Non-paralytic squint

Binocular single vision

In the absence of a squint (*strabismus*), both eyes are directed towards the same object of regard. Their movements are coordinated so that the retinal images of an object fall on corresponding points of each retina. These images are fused centrally, so that they are interpreted by the brain as a single image. This is termed *binocular single vision* (Figure 15.4). Because each eye views an object from a different angle, the retinal images do not fall precisely on corresponding points of each retina. This disparity permits a three-dimensional percept to be constructed. This is termed *stereopsis*. The development of stereopsis requires that eye movements and visual alignment are coordinated over approximately the first 5 years of life.
Figure 15.2  Right non-paralytic divergent squint. (a) The right eye is divergent in the primary position of gaze (looking straight ahead). (b) When the eyes look to the left the angle of deviation between the visual axis (a line passing through the point of fixation and the foveola) of the two eyes is unchanged.

Figure 15.3  Left sixth nerve palsy with paralysis of the left lateral rectus (paralytic squint). (a) The eyes are looking to the right, the visual axes are aligned, there is no deviation between the visual axes of the two eyes. (b) The eyes look to the left (the field of action of the left lateral rectus). The left lateral rectus is paralysed and thus the left eye is unable to move past the midline. Now there is a marked angle of deviation between the visual axes of the two eyes.
Binocular single vision and stereopsis afford certain advantages to the individual:

- They increase the field of vision.
- They eliminate the blind spot, since the blind spot of one eye falls in the seeing field of the other.
- They provide a binocular acuity, which is greater than monocular acuity.
- Stereopsis provides depth perception and estimation of distance.

If the visual axes of the two eyes are not aligned, binocular single vision is not possible. This results in:

- **Diplopia.** An object is seen to be in two different places.
- **Visual confusion.** Two separate and different objects appear to be at the same point.

In children, a non-alignment of the visual axes of the two eyes (or squint) results in suppression of the image in the squinting eye. This means that when the vision in the two eyes is tested together only one object is seen and there is no diplopia. If this is prolonged and constant during the sensitive period of visual development (the first 5 years) it causes a reduced visual acuity in the squinting eye (*strabismic amblyopia*). Amblyopia will only develop if the squint constantly affects the same eye. Some children alternate the squinting eye and do not develop amblyopia, since a focused image always falls on one or other retina. However, they do not develop stereopsis.

### Aetiology of non-paralytic squint

Non-paralytic squint:

1. May develop in an otherwise normal child with normal eyes. The cause of the problem in these patients remains obscure. It is thought to be caused by an abnormality in the central coordination of eye movements.
2. May be associated with refractive error or ocular disease:
a A refractive error which prevents the formation of a clear image on the retina. This is the most common factor. If the refractive error is dissimilar in the two eyes (anisometropia) one retinal image will be blurred.
b In a child with an equal degree of long sight (hypermetropia) in both eyes a convergent squint may develop because of the increased accommodative effort required to focus on both distant, and particularly near, objects. The link (synkinesis) between the accommodative and convergence mechanisms leads to an excessive convergence and ultimately to a convergent squint of one eye. Where the squint only occurs on attempted focusing on near objects (an accommodative squint), amblyopia does not develop since binocular visual alignment remains normal for part of the time, during distant viewing.
c Opacities in the media of the eye blurring or preventing the formation of the retinal image (i.e. corneal opacities or cataract).
d Abnormalities of the retina. Although a correctly formed image is formed, inadequate information is transmitted to the visual cortex.

History

The presence of a squint in a child may be noted by the parents or detected at preschool or school screening clinics. It may be intermittent or constant. There may be a family history of squint or refractive error. The following should be noted:

- When the squint is present – i.e. is it constant?
- How long a squint has been present.
- Past medical, birth and family history of the child.

Examination

First the patient is observed for features that may simulate a squint. These include:

- epicanthus (a crescentic fold of skin on the side of the nose that incompletely covers the inner canthus) (Figure 15.5). This simulates convergent squint.
- facial asymmetry.

Then the alignment of the two eyes is tested, using a pen torch. The corneal reflection of a torch light, held 33 cm in front of the subject, is a guide to eye position. If the child is squinting the reflection will be central in the fixating eye and deviated in the squinting eye (Figure 15.6).

A cover/uncover test (Figure 15.7) is next performed to detect a manifest squint (a tropia):

- The right eye is completely covered for a few seconds whilst holding a detailed near target, such as a toy, in front of the child as a fixation target. The left eye is closely observed. If it has been maintaining fixation it should not move. If it moves outwards to take up fixation an esotropia or convergent squint is
The principle of surgery is to realign the eyes by adjusting the position of the muscles on the globe or by shortening the muscle. Access to the muscles is gained by making a small incision in the conjunctiva.

- Moving the muscle’s insertion backwards on the globe (recession) weakens its action.
- Removing a segment of the muscle at its insertion (resection) strengthens its action.

**Prognosis**

Glasses and patching can significantly improve vision in the squinting eye. Unfortunately realignment, even if performed when the child is very young, is rarely associated with the development of stereopsis in the majority of non-paralytic squints. The operation is important from the cosmetic viewpoint, however, particularly when the child starts school.

