Routine eye examination

Part 3 - Binocular assessment

In the third part of our series on the eye examination, Andrew Franklin and Bill Harvey look at the assessment and interpretation of binocular status. Module C8290, one general CET point, suitable for optometrists and DOs

The assessment of binocular function is often one of the weaker areas of a routine, if observation of candidates in the professional qualifications examination is any guide. Tests are done for no clearly logical reason, often because they always have been, and in an order which defeats the object of the testing. Binocular vision seems to be one of those areas that practitioners shy away from, and students often take an instant dislike to. Many retests and subsequent remakes of spectacles are the result of a practitioner overlooking the effects of a change of prescription on the binocular status of the patient.

It would be useful to define what it is we are trying to determine:
● Does the patient have a squint or a phoria?
● If they have a phoria, is it compensated?
● If they have a binocular problem, is it going to need referral or management?

Tests of motor function can be divided into ‘binocular’ tests which maintain fusion (for example, fixation disparity) and those which dissociate the eyes (such as cover test and the Maddox rod). As a general principle, binocular tests should always precede dissociation tests. In practice, this is often reversed and frequently patients are tested for fixation disparity having been thoroughly dissociated before, and in some cases, during the test. The odd false positive might be expected in these cases.

Fixation disparity

Method

The fixation disparity test is often performed in such a way as to render it worthless. Even the wording of the instructions and questions to the patient can affect the chances of finding a fixation disparity, particularly in children and the more literal minded adult. This test should ideally precede any dissociation test.

Binocular vision should be stabilised, by reading a line of letters or words before the assessment of fixation disparity. This is particularly important if the patient has been dissociated recently, as they always will be during an examination. Taking monocular acuities, retinoscopy, ophthalmoscopy and so on will all disrupt the binocular status. It should be remembered that the polarised visor used significantly reduces light levels and illumination should be adjusted accordingly.

Before applying the visor, the patient should be asked: ‘Are the two red (green) lines exactly in line with each other or are they out of line?’ It is surprising how often a patient will report displacement of the lines even without the visor. Are they trustworthy observers? Do you want to prescribe on their subjective response?

Having established that the patient is not likely to lead you astray, repeat the previous question. Leading questions should be avoided, especially when dealing with children. If they are out of line ask the patient ‘Which one is out of line with the X?’

You should know before you start the test which line is seen by which eye. If you cannot remember it from last time, simply look at the target through the visor yourself (Figure 1). Even if you think you can remember, check anyway, as it is possible for the polarisation of the visor not to match that of the Mallet Unit at distance or near or both, especially if the visor is a replacement. If both eyes can see both bars, nobody will have a fixation disparity. Under no circumstances cover one of the patient’s eyes and ask ‘Which line can you see now?’ This is dissociation.

Following this, ask ‘Is it to the left or to the right?’ or ‘Is it towards me or away from me?’ With children, the latter question may be more sensible, as they tend to confuse their lefts and rights on occasion.

The minimum prism (to the nearest ½∆) or alteration in the spherical element of the Rx which aligns the polarised lines should be noted.

When assessing fixation disparity for near, don’t be restricted to one target position. Many patients read or look at computer screens in a variety of positions. Many patients have ‘A’ and ‘V’ patterns and it doesn’t take long to check if the patient is still compensated when the eyes are elevated or depressed.

Until you have done a cover test, you won’t necessarily know what the fixation disparity findings mean. No slip found on a patient with a phoria would indicate that the phoria is compensated, at least for the moment, but the same finding on a strabismic subject would indicate harmonious anomalous retinal correspondence. Small degrees of slip usually point towards an uncompensated phoria, especially if there are symptoms, but a larger slip may be associated with microtropia.

Sometimes the slip seems to vary at random, and the markers may oscillate.
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across the neutral point. This is indicative of binocular instability. The condition is associated with uncompensated heterophoria and the fusional reserves tend to be low. In general, if you keep adding small amounts of prism or sphere the slip will stabilise.

**Cover test**
The cover test is essential, being the only way to tell squints and phorias apart. It can also be used to estimate or measure the direction and size of the deviation and to indicate whether a phoria is compensated or not.

