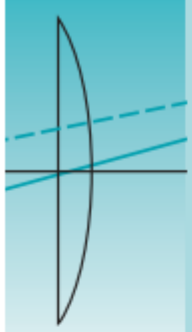


8 EXOPHORIC CONDITIONS

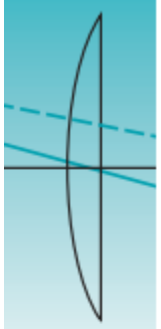
Although it has been shown that divergence is actively stimulated (Breinin 1957), exophoria appears to be a much more passive condition than esophoria. There are several potential explanations for this: the position of anatomical rest is relatively divergent, divergence has been thought to be a relaxation of convergence associated with a relaxation of accommodation, and the eyes do not diverge beyond the parallel in normal vision. High tonic impulses to the abductors do not seem to be considered such a major factor in most exophoria in the way that high muscle tonus of the adductors contribute to esophoria. For near vision, factors that produce excessive convergence in children can even mask a basic exophoric deviation.

The differential diagnosis of decompensated exophoria and intermittent exotropia is not always clear, and several references to intermittent exotropia are included in this chapter. One diagnostic sign is that about 10% of patients with intermittent exotropia have amblyopia (Santiago et al 1999). One long term follow-up study of intermittent exotropia found that 36% converted to exophoria or orthophoria (Rutstein & Corliss 2003), although another study found that the deviation only resolved in 4%, and more than half had an increase of at least 10 Δ within 20 years of their diagnosis (Nusz et al 2006). Haggerty and colleagues described a grading system for intermittent exotropia (Haggerty et al 2004). Intermittent exotropia is more likely to be associated with neurological disease (e.g. developmental delay, cerebral palsy, attention deficit disorder) if it is of the convergence weakness type rather than the other types listed below (Phillips et al 2005).

Based on the Duane–White classification, exophoria can be considered under four headings:

(1) *Convergence weakness exophoria:* shows decompensated exophoria for near vision but not for distance. For distance, there is usually a smaller degree of exophoria, which is compensated. This type will be dealt with together with basic exophoria.

(2) *Divergence excess:* in its typical form this is an intermittent divergent strabismus for distance vision with compensated exophoria for near vision.



(3) *Basic (or mixed) exophoria:* where the degree of exophoria does not differ significantly with the fixation distance.
(4) *Convergence insufficiency* is an inability to sustain sufficient convergence for comfortable near vision. Although this may be considered to be an anomaly of convergence rather than heterophoria in the strictest sense, it will be considered in this chapter with the exophoric conditions. Convergence insufficiency is sometimes considered to be synonymous with convergence weakness exophoria but there are differences, as discussed below.

Differential diagnosis of convergence weakness exophoria and convergence insufficiency

Some confusion arises owing to differences in nomenclature. In North America the term *convergence insufficiency* is often used to describe a problematic convergence weakness exophoria. The condition is often defined according to a set number of criteria. For example, Rouse et al (1998) defined convergence insufficiency as a syndrome based on near exophoria, low convergent fusional reserves (e.g. failing Sheard's criterion) and near point of convergence more remote than 7.5 cm. Depending on how many of these features were present, these authors classified their subjects as low suspect, high suspect or definite convergence insufficiency. Rouse et al (1998) found that 18% of patients seen in an optometry clinic might have such a condition that required treatment.

In the UK, such an anomaly might be termed a decompensated exophoria at near or a decompensated convergence weakness exophoria. The difference between the North American and UK nomenclature might be partly the result of differences in the diagnosis of the condition, as discussed in Chapters 4 and 5. In the UK, the term *convergence insufficiency* is generally taken to mean a remote near point of convergence (Stidwill 1997, Bishop 2001, Eperjesi 2001, Evans 2001b). Although this is often associated with a decompensated exophoria at near, the two can occur independently.

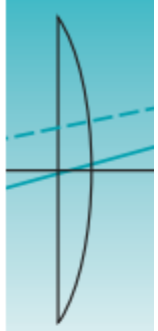
Basic and convergence weakness exophoria

Although basic exophoria and exophoria for near vision only (convergence weakness type exophoria) may be considered as two different conditions, the methods of examination and management have so much in common that they will be dealt with together. In the investigation and the management of convergence weakness exophoria, thought will need to be given particularly to near vision.