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**Paralytic squint**

**Isolated nerve palsy**

**Pathogenesis**

Disease of the third, fourth and sixth nerves and their central connections gives rise to a paralytic strabismus (Figure 15.9). Each nerve may be affected at any point along its course from brainstem nucleus to orbit. Table 15.1 details some causes.

**History and examination**

The patient complains of diplopia. There may be an abnormal head posture to compensate for the inability of the eye to move in a particular direction.

- A sixth nerve palsy results in failure of abduction of the eye.
- A fourth nerve palsy results in defective depression of the eye when attempted in adduction. It produces the least noticeable eye-movement abnormality. Patients may notice vertical double vision with some torsion of the image, particularly when going downstairs or reading.
- A third nerve palsy results in:
  - failure of adduction, elevation and depression of the eye;
  - ptosis;
  - in some cases, a dilated pupil due to involvement of the autonomic fibres.

**Treatment**

An isolated nerve palsy is often related to coexistent systemic disease. If a posterior communicating aneurysm is suspected the patient must be sent for
Figure 15.9 (a) Left third nerve palsy: note the dilated pupil and ptosis as well as the limitation of eye movement. (b) Left fourth nerve palsy: the defect is maximal when the patient tries to look down when the left eye is adducted. (c) Sixth nerve palsy: the left eye is unable to abduct.
Table 15.1 The causes of isolated nerve palsies.

<table>
<thead>
<tr>
<th>Category</th>
<th>Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orbital disease</td>
<td>e.g. neoplasia</td>
</tr>
<tr>
<td>Vascular disease</td>
<td>Diabetes (a ‘pupil sparing’ third nerve palsy, i.e. there is ptosis and extraocular muscle palsy but no mydriasis)</td>
</tr>
<tr>
<td></td>
<td>Hypertension</td>
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<tr>
<td></td>
<td>Aneurysm (most commonly a painful third nerve palsy from an aneurysm of the posterior communicating artery. Mydriasis is usually present)</td>
</tr>
<tr>
<td></td>
<td>Carotidocavernous sinus fistula (also causes myogenic palsy)</td>
</tr>
<tr>
<td></td>
<td>Cavernous sinus thrombosis</td>
</tr>
<tr>
<td>Trauma</td>
<td>Most common cause of fourth and sixth nerve palsy</td>
</tr>
<tr>
<td>Neoplasia</td>
<td>Meningioma</td>
</tr>
<tr>
<td></td>
<td>Acoustic neuroma</td>
</tr>
<tr>
<td></td>
<td>Glioma</td>
</tr>
<tr>
<td>Raised intracranial pressure</td>
<td>May cause a third or sixth nerve palsy (a false localizing sign)</td>
</tr>
<tr>
<td>Inflammation</td>
<td>Sarcoidosis</td>
</tr>
<tr>
<td></td>
<td>Vasculitic (i.e. giant cell arteritis)</td>
</tr>
<tr>
<td></td>
<td>Infection (particularly herpes zoster)</td>
</tr>
<tr>
<td></td>
<td>Guillain–Barré syndrome</td>
</tr>
</tbody>
</table>
neurosurgical review and angiography. The most common cause of a palsy is microvascular disease of a peripheral cranial nerve, itself associated with diabetes or hypertension. Here, nerve function recovers over some months and the symptoms abate.

Orbital disease (see Chapter 4) and disease in the cavernous sinus may also be the cause of multiple nerve palsies such as the third, fourth and sixth nerves, because they are anatomically close together. A CT or MRI scan will show the lesion (e.g. an orbital metastasis).

Diplopia can be helped by fitting prisms to the patient’s glasses, which realign the retinal images. Alternatively the affected eye can be patched. If eye movements fail to improve spontaneously then surgical intervention may be required. Such intervention will seldom restore normal full eye movement but is aimed at restoring an acceptable field of binocular single vision in the primary positions of gaze (i.e. straight ahead and in downgaze), the commonest positions in which the eyes are used.

Disease of the extraocular muscles

Dysthyroid eye disease

Pathogenesis

Disorders of the thyroid gland can be associated with an infiltration of the extraocular muscles with lymphocytes and the deposition of glycosaminoglycans in the tissues, leading to proptosis, exposure of the globes and limitation of eye movements. The condition occurs particularly in hyperthyroidism but also in hypothyroidism. An immunological process is suspected but not fully determined.

Symptoms and signs

The patient may sometimes complain of:

• a red painful eye (associated with exposure caused by proptosis) – if the redness is limited to part of the eye only it may indicate active inflammation in the adjacent muscle;
• double vision;
• reduced visual acuity (sometimes associated with optic neuropathy).

On examination (Figure 15.10a):

• There may be proptosis of the eye (the eye protrudes from the orbit, also termed exophthalmos).
• The conjunctiva may be chemosed and the eye injected over the muscle insertions.
• The upper lid may be retracted so that sclera is visible (due in part to increased sympathetic activity stimulating the sympathetically innervated smooth muscle of levator). This results in a characteristic stare.