There is a certain amount of confusion about the cover test, partly arising because it tends to be taught in a module labelled ‘binocular vision’ and often based on orthoptic practice rather than the needs of a routine eye examination. While there is considerable overlap, the two have different goals and requirements. In a routine eye examination we are screening a normal population for those individuals whose motor or sensory status requires intervention. In the hospital eye service, there is a greater need to classify and quantify so that the effects of treatment may be recorded. As this is an article about routine eye examination, the approach will be biased towards that.

**Target**
The target should be accommodative (small enough for the hypermetrope to employ enough accommodation to overcome their ametropia and hence reveal any eso-movement), so use a letter slightly larger than the acuity of the worst eye. If the target is too small, the maintenance of accurate fixation is difficult. The patient may narrow the palpebral fissure to see better, making observation of the eyes difficult. Occasionally ciliary spasm might be triggered.

If the acuity of the worst eye is below 6/18, a spotlight may be used. Note that this is a non-accommodative target. The reason for using it is that the angular subtense of letters larger than 6/18 is large enough to significantly distort the results, particularly when looking at small vertical elements. However, many practitioners find there is still more eso-deviation when a letter target is used. If in doubt, use both.

The position of the target is important, particularly at near. The cover test should be performed with fixation at a distance and position which is relevant to the patient and their habitual visual environment. There is occasionally a tendency to perform the near cover test with the eyes level, in the same position that they were in when fixating a distant target. This is fine if you want to compare distance and near deviations while removing any variability that an A or V pattern would induce. In other words, if you are trying to classify the deviation accurately. However, we are generally trying to find out what is happening while the patient goes about their daily business.

When performing the near cover test, it is a good idea to quickly check if there are any significant variations with elevation and depression of gaze.

Multiple positions of fixation may be useful to investigate incomitancy.

When examining myopic patients without their spectacles it should be remembered that unaided distance vision below 6/60 does not mean that a non-accommodative target should be used at near. Many myopes habitually read without spectacles at a non-standard distance, and most will be able to fixate an accommodative target for the near cover test. This applies to myopic presbyopes too.

**Occluder**
The occluder may be opaque or translucent. Opaque occluders should be wide enough to allow them to be angled so as to allow observation of the eye under the cover, while maintaining proper dissociation (Figure 2a). The latter allows us to observe eye movements behind the cover (Figure 2b) and is particularly helpful when trying to see dissociated vertical deviations.

The use of fingers, thumbs, hands and so on should be avoided as adequate dissociation may not be achieved. A translucent or white occluder is an asset, causing fewer pupil reactions which can be distracting when looking at small deviations.
Occluders should ideally have no sharp corners. In most respects other than this a frame rule makes a good occluder, but there is an outside chance of catching a lively patient in the eye.

**Technique**

The cover should be held over the eye for five seconds, which is rather longer than initially feels right. Less may result in incomplete dissociation and an under-estimation of the deviation. It should be remembered that repeated testing may increase the deviation through fatigue. The cover should be held close to the eye or dissociation may be incomplete.

Cover the right eye and observe the left. If it moves to take up fixation there is a squint. If it doesn’t move there is either no squint or a microtropia with identity. Uncover the right eye, still watching the left. If it moves now, two things are possible. If it moved to take up fixation when you covered the right eye, it is a squint and it is now moving back into its customary position. If there was no movement of the left eye when you covered the right, you are seeing a ‘Hering movement’ and the patient has central suppression in the left eye.

If no movement is seen in the left eye, cover the right eye again but watch the right eye under the cover this time. If it moves out, the patient has an exophoria. If it moves in, they have an esophoria. If it goes down, they have a hypophoria. Should it go up, they may have a hyperphoria or a dissociated vertical deviation, or both. If it is a right hyperphoria the left eye will move down when it is uncovered, and back up again when it is uncovered. Uncover the right eye, and watch it. It should be seen to move back to fixation. If it doesn’t, the patient may have dissociated and broken down to a squint. Repeat the above, covering the left eye.

