Binocular vision
Part 3 – Interpreting and recording your motility results

In the third of our series looking at practical aspects of binocular vision assessment in practice, Priya Dabasia explains how best to interpret the results of a motility test. Module C15263, one general CET point for optometrists and dispensing opticians

In the last part of this series we looked at the best way to undertake a motility test. This article explains how best to interpret the findings, how to record them, and what to do if an incomitancy is detected.

Recording results
A full and comprehensive record of ocular motility (OM) is required for detection, diagnosis, management and accurate monitoring of an anomaly. An individual with normal binocular movements will exhibit smooth, accurate, symmetrical and steadily maintained versions to the limit of binocular viewing, with no ‘jerks’ or reports of pain or diplopia. This could be recorded as ‘Full and smooth with no pain/Dp reported’ and annotated further with any details of end-point nystagmus observed. Bear in mind that a patient with a binocular vision anomaly such as heterotropia can exhibit normal motility if the deviation is ‘concomitant’ as the angle of deviation remains the same in every direction. This can be detailed in the record accordingly as, for example, L20Δ SOT in all directions; full and smooth movement with no pain/Dp reported.

An ‘incomitancy’ can occur congenitally due to a developmental disorder or traumatic incident, or arise later in life as a result of a neurogenic, mechanical or myogenic anomaly. If you suspect an incomitant deviation, ensure that notes are made on the following:
- Whether the movement was jerky with catch-up saccadic movements
- Changes in lid position with different directions of gaze
- Changes in globe position indicative of a possible mechanical restriction
- Fatigue on repeat testing common to myogenic disorders
- Abnormal head postures including face turns and head tilts
- Pain or discomfort on versions indicative of a mechanical restriction or inflammatory condition
- Any differences between duction

### TABLE 1
The likely observations and features of recent onset palsies of each of the three cranial nerves

<table>
<thead>
<tr>
<th>Cranial nerve</th>
<th>EOM’s innervated</th>
<th>Likely observations</th>
<th>Other features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oculomotor (3rd)</td>
<td>Superior rectus • Inferior rectus • Medial rectus • Inferior oblique</td>
<td>• Affected eye shows a hypo deviation with an exo component (down and out) • Dilated pupil • Ptosis of the upper lid</td>
<td>A complete palsy should be considered an ocular emergency possibly caused by an intracranial aneurysm</td>
</tr>
<tr>
<td>Trochlear (4th)</td>
<td>Superior oblique</td>
<td>• Affected eye shows a hyper deviation with an eso component (up and in)</td>
<td>Chin depression with a head tilt away from the affected side • Nerve emerges dorsally from the brainstem predisposing it to damage from frontal head injuries</td>
</tr>
<tr>
<td>Abducens (6th)</td>
<td>Lateral rectus</td>
<td>• Affected eye shows an eso deviation (in)</td>
<td>Deviation increases with distance fixation</td>
</tr>
</tbody>
</table>

![Figure 1](image1.png)

**Figure 1** Ocular motility observations of a recent onset complete left sixth nerve palsy

(a) Grading test

<table>
<thead>
<tr>
<th>Prism cover test</th>
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</thead>
<tbody>
<tr>
<td>25 Δ L SOT c Dp</td>
</tr>
<tr>
<td>25 Δ L SOT c Dp</td>
</tr>
</tbody>
</table>

(b) Prism cover test

<table>
<thead>
<tr>
<th>Prism cover test</th>
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</thead>
<tbody>
<tr>
<td>25 Δ L SOT c Dp</td>
</tr>
<tr>
<td>25 Δ L SOT c Dp</td>
</tr>
</tbody>
</table>

**Figure 2** (a) Grading of ocular movements; (b) Measurements of the PCT in a complete left sixth nerve palsy
and version movements.

The clinical features of a paresis (partial weakness) or paralysis (complete palsy) of each of the three cranial nerves supplying the EOM’s vary widely as summarised in Table 1. In recent onset anomalies, the ‘primary angle’ measured with the non-affected eye fixed is always smaller than the secondary angle where the affected eye is observing. Use the following as a guide:

1) Identify the two muscles acting in the given direction of gaze (see Part 2, Optician 29.10.10, Figure 2). The deviation usually increases as the eye turns in the direction of the limited movement, so that if the largest deviation was observed in depression, the left superior rectus or right inferior oblique muscles are most likely to be culpable.