Aetiology

Anatomical and physiological factors

Anatomical factors seem to play a large part in most cases of exophoria, and hypertonicity of the abductors may be a contributory factor. When



uncorrected, myopia may build up a false accommodation–convergence relationship for near vision.

Age

The average phoria for near vision increases with age from the early 20s, in a steady progression, becoming about 6 Δ exophoria by the age of about 60 years. With normal patients, this increasing physiological exophoria for near vision does not seem to be caused by the reading addition (Freier & Pickwell 1983). Elderly patients often have decompensated exophoria for near vision.

Absolute hypermetropia

This may be a factor in the cause of exophoria. Patients whose hypermetropia is high in comparison with their amplitude of accommodation reach an age when they are no longer able to compensate for their refractive error by accommodating. They allow their accommodation and their convergence to flag, resulting in decompensated exophoria. This can happen in high hypermetropia in children and commonly in low degrees of hypermetropia in incipient presbyopes, particularly in people who do not have to undertake a lot of near visual tasks. If the hypermetropia is fully or partially corrected then the patient may recommence using their accommodation and convergence for near vision, reducing the exophoria. It should be noted that this is counterintuitive: a plus correction can in these cases reduce an exophoria.

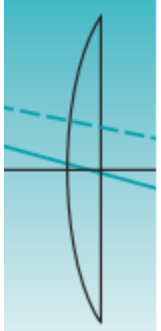
Extrinsic suppression

Suppression of one eye, which has been acquired because of long periods of using monocular vision, is also a factor. This used to occur in some occupations in which instruments with monocular eyepieces were used. Nowadays, instruments with binocular eyepieces are more often used.

Investigation

A routine eye examination should be carried out in each case, as described in Chapter 2. In addition to appropriate tests of binocular function, four points should be noted, particularly, in this type of exophoria:

(1) *Symptoms*, which are not usually as marked in exophoria as in esophoria. Suppression is more likely to be associated with exophoria and this will lessen the symptoms to some extent. The symptoms are likely to include frontal headache associated with prolonged use of the eyes, ocular fatigue and sometimes intermittent diplopia, particularly for near vision. A questionnaire has been developed and validated for quantifying symptoms related to convergence weakness exophoria (Rouse et al 2004b). Intermittent exotropia in children can be a cause of excessive blinking (Coats et al 2001). In old age there is often a high degree of exophoria for near vision that is not accompanied by symptoms. Decompensated convergence weakness exophoria can be a common cause of symptoms in children, according to parental and child reports, and symptoms of diplopia, closing or covering one eye or having to reread lines are



strongly suggestive of decompensated convergence weakness exophoria (Borstinget al 1999).

(2) *A cover test* may reveal the exophoria early in the routine examination; particular attention must then be paid to the recovery movement (see Table 2.1).

(3) *Tests of compensation* should be carried out, as described in Chapter 4.

(4) *Accommodative function* should be assessed, since convergence weakness exophoria is sometimes associated with accommodative insufficiency (Rouse et al 1999).

Management

Removal of cause of decompensation

Attention should be given to the patient's working conditions, adequate illumination and the possibility of a visual task involving monocular vision and causing extrinsic suppression. The patient's general health and any medication (Thomson & Lawrenson 2006) should also be considered.

Refractive correction

In myopia or in absolute hypermetropia, the refractive correction can assist in making the exophoria compensated, and this applies to distance and to near vision anomalies. In hypermetropic cases, care needs to be exercised in prescribing, as sometimes the correction increases the symptoms and difficulties. In other cases, fairly low refractive errors (e.g. astigmatism or hypermetropia) might be resulting in blur and impairing sensory fusion. In these cases, refractive correction might help to make a decompensated heterophoria become compensated.

The exophoria should be assessed for compensation with the full correction in place. Sometimes it can be demonstrated quickly that the degree of the exophoria is increased by the correction, and that the binocular vision has become less stable. It should be noted, however, that the patient's exophoria may adapt to the lenses if they are left in place for 2–3 min. In those cases where the hypermetropic correction results in the exophoria becoming decompensated, or if it is likely to so do, a partial correction is given. In the case of a patient who has had no previous refractive correction, the correction should be reduced by about one-third of the mean spherical error and the assessment of the exophoria repeated. The correction required is the highest correction that will maintain a compensated exophoria and will at the same time relieve symptoms associated with the hypermetropia. In a few cases, this may not be possible and, for these, prism relief or eye exercises are required in addition to correction of the hypermetropia.