The subjective alternate cover ('phi') test is a different matter. This can detect deviations that are too small to be seen by the practitioner (typically less than 1Δ). One of the recurrent myths in optometry is the one that says that deviations below 4Δ cannot be detected by the human eye.

This is nonsense, and the easiest way to prove this is to observe a subject successively fixating test chart letters of known separation. These are rarely of much significance if horizontal, but small vertical deviations are surprisingly common and may be a pointer towards incomitancy.

To do this, alternate the cover between the two eyes, and ask the patient if the target is moving at all. If it is, determine whether it moves in the same direction as the cover, which indicates exophoria, or in the opposite direction, as it would with an esophoric patient. If there is a vertical movement, it is time to use the Maddox rod.

**Measurement**

This may be achieved with loose prisms or a prism bar, but this is rarely necessary in routine examination. Estimation is accurate enough with practice unless surgery is contemplated (unlikely in routine practice). To practise, a tangent streak or arrow is pointing to immediate fixation, or a prism bar, but this is rarely necessary in routine examination. Estimation is accurate enough with practice unless surgery is contemplated (unlikely in routine practice). To practise, a tangent streak or arrow is pointing to immediate fixation, or a prism bar. This may be used to measure the deviation of either with symptoms as bad. As the cover test is always done it is questionable whether this test yields any essential information most of the time.

The target is set at 30cm, which is too short for anyone over 5 foot tall, and the scale is a poor accommodative target.

‘Flash’ Maddox test

This is basically a cover test which uses the tangent scales of the Maddox rod or wing to measure the deviation, as an alternative to prism measurement. The eye fixating the streak, or the arrow of the wing test, is covered. The patient is instructed to tell you which number the streak or arrow is pointing to immedi-
ally after you remove the cover. This is probably the most useful way to use Maddox tests and it has been used in research.

**Convergence**
The RAF rule is the usual tool, but any thin vertical line will do, as will a single letter on a budgie stick. The end of the instrument nearest to the eyes should be supported by the patient to ensure that it cannot slip and catch the eye. Care should be taken that the rule is angled slightly downwards rather than perpendicular to the face or higher as the eyes usually look slightly down when converging, and most patients find convergence easier with some depression of the eyes (Figure 3). However, there are exceptions to both of these statements. Computer operators may need to converge with their eyes level or elevated, and those with A patterns may be happier in this position. The target is moved slowly towards the patient and the patient is asked to report when the target goes double (normally 8-10cms). The target is then withdrawn until recovery occurs (10-15cms). The near point is often more remote in tall patients or those with long working distances. This test activates both voluntary and reflex convergence.

The practitioner should watch the eyes, rather than relying on the patient to report diplopia. Sometimes convergence breaks but the patient does not report diplopia. This may simply be down to wandering attention, but it could also indicate suppression. The eye doesn’t necessarily always deviate outwards. Patients with exophoria and a high AC/A ration will over-converge. The near point of convergence should be recorded in centimetres, along with which eye deviated and in which direction. If the patient does not report diplopia when dissociated, this should also be noted.

**Jump convergence**
Jump convergence is useful, especially in those who need to change fixation frequently. The patient is asked to fixate in turn on distant and near targets and to report any diplopia. Voluntary convergence is almost exclusively activated by this test.

**Accommodation**
This will be discussed in a later article on near corrections, though it is frequently investigated along with near point of convergence.

**Motility**
**Target**
The ideal target is a pen-torch, used unfocused, and preferably not too bright, held as demonstrated in Figure 4. Too bright a torch may cause spontaneous dissociation, especially in exophores, and avoidable discomfort.

Paradoxically, cheaper pen-torches obtainable from market traders are often the best, and they are cheap enough to be lost without pain. The pen-torch
allows us to see a reflex on the cornea which may help to decide if both eyes are fixating the target. This is particularly useful when the visual axis of one of the eyes is intercepted by the patient’s nose. Under such circumstances we are effectively performing a cover test and the patient’s phoria will be expressed. Unless we know that one of the eyes cannot see the target, it is possible that we might misinterpret the deviation as being due to an incomitancy, rather than the relationship between accommodation and convergence.