2) Make use of the patient’s subjective responses since the primary problem is usually identified as the direction of gaze in which maximal diplopia is reported. A reliable patient can detect the smallest degree of misalignment and identify variations across the field. As a guide, the outermost image relates to the under-acting eye.

3) Interpret the results of the alternate cover CT as follows:

- An overacting muscle is indicated when the previously occluded eye moves away from the primary position towards the fixation light.
- An underacting muscle is indicated when the previously occluded eye moves away from the primary position towards the fixation light.

A left sixth abductory nerve palsy has been used as an example to show the results expected of primary investigations with suggestions of how to record the findings. A complete palsy of this nerve will result in an esotropic eye greater at distance, as a result of the unopposed action of the antagonistic medial rectus muscle.

From a practitioner perspective, diagnosing the primary muscle implicated on initial presentation is relatively easy. However, adaptations better known as ‘sequelae’ that occur with time make the deviation less sinister in nature; adaptations are necessarily sinister in nature; by definition, alphabet (A and V) patterns are also classified as types of horizontal incomitance as they describe a significant variation in angle between elevation and depression. They are fairly common and mainly congenital, thought to be the result of secondary actions of the vertically acting EOMs. These patterns can refer to both ‘eso’ (convergent) or ‘exo’ (divergent) deviations. For example an ‘A eso’ and ‘V eso’ pattern describes an esophoria or esotropia greater on elevation and depression respectively.

**Management of incomitancy**

First and foremost, it is essential that the underlying cause of any recent onset case is investigated and managed since centres involved in eye movement cross important structures of the cranium. Therefore an emergency referral to a physician and/or ophthalmologist is advised for further blood tests and neurological evaluation in any suspected new presentations. This applies to patients of all ages but take extra precautions with young children who adapt rapidly to disruption of

<table>
<thead>
<tr>
<th>Cranial nerve palsy</th>
<th>Possible causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Third nerve</td>
<td>Head injury</td>
</tr>
<tr>
<td></td>
<td>Aneurysm</td>
</tr>
<tr>
<td></td>
<td>Haemorrhage</td>
</tr>
<tr>
<td></td>
<td>Neoplasm</td>
</tr>
<tr>
<td></td>
<td>Diabetes or perfusion anomaly</td>
</tr>
<tr>
<td>Fourth nerve</td>
<td>Idiopathic</td>
</tr>
<tr>
<td></td>
<td>Head trauma (typically related to road traffic accidents)</td>
</tr>
<tr>
<td></td>
<td>Diabetes</td>
</tr>
<tr>
<td></td>
<td>Multiple sclerosis</td>
</tr>
<tr>
<td></td>
<td>Neoplasm</td>
</tr>
<tr>
<td></td>
<td>Aneurysm</td>
</tr>
<tr>
<td>Sixth nerve</td>
<td>Head injuries</td>
</tr>
<tr>
<td></td>
<td>Aneurysms</td>
</tr>
<tr>
<td></td>
<td>Neoplasms</td>
</tr>
<tr>
<td></td>
<td>Multiple sclerosis</td>
</tr>
<tr>
<td></td>
<td>Brain infections (meningitis, abscess)</td>
</tr>
<tr>
<td></td>
<td>Complications of a severe ear or eye infection</td>
</tr>
<tr>
<td></td>
<td>Wernicke’s encephalopathy (related to chronic alcoholism)</td>
</tr>
<tr>
<td></td>
<td>Raised intracranial pressure</td>
</tr>
<tr>
<td></td>
<td>Respiratory infections, particularly in the young</td>
</tr>
<tr>
<td></td>
<td>Birth trauma</td>
</tr>
</tbody>
</table>

Conducted on presentation of a new anomaly as well as at intervals during the adaptation period should reveal the following:

- Primary underaction of the left lateral rectus muscle with limited abduction (see Figure 1 for diagrammatic summary and Figure 2 for recordings of OM and PCT)
- Overaction of the contralateral medial rectus (first sequelae occurs at onset)
- Overaction of the ipsilateral medial rectus (second sequelae occurs one month later)
- Secondary underaction of the contralateral lateral rectus (third sequelae occurs two months later).