In presbyopia, the reading addition should be kept as low as is compatible with adequate near vision, particularly in decompensated exophoria for near vision only.

Modification of the refractive error can be used to treat some cases of decompensated exophoria, particularly when the patient does not have the

CASE STUDY 8.1 Ref. F6833

BACKGROUND: Girl, aged 12, previously given eye exercises for decompensated exophoria but abandoned these (motivation poor).

SYMPTOMS: Near vision blurs. Headaches, about twice a week, at school.

CLINICAL FINDINGS: *Normal:* ocular health, visual acuities, refractive error (low long-sightedness), accommodative function. *Cover test*: orthophoric at distance. 10 Δ XOP at near with poor recovery. *Convergent fusional reserve* (Δ) at near −/7/2.

Mallett aligning prism at near 2 Δ in each eye, or aligning sphere −1.75 D each eye. With this 'negative add' near cover test recovery good.

MANAGEMENT: Patient not keen on more eye exercises, so given negative add 'exercises glasses' for near vision. To return if any blur/diplopia/asthenopia.

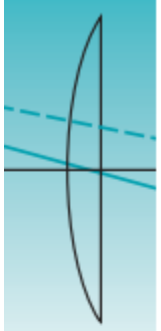
FOLLOW-UP: Glasses used for most close work and in class virtually eliminate symptoms. Negative add gradually reduced every 3 months (each time, minimum prescription to give alignment on Mallett fixation disparity test and good cover test recovery). After 18 months, patient asymptomatic and compensated without glasses.

time or inclination for eye exercises or when exercises are proving unsuccessful (Case study 8.1). A 'negative addition' can be used; i.e. over-minusing or under-plussing the refractive correction. For example, in an emmetrope the effect of negative lenses on the deviation at the appropriate distance(s) can be investigated using the cover test or fixation disparity test. If a power of lens (*aligning lens*) is found through which the patient can comfortably accommodate and which renders the heterophoria compensated, then this is prescribed. The aim, as with all treatments based on modification of the refractive error, is to reduce the correction over a period of months, and possibly years, as the patient becomes more able to compensate for the heterophoria themselves.

A patient with convergence weakness exophoria might require a negative add for near but not for distance. Such cases can be prescribed with executive bifocals fitted upside down. For example, an emmetropic patient could have executive bifocals made of the following prescription: −2.00 DS add +2.00. If these were then glazed upside down into a spectacle frame the top portion would be plano and the bottom −2.00.

Eye exercises

In patients who are old enough to understand the instructions, eye exercises may be appropriate, depending on the motivation of the patient, the time available, etc. (Ch. 6). Exercises may be successful if the exophoria has been compensated but has become decompensated through stress. In such cases, a short course of orthoptic exercises aids the restoration of compensation when the factors of stress have been dealt with.



Where treatment is given, the general plan should be:

(1) Develop the convergent fusional reserves and/or the negative relative accommodation
(2) Develop a correct appreciation of physiological diplopia
(3) Treat any suppression that has been demonstrated.

Examples of exercises appropriate to these objectives are described in Chapter 10. A recent randomized controlled trial suggested that intensive exercises are more effective at treating convergence weakness exophoria than simple pen-to-nose exercises (Scheiman et al 2005a). Indeed, the pen-to-nose exercises were not found to be effective, but it has been argued that these were very basic (Kushner 2005).

Relieving prisms

Prism relief in exophoric patients often proves a simple and effective method of management. It is frequently more appropriate than eye exercises in adult patients.

The power of the prism to incorporate in the prescription is the lowest that will ensure compensation of the exophoria. This can be estimated by repeating the cover test with prism relief in place before the eyes, or by measuring the aligning prism with a Mallett fixation disparity test. Typically, the smallest prism that restores the monocular markers to their central position is prescribed. There is often a subjective improvement reported by the patient when reading the near-test types with the prism in place, and it may be noticeably worse if the prism is removed.

A recent study of patients with convergence weakness exophoria or convergence insufficiency found that base-in prisms were no more effective than a placebo at alleviating symptoms (Scheiman et al 2005a). However, these authors based the prescribing of prisms on an old technique suggested by Sheard (1930). In particular, this study did not use the Mallett unit, either for diagnosis or for prescribing prisms.

If there is a small degree of comitant hyperphoria in addition to the exophoria, then an appropriate vertical prism will help the compensation of the exophoria (London & Wick 1987).

Referral

Where other methods of treatment fail, surgical relief is sometimes considered but the degree of the exophoria has to be large enough to exceed the accuracy of surgery.

