autosomal recessive;* related to gene *PHOX2A/ ARIX* 11q13.2 of chromosome 11.
CFEOM3	*Classic CFEOM3;* related to gene 16q24.2-q24.3/*TUBB3* of chromosome 16. *Subtypes of CFEOM3;* related to gene *KIF21A*/12q11-q12 of chromosome 12cen.

CASE REPORT

An 18-year-old male presented to clinic for a pre-military ocular assessment, with signs of CFEOM. He had bilateral blepharoptosis (R>L), restrictive external ophthalmoplegia with the eyes fixed in infraduction, and a chin-up AHP markedly increased at distance. Bilateral eye movement restrictions with hypoglobus were similarly exhibited in his mother and older brother. In addition, he had fine manifest rotary nystagmus, with no history of surgery undertaken in the past and no associated learning barriers.

As he was unable to alternate fixation without moving his head, due to the restrictive ophthalmoplegia, the Krimsky test was performed instead of the prism cover test. This is because the Krimsky test relies on centring corneal reflections with a prism, either the non-fixing or fixing eye, while the prism cover test relies on the ability of the eyes to alternate fixation; something that he cannot do due to the restrictive external ophthalmoplegia.[19] The primary Krimsky method cannot be used in this instance as it relies on placing the prism on the fixing eye and Hering's Law, while watching for the corneal reflections to centralise in the deviating eye. Therefore the secondary Krimsky method was used, with the prism placed in front of the non-fixing left eye.[19] The Krimsky test performed with AHP revealed a right exotropia (RXT) of variable angle (approximately 20-30 prism dioptres), though appearing esotropic at times for near, and right hypertropia of 10 prism dioptres at both near and distance.

Assessment of his ocular movements showed bilateral superior recti restrictions of -5 resulting in an inability to elevate the eyes. There were however, less bilateral restrictions (-1) on downgaze/depression. The movement restriction of the left eye on laevoversion was worse than for the right, with the left lateral rectus not able to abduct the eye past midline (-4) and the right medial rectus unable to adduct by -2. On dextroversion, the left medial rectus was unable to adduct by -2½ and the right lateral rectus was unable to abduct by -½.

His distance visual acuity (VA) tested on the Snellen chart with his glasses (RE +1.50/-3.00x165°, LE +1.50/-3.25x10°) was reduced: RE 6/21 and LE 6/45, and no improvement was achievable with pinhole. Auto-refraction was performed (RE +1.50/-4.25x20°, LE unable to take measurement), but a retinoscopy was not performed as a manifest refraction taken from auto-refraction results could not improve VA. Near VA however was good at N5, when tested using the Moorfield's Bar Reading Book. The Ishihara test revealed no colour vision defect, and pupils were equally reactive to light. Fundal examination appeared normal with no pathological changes. Stereoacuity was also assessed, but no stereopsis was demonstratable, using the near Frisby real-depth and distance Mentor BVAT contour-line stereotests.

DISCUSSION

CFEOM is a disease which truly debilitates the functionality of the eyes. Therefore, the need for appropriate management at an early age is vital, in order to minimise the AHP and to lower the risk of developing amblyopia.[3,5,7,9] Interventions include surgical correction of the blepharoptosis and strabismus for cosmesis, as well as correction of any refractive error using glasses, due to the likely presence of significant astigmatism and amblyopia.[3-4,6,8,16,20] Early detection of amblyopia should be treated aggressively[4] through occlusion therapy for best visual outcome.[20-21] Although studies have shown the possible improvement of VA in amblyopic eyes with compliant full-time occlusion in children aged 7 to 17 years old,[21-22] our patient was not keen on occlusion, thus it was not prescribed. As his condition was long-standing from early childhood, binocular functions were absent and he did not suffer from diplopia due to suppression. Surgical treatment would therefore result in a cosmetic, rather than functional outcome.[5]

Before surgery is undertaken, forced duction testing should be performed to reveal the true extent of the extraocular muscle restrictions.[8,14] Management should be individually tailored due to the differing nature and extent of ocular fibrotic muscle involvement, which in turn, is dependent on the type of genetic loci involved.[3,6-7] Any history of previous extraocular muscle surgery needs to be taken into consideration because scarring can result from repeated surgical procedures and this can affect the treatment outcome.[3,6] Surgery should be sequenced in order of vertical, horizontal and lastly, ptosis correction to reduce lid alteration from precedent strabismus surgery.[3,7,11,14]

