

## ESOPHORIC CONDITIONS

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Most esophoria is 'accommodative' in that it largely results from excessive accommodation due to uncorrected hypermetropia or excessive close work. As a result of the accommodation–convergence linkage, the excessive accommodation produces excessive convergence. Some eso-deviations do not have this accommodative factor and are then known as 'non-accommodative' or sometimes 'anatomical' esophoria.

Esophoria can be classified (Duane–White classification) according to whether the convergence is greater for distance or for near vision, or if it is the same for both:

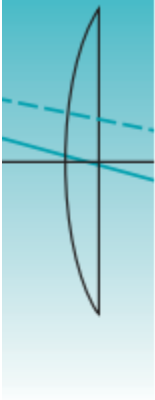
- (1) *Divergence weakness type*: shows decompensated esophoria for distance vision. In near vision, the heterophoria will be compensated. In older patients, there will be the expected degree of physiological exophoria, reducing the measured degree of esophoria for near vision.
- (2) *Convergence excess*: characterized by an increase in the degree of esophoria for near vision. There is usually a small degree of compensated heterophoria for distance vision and a higher degree of esophoria that is decompensated for near vision. This is in contrast to the normal physiological exophoria.
- (3) *Basic (or mixed or non-specific) type*: shows decompensated esophoria of about the same degree in distance and in near vision. The methods of investigation and management that apply to both divergence weakness esophoria and to convergence excess esophoria will apply to basic esophoria. A separate section on basic esophoria is therefore not included.

### ■ Divergence weakness esophoria

#### *Aetiology*

##### **Uncorrected hypermetropia**

This is the most common cause for decompensated esophoria in distance vision. It is usually decreased by the refractive correction to the extent that it becomes compensated.



### Anatomical factors

Factors such as abnormal orbital shape, lengths of check ligaments, muscle insertions, etc. are thought to contribute to esophoria in some patients. There is no evidence to show that these change in adult life, except after injury. If esophoria becomes decompensated, therefore, it is because other factors have intervened: poor health, deteriorated working conditions, etc. The anatomical factors may, however, explain why some patients have a predisposition for their esophoria to decompensate.

### Excitable or 'neurotic' temperaments

The esophoria in these cases may be variable with the emotional state and level of anxiety, being compensated one day and decompensated the next. It is also aggravated by stimulants.

### Pathology

Patients with advanced acquired immunodeficiency syndrome (AIDS) have more esophoria/less exophoria at distance and near than a control group (España-Gregori et al 2001) and may therefore be more likely to suffer from decompensated esophoria.

Pathological disturbances, particularly those affecting the central nervous system, can cause incomitant esophoria which will tend to break down into strabismus in one direction of gaze. In particular, lateral rectus palsy will cause an eso-deviation which is worse for distance vision and when the patient looks to the side of the affected muscle (Ch. 17).

### Investigation

A routine examination of the eye and vision is carried out in each case. In this type of esophoria, particular attention can be given to the undermentioned factors:

- (1) *Symptoms*, usually associated with distance vision and with prolonged use of the eyes. Symptoms will usually be less or absent in the morning, except headaches, which may occur on the day after prolonged use of the eyes (Rabbetts 2000, p 178). The symptoms are likely to be headaches in the frontal area, sometimes intermittent diplopia and blurred near vision if uncorrected hypermetropia is present.
- (2) *Refraction*, which is very important because of the association with uncorrected hypermetropia. In young patients significant esophoria is an indication for cycloplegia (see Box 2.1).
- (3) *Decompensation tests*, which will be the most important aspect in the investigation. The skills required to assess compensation are fully described in Chapter 4. Measurement of the heterophoria by the cover test or subjective dissociation tests will show a higher degree for distance than for near vision.

## Management

### Removal of cause of decompensation

The factors likely to put stress on the visual system or on the general well-being of the patient should be considered (Ch. 4). Consider particularly the patient's visual working conditions in this type of esophoria.