Divergence excess

Divergence excess shows a large degree of exophoria for distance vision, which in many cases will be found to break down into a divergent strabismus. For near vision, the heterophoria is less by at least 7 Δ (Duane 1897) and is compensated. Sometimes it is defined as an exo-deviation of 15 Δ greater

Table 8.1 A classification of true and simulated divergence excess, according to Ansons & Davis 2001

Classification	*Response of near deviation to occlusion*	*AC/A ratio*
True divergence excess	No significant increase	Normal or low
Simulated with high AC/A ratio	Increases to be similar to distance deviation	High
Simulated with normal AC/A	Increases to be similar to distance deviation	Normal or low

for distance vision than for near. The majority of patients with divergence excess are female and the condition commonly presents itself in the mid-teens (Pickwell 1979b).

Aetiology

The causes of divergence excess are uncertain, and there has been a good deal of speculation as to the relative importance of the tonic and anatomical factors. This subject was reviewed by Cooper (1977).

True and simulated divergence excess

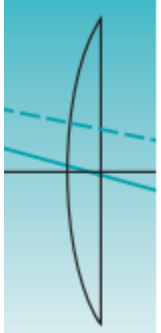
A distinction has been made between 'true divergence excess' and 'simulated divergence excess' (Burian & von Noorden 1974). In simulated divergence excess, unilateral occlusion for 30–45 min causes an increase in the near deviation revealing a basic exo-deviation, not divergence excess. It seems likely that in these cases high tonic, accommodative or proximal convergence obscures the real nature of the deviation for near vision. The high convergence lessens as the patient reaches adult age, and simulated divergence excess then reveals itself to be a basic exo-deviation. This may be important where surgery is to be considered, but non-surgical management may be the same for true and simulated divergence excess in the initial stages. In simulated divergence excess, the management may have to be modified as the patient gets older.

Ansons & Davis (2001) further classified the condition, mainly based on the response to occlusion and on the size of the AC/A ratio. Their classification is summarised in Table 8.1.

Investigation

The investigation of divergence excess should follow the routine eye examination, giving particular attention to the following points:

(1) *Symptoms:* patients with divergence excess do not usually complain of any marked subjective symptoms. If asked, they may report that intermittent diplopia has been present for as long as they can remember, but



often there is established suppression and diplopia is not experienced. Some patients learn to control the deviation for distance by accommodating and will report some blurred vision as a result. The most usual reason given for presenting for eye examination is that their friends and relatives have noticed the divergence of one eye. This deviation becomes apparent with inattention, tiredness, emotional stress, poor health and alcohol. Bright sunlight is also reported to produce the deviation (Eustace et al 1973). Patients may therefore report that they close one eye in bright light, which may be a mechanism to avoid diplopia and confusion (Wang & Chryssanthou 1988). A recent study found that eye closure in bright sunlight in intermittent exotropia is more likely to be related to photophobia than to diplopia avoidance (Wiggins & von Noorden 1990). Poor health or small amounts of alcohol can also produce the deviation.

(2) *A cover test*, which may show decompensated exophoria for distance vision, but sometimes this can appear compensated if the patient is exercising a high level of concentration. If the cover test is repeated, or the alternating cover test carried out, the distance vision deviation increases and the exophoria may break down into a divergent strabismus. A V-syndrome often accompanies divergence excess (Ch. 17). An important diagnostic sign is that the deviation increases for true distance vision, that is fixation distances much greater than 6 m. This can be detected by repeating the cover test when the patient looks out of a window. Dissociation tests and compensation tests may also show similar variation for distance vision.

(3) *Refractive error*, which in divergence excess is usually either low hypermetropia or myopia (Pickwell 1979b).

(4) *Fusional reserves*, which are usually very abnormal in that the base-in amplitude for distance vision is very high: instead of the average value of 6–9 Δ, they may exceed 20 Δ. The very divergent position produced by measuring the base-in fusional reserve for distance vision is usually accompanied by suppression. This means that, in some cases, when the limit of the divergent amplitude is reached, no diplopia is reported and this may give the appearance of a very much higher amplitude, unless the practitioner watches the patient's eyes to note the point at which the divergence of one eye ceases. The very high base-in fusional reserve for distance vision is a major diagnostic feature.