Be aware that not all incomitancies are necessarily sinister in nature; by definition, alphabet (A and V) patterns are also classified as types of horizontal incomitance as they describe a significant variation in angle between elevation and depression. They are fairly common and mainly congenital, thought to be the result of secondary actions of the vertically acting EOMs. These patterns can refer to both ‘eso’ (convergent) or ‘exo’ (divergent) deviations. For example an ‘A eso’ and ‘V eso’ pattern describes an esophoria or esotropia greater on elevation and depression respectively.
binocular vision by suppressing the image of one eye, masking potentially life threatening issues. Some causes of incomitancy are listed in Table 2. Note this is not an exhaustive list.

On completion of these preliminary investigations, patients usually remain under the care of the hospital eye service to monitor the recovery of muscle functions, and evaluate the stability of these adaptations during a 9-12 month period. Assessments are conducted on a monthly to six weekly basis comprised of acuity measurements, CT with PCT, motility, field of binocular single vision and Hess plots. The latter is a dissociation test that allows the field of one eye to be compared with the other and against a normal reference evaluating details of position, shape and size. The plots thereby provide repeatable and reliable measures of the over- and under-acting muscles in each direction of gaze for precise monitoring. During this period, intervention is required to improve the patient’s symptoms and cosmesis as follows:

- Short-term use of prisms such as Fresnel varieties
- Advise the patient to adopt an abnormal head posture to join the diplopia and place the eyes in a position of binocular single vision
- Occlusion of the affected eye for larger deviations using a frosted lens or suitable alternative
- Botulinum Toxin A to relax the contracted muscle once adaptation takes place.

In general a surgical procedure to weaken over-acting or tight muscles is only indicated if full recovery does not take place spontaneously.

This management strategy contrasts greatly to that recommended for a patient with a longstanding incomitancy. If a previously investigated deviation is deemed stable and well compensated with little or no abnormal head posture, an annual review in practice will suffice with prisms incorporated in their spectacle correction as required. A routine referral to an orthoptic clinic is, however, indicated if there is a risk of decompensation, or symptoms arise as a result of an abnormal head posture becoming increasingly uncomfortable. In such cases, further treatment with possible surgical intervention may be necessary to regain binocular single vision.

In conclusion, OM assessment is a quick and economical indicator of binocular function, but when conducted by a skilled examiner with knowledge of anatomy and physiology, it yields information that could potentially save a patient’s life.

The next article in this series will evaluate tests to assess the control of heterophoria and review the management of poorly controlled or ‘decompensating’ deviations.

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**MULTIPLE-CHOICE QUESTIONS** - take part at opticianonline.net

1. Which of the following would you be most likely to observe in a complete third nerve palsy?
   - A: Change in amplitude of accommodation
   - B: Lid retraction
   - C: Pupil constriction
   - D: Ptosis of the lower lid

2. You detect a misalignment of the eyes in laevo-elevation. A cover-uncover test in this direction reveals a movement of the left eye towards the fixation light and movement of the right eye towards the primary position. What is the most likely diagnosis?
   - A: Right IO underaction + Left SR underaction
   - B: Right IO overaction + Left SR underaction
   - C: Right SR overaction + Left IO underaction
   - D: Right IO underaction + Left SR overaction

3. A patient attends your practice complaining of sudden onset diplopia, having never attended a hospital eye clinic before. Your tests reveal a possible anomaly of the extraocular muscles. Which of the following is the most appropriate action?
   - A: Refer within two weeks to the GP and HES
   - B: Refer within two days to the GP and HES
   - C: Refer within one week to the GP and monitor the patient monthly for spontaneous recovery
   - D: Refer within two days to the GP and HES and prescribe prisms to correct the deviation

4. Which of the following is not useful in the immediate management of diplopia?
   - A: Fresnel prisms
   - B: Botulinum toxin
   - C: Exercises
   - D: Occlusion

5. What is meant by the term ‘paresis’?
   - A: Paralysis
   - B: Complete loss of function
   - C: Anaesthesia
   - D: Partial loss or weakness

6. What is the result of a complete sixth nerve palsy on distance viewing?
   - A: Esotropia
   - B: Exotropia
   - C: Hypertropia
   - D: Orthotropia until the eyes gaze peripherally

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Successful participation in this module counts as one credit towards the GOC CET scheme administered by Vantage and one towards the Association of Optometrists Ireland’s scheme.

**Deadline for responses is December 23 2010**

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26.11.10 | Optician | 27