### Refractive correction

Uncorrected hypermetropia is the most common cause of decompensation in this type of esophoria, and therefore the refractive correction is most likely to remove the symptoms. In many cases, no other form of treatment is required. To encourage emmetropization in young children (Hung et al 1995), it is advisable to give the weakest correction that renders the esophoria compensated and that provides good visual acuities. Some patients will require the full refractive correction to prevent decompensation. In children and young adults, a cycloplegic refraction is necessary if variable refractive findings make it difficult to assess the refractive error or if latent hypermetropia is suspected.

The patients should be asked to wear the correction constantly for distance and near vision for about a month and then tests for compensation should be repeated if symptoms persist. Where the spectacles or contact lenses resolve the symptoms and the esophoria becomes compensated, the refractive correction should be worn when the patient finds the need.

In some cases the esophoria is not changed by a hypermetropic correction or there is found to be no refractive error: the esophoria is non-accommodative. Consideration should then be given to eye exercises or relieving prisms. Occasionally, myopes have decompensated esophoria for distance vision and in young patients the possibility of latent hypermetropia should be excluded with cycloplegia. The lowest refractive correction is given that is consistent with acceptable distance acuity.

### Eye exercises

If the decompensation of divergence weakness type esophoria persists after consideration has been given to the general decompensating factors and the refractive correction, orthoptic exercises may be considered.

Teaching an appreciation of physiological diplopia has been found to be useful in this condition. The patient is asked to look at a small isolated object (not confused with background details) at a distance of 3–6 m. A second object, such as a pencil, is held on the median line at about 40 cm from the eyes. The patient is encouraged to notice that this second object is seen in physiological diplopia as long as fixation is maintained on the distance one. When this has been appreciated, fixation is changed to the near object and physiological diplopia of the distance one is observed. The patient is then encouraged to alternate between fixating the distance object with crossed physiological diplopia of the near one and fixating the near object with uncrossed physiological diplopia of the distant one. A pause of several seconds must be made with each change of fixation, or confusion







results. This exercise in vergence coordination seems to be particularly useful in young patients.

Exercises to increase the divergent amplitude of fusional reserves (the negative fusional reserve) and/or the positive relative accommodation are also of help in this type of esophoria and are often the main orthoptic therapy. A range of suitable exercises is described in Chapter 10.

### Relieving prisms

Prism relief in esophoria is required only for a minority of cases. The symptoms in most cases are relieved by refractive correction or by eye exercises. Prisms may be considered when eye exercises have been tried and found not to be successful, or where they are inappropriate because of the patient's age, poor health, unwillingness or inability to give the time required. The power of the prism required is that which is likely to make the esophoria compensated, as assessed by the methods described in Chapter 6. In general, it will be the lowest prism power that will give no disparity on the fixation disparity test, and/or a smooth prompt recovery on the cover test.

### Referral

This will be the first consideration when a pathological cause is suspected but it is unlikely that surgery will help in other cases. It should be noted that a distance esophoria can be a sign of a sixth nerve paresis, in which case the deviation will increase when the patient looks to the side of the affected muscle (Ch. 17).

## Convergence excess esophoria

This type of esophoria is low in degree for distance vision but increases on converging for near vision.

### Aetiology

#### Excessive accommodative effort

This is usually the main factor and may be caused by uncorrected hypermetropia, latent hypermetropia, early presbyopia, spasm of the near triad or of accommodation, or pseudomyopia. Another cause is very prolonged work at an excessively close working distance.

#### High AC/A ratio

The accommodative convergence/accommodation (AC/A) ratio is often a factor in producing convergence excess esophoria. The ratio is a measure of the effect of a change in accommodation on the convergence and is expressed as the change in convergence ( $\Delta$ ) for each dioptre change in accommodation (p 36). This is normally about 4  $\Delta$ /D and when it is high

(>6), accommodation for near vision will result in an excess of convergence. Convergence excess rarely occurs with a low AC/A ratio.