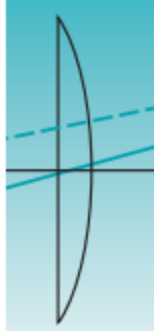
Management

Removal of cause of decompensation

This is not usually possible in divergence excess.

Refractive correction

Correction of any myopia assists by clearing the blurred distance vision and inducing accommodative convergence. In some cases, a negative distance addition can be used to correct the distance deviation and bifocals may be



necessary to prevent excess accommodative convergence at near (Percival 1928). A negative distance addition is not usually a long-term solution but serves to keep the eyes straight while the convergent fusional reserves are being built up.

Where there is a low degree of hypermetropia, a correction does not seem to assist unless it is required to equalize the acuities. Sunglasses or tinted prescription lenses sometimes assist compensation (Eustace et al 1973).

Eye exercises

With teenage patients, eye exercises can be helpful for divergence excess. The incentive of the patient may not be very high, as there are often no marked symptoms, but where there is a reasonable level of cooperation then exercises may be the most appropriate form of management. Exercises are less likely to work in cases where there is a vertical deviation, high AC/A ratio or large angle (Daum 1984).

Where eye exercises are given, the same three aims given above for basic exophoria are equally appropriate to divergence excess: treat the suppression; develop the convergent fusional reserves and/or negative relative accommodation; and develop a correct appreciation of physiological diplopia. These aims may be achieved by some of the exercises described in Chapter 10. They may be taken in the above order, or an exercise may be used that incorporates more than one aim. For example, physiological diplopia can be used in such a way that it develops convergence and relative accommodation, and at the same time it will, by its nature, help in checking suppression. This type of exercise has been found particularly useful in divergence excess.

Relieving prisms

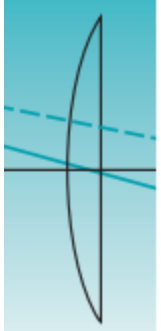
These are seldom satisfactory in divergence excess, as they disturb near vision.

Referral

Surgery may be considered in cases of simulated divergence excess as the patient gets older, particularly if an exo-deviation occurs at all distances of fixation.

Convergence insufficiency

Convergence is essential to binocular vision at near and therefore any inadequacy is of great clinical importance. Convergence insufficiency has been recognized as a fairly common condition since it was described by von Graefe (1862). It may be defined as an inability to obtain or to maintain sufficient convergence for comfortable binocular vision at near. The condition can be conceptualized as a permanently decompensated exophoria at an unusually close working distance, which can result in a transient decompensation at the normal working distance when the patient is tired or binocular vision is under stress.



Some confusion arises owing to differences in nomenclature (Evans 2001b), and this was discussed earlier in this chapter.

Aetiology

(1) *Disuse of accommodative convergence* can be a cause of convergence insufficiency. Uncorrected myopes, presbyopes wearing their reading glasses and absolute hypermetropes may all make reduced accommodative effort, which can result in insufficient convergence because of the accommodation/convergence relationship.

(2) *Accommodative insufficiency.* Approximately half of cases with accommodative insufficiency also have convergence insufficiency (Francis et al 1979). It is not always clear whether the accommodative or convergence anomaly is the primary dysfunction.

(3) *Prolonged use of computer displays* can cause the near points of convergence and of accommodation to become more remote (Gur et al 1994). Presumably, this might cause a borderline convergence insufficiency to become symptomatic.

(4) *Anatomical factors* such as a large pupillary distance or a divergent position of anatomical rest may contribute.

(5) *Developmental (or phylogenetic) factors* may also play a part. Convergence is said to be the most recently developed aspect of binocular vision and may most readily break down under stress.

(6) *Strabismus* can be a contributory cause. It has long been recognized that divergent strabismus in early life can be a factor (Duane 1897) but a survey showed that, in strabismic patients, convergence insufficiency was present in both convergent and divergent deviations in about the same proportions as the general prevalence of convergent to divergent strabismus overall (Pickwell & Hampshire 1981b).

(7) *Disuse of an eye* for any length of time (e.g. from amblyopia or a blurred image) can also induce convergence insufficiency.

(8) *Hyperphoria or cyclophoria* may cause convergence insufficiency. The cyclovertical heterophoria may be comitant in some cases or it may be found to be incomitant and break down into a strabismus in some directions of gaze or under adverse visual conditions. In the latter case, surgery is suggested before treatment of the convergence inadequacy (Lyle & Wybar 1967).