All adhesions or fibrotic bands need to be removed from the muscles before any surgical recessions and resections are performed.[2,14] Maximal inferior rectus recessions are very popular for relief of AHP and hypotropia.[3-4,7,11,14,20] Superior rectus resections may also be performed, however they are only used to enhance inferior rectus recessions if needed such as in cases of bilateral involvement.[4,14] Resections are usually avoided no matter the action of the muscle, as CFEOM is a CCDD and there is fear of creating

or worsening the enophthalmos.[8] If there is fibrotic superior rectus involvement, resection and transposition of the superior oblique muscle to the superior rectus insertion is an option.[3,16,20] Inferior rectus recessions are preferred to tenotomies.[11] A silicon plate can also be inserted on the orbital floor, which may improve the hypotropic deviation in primary position, as well as ptosis and palpebral retractions.[20]

With associated horizontal deviations, very large recessions (often greater than 10 mm) are the preferred treatment option, with only occasional resections performed alongside stay sutures and bare sclera conjunctival closures.[6,16] For exotropia, lateral rectus recessions are most popular surgically.[4,7,11,20] They are only accompanied by medial rectus resections if the recession did not have a significant enough impact.[4] However, due to the variability of the horizontal angle in this case, this may be problematic to correct.[4,7] The accuracy of the strabismus angle measurement may be compromised by the use of the Krimsky test due to the inability of the patient to maintain a repeatable and consistent AHP, so care should be taken with the choice of surgical correction.[23] The Krimsky test may therefore be repeated on future visits to eliminate any clinician errors such as placement, size of prism and Krimsky method used and to factor in any possible variability of AHP upon testing.[19] The presence of nystagmus could also have affected the measurements due to the constant oscillation of the eyes.[24] Although not typically a reported factor of CFEOM, nystagmus alongside astigmatic and amblyopic symptoms may coincide with familial CFEOM, as well as some neurological diseases.[4,7,9-11]

A sliding suture or hang-back method is another method that may be used to move the recti muscles as far back as needed for alignment purposes.[4] A traction suture is then used so that the globe maintains its position postoperatively.[4] A conjunctival recession over any recessed muscles may also be performed to enhance weakening.[4,7] The combined correction of hypotropia and exotropia would be required to achieve the best ocular alignment for our patient.

As many extraocular muscles are involved, the aim of the recessions is mainly to shift the eyes to a more appropriate position to relieve the AHP, rather than being effective in treating the extraocular muscle restrictions.[2-3,11,14,25] Full ocular rotations are difficult to restore, usually with unpredictable outcomes.[2-3,19,25] Subsequent surgeries may therefore be required.[3-4,7,11,20] If the AHP is not severe and the patient is not concerned about cosmesis, surgery may be deferred due to the unpredictability of the surgical outcome.[2-3,8,20,25] This information should be provided to the patients and/or their parents preoperatively so that there are no unrealistic postoperative expectations.[3,8,11,14,20]

Treatment of blepharoptosis, may be corrected by frontalis sling suspension and autologous fascia lata or brow alongside inferior rectus surgery if levator action is absent.[4,7,11,14,16,20] In some cases of moderate to severe lid ptosis, a resection of the levator muscle by skin approach rather than conjunctival may be preferred.[3,7] In mild cases, levator resection is effective.[4,7,14] It should be noted that ptosis surgery runs the risk of overcorrection, possibly resulting in exposure corneal keratitis.[6,8,14] Therefore, the aim is to slightly under-correct the ptosis by placing the lid 1 - 2 mm above the pupil in primary position, allowing the visual axis to remain clear and also possibly reducing the AHP.[8,11,14] Lubricant eye drops may be given to those with a higher risk of corneal exposure keratitis both preoperatively and postoperatively.[14]

CONCLUSION

CFEOM is a rare, non-progressive congenital disease, resulting in restrictions of movement of the eye/s, blepharoptosis, AHP and possible amblyopia.[2-3,5-7] Therefore, early interventions such as surgery at a young age is of great importance.[2-3,5-7] Surgical aims include the achievement of improved lid positions, cosmetic or even functional adjustments of the eyes (depending on the length of presentation of the condition), and a reduction or elimination of AHP.[11] Amblyopia management upon early detection, should be carried out through refractive and occlusive treatment regimes.[20] The management options for our patient may include inferior recti recessions to correct the bilateral hypoglobus, lateral recti recessions to correct the exotropia, and frontalis sling suspension to correct the bilateral blepharoptosis. However, as the patient is not concerned with the cosmesis of the strabismus and as the longstanding AHP is not severe, he is reluctant to proceed with any surgical management at this stage.

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