### Visual convergence reaction

Convergence excess can also be present as a visual convergence reaction. When this occurs it is usually in young, energetic patients and it is typically accompanied by some psychological stress or anxiety, for example school examination pressures or relationship difficulties.

### Incipient presbyopia

This can occasionally result in convergence excess because of the high ciliary muscle effort needed to produce adequate accommodation.

### Excessive proximal convergence

Of the three main cues that cause convergence during near vision (proximity, disparity and accommodation) the proximal cue is the most powerful (Joubert & Bedell 1990, North et al 1993). The magnitude of the proximal cue varies between individuals and it is quite likely that a convergence excess esophoria that is not caused by any of the previously listed causes will result from excessive proximal convergence.

### Investigation

Each case of convergence excess esophoria will require a full routine eye examination and probably a cycloplegic refraction. Particular attention should be given to the following factors:

- (1) *Symptoms* are usually associated with prolonged use of the eyes in near vision. Sometimes they are so severe as to render close work impossible for more than short periods. Frontal headache, ocular fatigue and blurred near vision are usual symptoms. Sometimes difficulty is experienced in refocusing the eyes for distance vision after a lot of close work.
- (2) *Refraction*, which may show variable and unreliable results. It may be seen during the retinoscopy; neutralization appearing at one moment and 'with' or 'against' movement the next, without any test lens change. This is a sign of active accommodation and may indicate the presence of latent hypermetropia. Another sign of latent error is a lower subjective result than that shown in retinoscopy. These are clear indications that a cycloplegic refraction is required to reveal any latent error or spasm of accommodation that may accompany convergence excess esophoria (see Box 2.1). Occasionally, the spasm is such that pseudomyopia occurs. This is usually of low degree but can be as high as 10 D. Where myopia occurs in a young patient with high esophoria, the possibility of spasm should be explored by cycloplegic examination.

- (3) A *gradient test* gives useful information in convergence excess. It is one way of measuring the AC/A ratio and is described on page 36.
- (4) A *cover test and fixation disparity test* for near vision, which will indicate decompensation of the heterophoria at near.

### Management

#### Removal of cause of decompensation

It may be necessary to restrict the patient's close work and/or to increase the working distance. In many cases of convergence excess, the working distance has become unnecessarily close because of bad visual habits. Patients acquire the habit of working excessively close during childhood, when the amplitude of accommodation is sufficient to permit this without symptoms, but, on reaching an age when the amplitude is reduced, stress occurs and becomes the cause of the convergence excess (above). Most patients with this condition are between 14 and 20 years of age. The onset will vary with the amount of close work and the working distance, as well as with the degree of uncorrected refractive error. It may also be brought on by a marked increase in the amount of close work, for example due to an approaching school examination period or leaving school for an office job with longer hours of sustained near vision.

In some cases, changing the visual habits to require the patient to employ a more appropriate working distance will clear up the symptoms with no other treatment. A distance of 35–40 cm should be regarded as a minimum and with modern computer use in offices this is usually achievable. It is not always easy for patients to acquire new visual habits when the concentration is on the job in hand. It may be necessary for them to ask someone else to keep reminding them of the required working distance.

#### Refractive correction

As noted earlier in this chapter, to aid emmetropization the minimum correction required to render the esophoria compensated and to allow clear and comfortable vision should be prescribed. Some cases require the full hypermetropic correction, which may blur the distance vision at first. If it does not clear after a few days then a cycloplegic can be instilled to help the patient adjust to the glasses.

In any case, the patient should be seen again after wearing the correction for a few weeks, and the symptoms and decompensation should be reassessed. If the symptoms have cleared, the glasses should continue to be worn for reading and other close work, and for distance vision as required to maintain relief of the symptoms (Case study 7.1). In cases of high hypermetropia, this may involve continued constant wear.