(9) *General debility and pathology.* Poor general health has been shown to be a factor (Pickwell & Hampshire 1984). Independent of health, there is a greater prevalence with age (Pickwell 1985), and in urban populations compared to rural (Pickwell et al 1986). Metabolic disorders, toxic conditions and local infections or endocrine disorders are important factors. For example, convergence weakness can accompany thyrotoxicosis as an early sign (Moebius's sign). In very rare cases, convergence insufficiency can be associated with pineal gland tumours (Ainsworth 1999) and combined convergence and accommodative palsy can result from lesions in the superior colliculus (Ohtsuka et al 2002).

The effect of any medication that the patient is taking should also be considered (Thomson & Lawrenson 2006).

(10) *Paralysis of convergence* can also rarely occur in conditions affecting the brain stem, in disseminated sclerosis, tabes dorsalis and some traumatic conditions. In these cases, there is a sudden onset of diplopia for near vision and usually other signs and symptoms of the primary condition. Convergence paralysis may be associated with reduced accommodation (Bishop 2001).

Classification: primary and secondary convergence insufficiency

Some authors differentiate between primary convergence insufficiency, resulting from a primary deficit of convergence, and secondary convergence insufficiency, where the poor convergence results from some other anomaly, such as intermittent exotropia, heterophoria, neurological disease, and mechanical and paralytic strabismus (Ansons & Davis 2001, p 319). Some authors classify convergence insufficiency that is associated with monocularly decreased amplitudes of accommodation as primary (Ansons & Davis 2001, p 319) and others as secondary (Bishop 2001) convergence insufficiency.

Investigation

In the investigation of convergence insufficiency, particular attention should be paid to the following points.

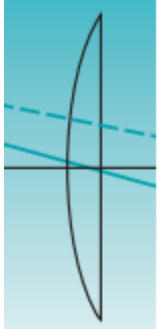
Symptoms

Symptoms are typically associated with near vision and consist of tired or sore eyes, intermittent blurring and double vision, and headache. The headache is often said to be frontal (Bishop 2001). Sometimes patients will report that the symptoms are relieved if one eye is closed or covered. The symptoms are worse if the patient is suffering from tiredness, ill-health, overwork, anxiety, etc., as they are with other heterophoric conditions.

Convergence tests

Two clinical tests are of particular value and are simple and brief enough to include in a standard routine examination. The methods of application of these tests are described in Chapter 2.

Near point of convergence The near point of convergence should normally be less than 8 cm from the eyes. It should be observed by the practitioner as the distance at which one eye ceases to converge, and also the point at which the patient reports a doubling of the target as it approaches the eyes. In some cases, no doubling is reported but the limit of convergence can be seen objectively. This will indicate suppression, which may be the first sign of possible difficulty. Patients whose near point of convergence is between 8 and 20 cm may have convergence difficulties. Such patients need to be assessed when any anomaly of jump convergence is



known and normal near visual working distance has been taken into account.

Jump convergence The patient is asked to look at a distance object and then to change fixation to one held at about 15 cm from the eyes and on the median line (Pickwell & Stephens 1975). The eyes are observed to see if the change of convergence is performed satisfactorily. Normally, a prompt and smooth convergence movement from distance fixation to near is seen. There are four types of abnormal response that may be observed:

(1) Overconvergence, which may be followed by a corrective movement; this is not significant in the context of convergence insufficiency
(2) Versional movement: both eyes move an equal amount to allow the motor dominant eye to take up fixation; the non-motor-dominant eye then converges to restore binocular fixation
(3) Slow or hesitant movement
(4) No movement of either eye or of only one eye.

The last three of these responses indicate a failure of normal convergence and it is likely that there will be trouble in maintaining convergence for near vision. Clearly, all clinical tests need to be completed in a short time but what is important to the patient is whether symptoms will arise during longer periods of reading and close work. If the patient has a near point of convergence of 8–15 cm and the jump convergence is normal, it is unlikely that there will be symptoms. Failure on the jump convergence test occurs more often than a poor near point, and appears to be associated with symptoms more frequently (Pickwell & Hampshire 1981a). Some patients can perform well on the near point test by exercising an unusual amount of effort but cannot maintain this degree of convergence for sustained near vision.

Heterophoria tests for near vision

These tests usually show compensated exophoria. In about one-third of the patients with convergence insufficiency there is decompensated exophoria for near vision (Pickwell & Hampshire 1981a). This is more likely to occur in the very elderly patient. Fixation disparity tests for near vision show suppression of one of the monocular markers in about one-fifth of the convergence insufficiency cases. In the absence of a strabismus, this suppression for near vision can be taken as a possible indication of the presence of convergence inadequacy.