Some practitioners, however, do seem to carry this to extremes, turning off the main room lights in order to see the reflex better. It’s true you can see the reflex very well, but little else is discernible. Keep the lights on, you are less likely to miss something important.

Method
Instruct the patient to follow the target and report any diplopia or pain. The practitioner should rely on observation of the patient’s eyes rather than patient reports, as the patient might be suppressing. The pattern used is of little consequence provided that it is methodical.

A ‘star’ pattern is typically used (Figure 5) but the ‘H’ pattern or its variants are equally effective. Move the target slowly or you will not be able to interpret the movement of the eyes.

If you think there might be an incomitancy present but it isn’t an obvious one, base your diagnosis on the cover test in different positions of gaze rather than simple observation of the moving eyes.

All eight diagnostic positions of gaze should be investigated, the straight up and down positions being used to look for A and V syndromes rather than any specific muscle anomaly.

The eyelids should also be observed as a narrowing of the palpebral fissure may indicate the presence of Duane’s syndrome. Voluntary movements (as opposed to the pursuit movements used in motility) may be checked during orthophthalmoscopy. It is possible for one to be normal and the other not.

Stereoscopic acuity
This is an indication of binocularity. Where visual acuities are good and equal, stereoscopic acuity should be good, even in pre-school children (although with these patients it may be more difficult to demonstrate). Poor stereoscopic acuity in patients with good visual acuity is indicative of poorly compensated ocular motor balance. Useful tests include:

Titmus (Wirt) (Figure 6)
This is supposed to be performed at 40cms but the actual testing distance depends on the length of the patient’s arms. The patient wears polarising spectacles. It can measure stereoscopic acuity up to 40 seconds of arc. It also features grosser tests for children (The animals go down to 100 seconds) but many quite young children can be tested with the main rings. Those new to the test seem to work their way through the fly and animals just because they have a child sitting in their chair. The gross tests are not compulsory, if the patient can do the rings. It is important not to let the patient see the targets without the polarising visor as monocular cues are rather obvious on the first two rings and the animals.

TNO
This is used at approximately 40cms with the patient wearing red and green goggles. It can measure stereoscopic acuity up to 15 seconds (but more usually 30 seconds) of arc. There are also some gross tests for children.

Lang
This is a grosser test, designed to be a screening device for young children.

The pictures go from 1.200 seconds to 550 seconds of arc on the Lang I card, and from 600 seconds to 200 seconds on the Lang II. Failure indicates the presence of a clinically significant anomaly which should be followed up.

Frisby
This consists of random-dot patterns on plastic slabs of varying thicknesses, which should be viewed against (and not too close to) a blank surface. Parallax clues are a problem unless the patients head is stationary and the test is difficult to explain to under-fives.

Mallet unit
This should be used in near darkness and relies on a degree of patient understanding and compliance often not possible. For this reason, it is probably only worth using if no other stereo test is available, as patients tend to dissociate while using it.

MULTIPLE-CHOICE QUESTIONS – take part at opticianonline.net

1 Which of the following is not a dissociating test?
   A Cover test
   B Maddox rod
   C Fixation disparity measurement
   D Monocular acuity measurement

2 What might oscillating markers on the mallet unit indicate?
   A Lack of stereopsis
   B Uncompensated heterophoria
   C Microtropia
   D Anomalous retinal correspondence

3 The eye behind the translucent cover shoots up, both right and left. What might this indicate?
   A Dissociated vertical deviation
   B Right hyperphoria
   C Right hypertropia
   D Microtropia

4 What is a suitable time to occlude during the cover test?
   A As little as possible to minimise the dissociation
   B 1 second
   C 5 seconds
   D As long as it takes to completely break down the binocular lock

5 If the eye move from one target to a second 12 cm apart, both at a 6 metre viewing distance, what eye movement will be required?
   A 0.5
   B 1
   C 2
   D 5

6 What might be the expect distance at which a target moving towards the face becomes double?
   A 0cm
   B 5cm
   C 8-10cm
   D 10-15cm