Multifocals, with a reading addition that relieves the decompensation of the esophoria for near vision, are sometimes prescribed. The addition can be found with the gradient test method or by adding positive spheres until the cover test or fixation disparity test indicate compensation. This approach to convergence excess is seldom necessary in patients over the



**CASE STUDY 7.1 Ref. F2189 25/10/91 (AGED 9 YEARS)**

**HISTORY:** First eye examination. Has passed several vision screening checks.

**SYMPTOMS:** Frequent diplopia, horizontal, at any distance. Slightly blurred vision at distance and near. Difficulty with literacy and numeracy at school. Headaches, about once a week, occurring at any time.

**CLINICAL FINDINGS:** *Normal:* ocular health, pupil reactions, NPC. *Ocular motility:* no incomitancy, but transient LE convergent spasm. *Distance unaided vision:* R = L = 6/12. *'Dry' retinoscopy:* R = L = + 0.50 DS = 6/9. *Cover test:* D orthophoria, N 5  $\Delta$  SOP, fair recovery. *Aligning prism:* D 1.5  $\Delta$  out RE, N 2  $\Delta$  out RE. *Dissociation tests:* D 4  $\Delta$  out, N 8  $\Delta$  out; nil vertical. *AC/A ratio:* 3.5  $\Delta$ /D. *Fusional reserves:* not measurable as immediate diplopia. *Amplitude of accommodation:* R = L = 11.00 D. *Stereoacuity:* normal. *Cycloplegic refraction:* R + 1.25/−1.00  $\times$  10 L + 1.00/−0.50  $\times$  165.

**MANAGEMENT:** Prescribed cyclo correction with 1  $\Delta$  out each eye.

**FOLLOW-UP (3 MONTHS):** Patient voluntarily wears glasses most of time, diplopia very rare when wearing glasses, headaches reducing. Clinical findings similar, but VA and orthoptic function improved with spectacles.

**FOLLOW-UP (12 APPOINTMENTS OVER 15 YEARS):** Prescription gradually reduced, first reducing prisms. By 1995 no prisms required, by 2002 no correction required. In 2006, aged 24: asymptomatic, no headaches, no refractive correction required; cover test orthophoric at distance, 6  $\Delta$  SOP at near, no aligning prism.

**COMMENT:** In some cases a relatively low refractive correction can be enough to render a heterophoria compensated.

age of 14 years. The bifocal design should be large and set with the segment top at the same height as the pupil centre (Ch. 14).

Sometimes convergence excess breaks down into a strabismus for near vision. In these cases, bifocals may be appropriate if binocular vision is restored when the patient looks through the segment (Ch. 14). Patients with bifocals should be checked every 3–6 months, with a view to reducing the addition. Bifocals are unlikely to be effective if the AC/A ratio is low.

Where convergence excess occurs in incipient presbyopia, reading glasses or multifocals are prescribed.

### Eye exercises

If the symptoms persist after the constant wear of any appropriate refractive correction for several weeks, orthoptic exercises may be considered. Exercises that develop the positive relative accommodation are particularly useful. The aim of such exercises is to encourage accommodation without convergence; pairs of negative spheres increasing in power can be placed before the eyes while the patient maintains clear single vision.



Alternatively, the divergent amplitude of the fusional reserve can be developed. In this case the accommodation is unchanged while the eyes diverge. This can be done by a fusional reserve exercise. Details of these exercises are given in Chapter 10. In the case of convergence excess, the exercises will be carried out for near vision.

### Relieving prisms

This is not appropriate to convergence excess, unless the AC/A ratio is very low (e.g. 2), which is unusual.

### Referral

Medical attention should be sought if pathology is suspected, or appropriate help can be sought where there is psychological stress.

### Clinical Key Points

- In decompensated esophoria always suspect hypermetropia. If hypermetropia is not readily apparent in young patients then do a cycloplegic refraction. If you find hypermetropia in decompensated esophoria, then prescribe
- Sometimes, quite small hypermetropic corrections can have a large effect on symptoms
- In divergence weakness, look carefully for a lateral rectus palsy
- Cases of convergence excess respond well to treatment with multifocals
- Eye exercises can be helpful in many cases