It can also be useful to carry out tests of compensation, particularly the Mallett fixation disparity test, at an unusually close working distance. Reading at 20 cm usually results in an increased exo-slip (Pickwell et al 1987a) and this effect is likely to be greater in convergence insufficiency.

Tests of accommodation

The amplitude of accommodation will be found to be low in some patients with convergence insufficiency. Indeed, it has been suggested that the

symptoms of convergence insufficiency are attributable to accommodative insufficiency (Marran et al 2006). These cases of combined convergence and accommodation insufficiency are distinguished from ophthalmoplegia (Ch. 17), as the latter condition has a sudden onset of symptoms. The effect of any medication that the patient is taking should also be considered (Thomson & Lawrenson 2006). Convergence insufficiency with accommodation insufficiency usually starts to give trouble in the teenage years, and sometimes improves after several years. The AC/A ratio is very low in these cases.

A useful objective measure of accommodative function is accommodative lag which can be assessed by MEM retinoscopy (p 31). Some patients with convergence insufficiency maximize their accommodation to induce accommodative convergence in order to augment their poor convergence (Jennings 2001a). These patients will have an accommodative lag that is lower (less plus) than the usual +0.50 D.

Management

Treatment of convergence insufficiency is usually by eye exercises and is nearly always successful, even with older patients. The management is considered under the five general headings given in Chapter 6 on the basic principles of management. Many cases of convergence insufficiency are associated with accommodative insufficiency and these cases are considered separately towards the end of this section.

Removal of cause of decompensation

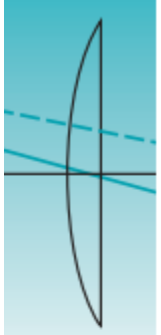
The factors that create decompensation of heterophoria may also aggravate convergence insufficiency so that thought should be given to the working conditions, to the general health and to the general wellbeing of the patient.

Refractive correction

A refractive correction should be given where necessary. Patients with previously uncorrected myopia may find that correction of the myopia relieves the convergence insufficiency. Very rarely, a negative add can be useful to induce accommodative convergence.

Eye exercises

Convergence insufficiency can be successfully treated by eye exercises in about three-quarters of cases (Grisham 1988). 'Pencil-to-nose' type exercises are commonly given and prove quite successful for convergence insufficiency. Some practitioners prefer 'jump' convergence exercises in which the patient alternates their fixation between distance and near targets (Case study 8.2). Slightly more sophisticated exercises that include an appreciation of physiological diplopia can be very successful if properly understood by the patient. All these types of exercise are discussed in more detail in Chapter 10.



CASE STUDY 8.2 Ref. F6714

BACKGROUND: 10-year-old boy, first eye examination.

SYMPTOMS: Near vision blurs and occasionally appears to change size. Rare horizontal diplopia when reading: after a blink text returns to single. Sore and tired eyes when reading and headaches, but details of headaches vague.

CLINICAL FINDINGS: *Normal:* ocular health, visual acuities, refractive error (low long-sightedness). *Amplitude of accommodation:* slightly low (R = L = 8.0 D), accommodative lag R = L = 0.75 D, accommodative facility (±2.00 D) 7 cpm. Orthophoric at distance with small exophoria at reading distance, adequate fusional reserves, no aligning prism on D or N Mallett units. Ocular motility, foveal suppression test and stereoacuity all normal. Push-up near point of convergence breaks at 14 cm, recovery at 17 cm.

MANAGEMENT: Given eye exercises to train 'jump' convergence (and accommodation) between distance and near accommodative targets while trying to bring the near target in closer, with parent watching eyes to ensure correct convergence.

FOLLOW-UP 3 WEEKS LATER: Exercises found to be 'fairly easy', can now converge to nose. Symptoms greatly improved: only one headache since last appointment. Clinical findings similar to before, except amplitude of accommodation improved (R = L = 11 D), near point of convergence break 7 cm, recovery 8 cm. Exercises stopped.

FOLLOW-UP 6 MONTHS LATER: Improvement in signs and symptoms sustained.

Patients will usually be able to teach themselves to develop a near point of convergence of less than 8 cm and to perform the jump convergence test quite quickly, usually in several weeks. Some authors argue that the exercise should be continued for 2 weeks after this or else the convergence insufficiency may recur. However, this is certainly not always the case (Case study 8.2). Regardless of the approach, with some patients it may be necessary to repeat the exercises at intervals of a few months to maintain adequate convergence. If the convergence insufficiency does recur after a few months, more thought should be given to the possibility of aggravating factors such as poor general health, inadequate lighting, etc.

It is sometimes stated that voluntary convergence should be trained as the final stage of the treatment of convergence insufficiency (Bishop 2001). One approach is for the patient to try to maintain convergence at their near point of convergence once the near fixation target has been removed. Free-space stereogram exercises usually involve an element of training voluntary convergence, when the patient reaches a stage when a pencil is not needed for fixation (Ch. 10).

In fact, any of the exercises that can be used to train convergent fusional reserves (Ch. 10) can be used to treat convergence insufficiency and Bishop (2001) recommended that convergent fusional reserve exercises should be

part of the treatment plan for convergence insufficiency. A recent study indicates that an intensive programme of exercises is much more likely to be effective than simple pencil push-ups (Scheiman et al 2005a). The Institute Free-space Stereograms (p 156) have been used to successfully treat convergence insufficiency (Evans 2000a).

Relieving prisms

These are not usually appropriate to convergence insufficiency, except when it is combined with accommodative insufficiency, as described below.

Combined convergence and accommodative insufficiency

When convergence insufficiency is combined with accommodative insufficiency in teenage patients, it is sometimes necessary to give a reading addition. The power is decided on the basis of allowing the patient to use about two-thirds of the amplitude of accommodation for the normal near working distances, the rest being made up by the reading addition. Base-in prism may also help in these particular cases, sometimes combined with the near correction (Francis et al 1979). The prism power can be determined by giving the weakest prism that will allow the patient to show prompt and smooth convergence on the jump convergence test, or to eliminate any fixation disparity at the appropriate distance. These reading glasses relieve the symptoms in convergence and accommodative insufficiency and are usually discarded by the patient when the condition becomes less problematic, within 2–3 years.

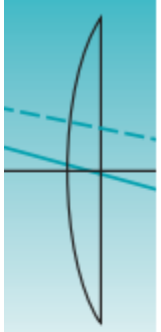
Convergence exercises are sometimes effective at treating a combined convergence and accommodative insufficiency (Francis et al 1979). A non-placebo-controlled trial found that treatment (plus lenses and exercises) for combined accommodative and convergence insufficiency could improve symptoms but did not influence objective measurements (Mazow et al 1989). Von Noorden (cited in Mazow et al 1989) claimed that eye exercises are unlikely to be effective if convergence insufficiency is associated with accommodative insufficiency but are effective in other cases of convergence insufficiency.

Referral

Usually, convergence insufficiency is treated by eye exercises and does not require referral. Where primary spasm of convergence is suspected, or where it is combined with the signs of a pathological cause, the patient will require medical investigation. For example, convergence insufficiency will require referral where it appears with other indications of thyroid problems: Moebius's sign (see Ch. 17 for thyroid eye disease).

Concluding remarks on patient selection for management options

For most of the cases of decompensated exophoria that optometrists encounter all that is required is to choose between spectacles (with a 'negative



add') or exercises. It is best for practitioners not to be too dogmatic about their own personal treatment preferences but rather to reach a joint decision with the patient and, if young, with their parents. It should be explained to the parent and child exactly what commitment is required for eye exercises and to explore how much the patient would dislike wearing glasses. If the parent/child team have made a voluntary commitment to exercises then they are far more likely to do them than if they have been persuaded by the practitioner. If they choose glasses then they are told that they can always come back for exercises at any time.

It is important that patients with a refractive modification to treat a heterophoria fully understand that their glasses are not for a refractive error but are to improve their binocular coordination. If the patient moves to another practitioner then they may need to explain to this practitioner why the spectacle prescription differs from their refractive error. A useful phrase to describe these glasses is 'exercise glasses', which further reinforces the notion that the goal is to reduce the overcorrection with time. The copy of the optical prescription that is given to the patient can also be annotated to this effect.

Clinical Key Points

- Exophoric conditions can be classified as convergence weakness, divergence excess, basic (mixed) and convergence insufficiency
- The effect of correcting the refractive error should be investigated, particularly with uncorrected myopia or astigmatism
- Eye exercises are usually an effective treatment, particularly for convergence weakness and convergence insufficiency
- Refractive modification (negative adds) or base-in prism can be effective treatments in some cases