Diplopia or double vision is the subjective complaint of seeing two images of an object instead of one. The causes may vary from benign ocular causes to life threatening systemic disorders. The aim of this article is to highlight a systematic approach to a case of diplopia so that a probable diagnosis can be arrived at.

**Mechanism of Diplopia**

The two most common mechanisms for diplopia are visual axis misalignment and abnormalities of the ocular media or refractive errors. In ocular misalignment, the image of an object that is being viewed does not fall on fovea of both retinas. This causes binocular diplopia which disappears on closing one eye.

The abnormalities of the ocular media or refractive errors lead to monocular diplopia that persists in the affected eye even if the other eye is closed.

Diplopia without any pathological cause is termed functional. However, it is a diagnosis of exclusion and a thorough examination and appropriate investigations are mandatory to rule out a pathological cause first.

It is important to differentiate monocular from binocular diplopia. The diagnosis of monocular diplopia usually obviates the need for a detailed neurological examination.

**Causes of Diplopia**

**Causes of Monocular Diplopia**

Monocular diplopia usually results from abnormalities of the ocular media or refractive errors and tends to disappear when one looks through a pinhole. Causes are as enumerated in (Table 1).

**Causes of Binocular Diplopia**

The causes are multifactorial but results most commonly from an acquired misalignment of the visual axis secondary to recent onset extraocular muscle paralysis. Causes of binocular diplopia are enumerated in (Table 2).

**History**

A detailed history taking is essential to find out the cause for diplopia.

Following points in history taking help to find the probable cause -

1. When and how did the double vision started?
2. Whether diplopia disappears or persists after closing one eye (Binocular vs monocular diplopia)?
3. Associated symptoms with double vision if any like – light headedness, giddiness; weakness or tingling in face, arm or leg; difficulty with speech or swallowing, facial or ocular pain?
4. Is it constant in all gazes or more in a particular gaze (comitant vs incomitant)?
5. Is it more for far or near fixation?
6. Whether the images are horizontally, vertically or obliquely separated?
7. Is the diplopia constant, intermittent or variable?
8. Whether diplopia worsens at the end of the day? More than 50% of patients with myasthenia gravis, present with ptosis and diplopia without other symptoms or signs of weakness.
9. History of any trauma to eye, face, head or any history of ocular surgery recent or in past.
10. Detailed history of systemic diseases like diabetes mellitus, hypertension, thyroid disorders, myasthenia gravis should be taken.

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**Table 2: Causes of Binocular Diplopia**

<table>
<thead>
<tr>
<th>Category</th>
<th>Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) <em>Orbital disorders</em></td>
<td>Trauma, mass or tumor, infection, thyroid-associated opthalmopathy.</td>
</tr>
<tr>
<td>b) <em>Extraocular muscle restriction</em></td>
<td>Thyroid – associated opthalmopathy, mass or tumor, extraocular muscle entrapment, extraocular muscle injury or hematoma due to ocular surgery.</td>
</tr>
<tr>
<td>c) <em>Extraocular muscle weakness</em></td>
<td>Congenital myopathies, mitochondrial myopathies, muscular dystrophy.</td>
</tr>
<tr>
<td>d) <em>Neuromuscular junction dysfunction</em></td>
<td>Myasthenia gravis, botulism.</td>
</tr>
<tr>
<td>e) <em>Palsies of the third, fourth or sixth cranial nerves</em></td>
<td>Ischemia, haemorrhage, tumor or mass, vascular malformation, aneurysm, trauma, meningitis, multiple sclerosis.</td>
</tr>
<tr>
<td>f) <em>Brain stem injury to cranial nerve nuclei</em></td>
<td>Stroke, haemorrhage, tumor or mass, trauma, vascular malformation.</td>
</tr>
<tr>
<td>g) <em>Supranuclear injury (pathways to and between cranial nerve nuclei)</em></td>
<td>Stroke, haemorrhage, tumor or mass, trauma, multiple sclerosis, hydrocephalus, syphilis, Wernicke’s encephalopathy, neurodegenerative disease.</td>
</tr>
</tbody>
</table>

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**Clinical Evaluation**

For monocular diplopia refraction, slit lamp and dilated fundus examination is to be done to find out the cause.

The evaluation of binocular diplopia includes:

1. Abnormal head posture- The patient prefers a head posture in which the ocular deviation is least and the images can be fused.

It has three components:

(a) Chin elevation or depression (vertical)
(b) Face turn to right or left side (horizontal)
(c) Head tilt to right or left shoulder (torsional)

Comparison with an old photograph is helpful to differentiate whether head posture is long standing or recent.

2. Orbital and lid abnormalities – Examine lid and orbit for proptosis, ptosis, periocular swelling, ocular trauma, lid retraction, lid lag or other signs of thyroid associated opthalmopathy.

3. Extraocular muscle movements – Ocular movements ductions and versions should be checked in all nine positions of gazes.

4. Pupillary reactions – Pupillary examination is vital as its involvement indicates third nerve palsies due to compressive lesions or AV malformations and sparing indicates cases of third nerve palsies due to ischaemic causes.

5. Neuromuscular junction examination – Patient should be examined for extraocular muscle fatigue by making the patient sustain gaze in the direction of paresis. Fatigability of ocular movements can be demonstrated by examining repetitive saccades or sustained gaze in various directions.

6. Examination of cranial nerves especially third, fourth and sixth cranial nerves

   a) **Third cranial nerve palsy**

   Pupil involving third nerve palsy should prompt neuroimaging to rule out an aneurysm whereas pupil sparing third nerve palsy is usually due to ischemia secondary to micro vascular disease like DM, HTN and dyslipidemia.

   b) **Fourth nerve palsy**

   Fourth nerve palsy causes diplopia that is worse in downgaze.

Park – Bielschowsky 3 – step test is an algorithm for identifying patterns of ocular motility that confirm the dysfunction of cyclovertical muscles. The three steps are as follows:
• Find the side of hypertropia
• Determine if the hypertropia is greater on left or right gaze.
• Determine if the hypertropia is greater on left or right head tilt.

In a superior oblique palsy, the hypertropia of the affected eye worsens in contralateral gaze and with ipsilateral head tilt.

c) Sixth nerve palsy

The sixth cranial nerve innervates lateral rectus, which is an abductor. Hence with the normal eye fixing, the paralysed eye is deviated inwards.

7. Prism Bar Cover Test - Measurement of angle of deviation to quantify the amount of deviation in different gazes should be done. Prism Bar Cover test (PBCT) should be done in all 9 positions of gaze with each eye fixing and both for distance and near.

8. Maddox rod test – This gives a quantitative information about the degree and type of ocular misalignment.

9. Double Maddox Rod Test - Maddox rods with same orientation in front of each eye (vertically oriented to produce a horizontal streak) can be used to assess torsional misalignment when vertical diplopia is present.

10. Diplopia Charting – This test helps in recording the subjective deviation by asking the patient to quantify the separation between the double images, dissociated by red green glasses. This is to be done in all 9 positions of gaze and both for distance and near. Main points to be remembered are:

- Maximum separation is in the quadrant in which the muscle acts most (field of action)
- The image that appears farthest, belongs to the deviating eye
- The image is displaced in direction of action of paralysed muscle.

11. Paretic vs restrictive etiology

a) Forced Duction Test (FDT) – A forced duction test helps to differentiate paretic from restrictive cause.

b) Exaggerated FDT for obliques

c) Active Force Generation Test (AFGT)

d) Ocular movement restriction from thyroid eye disease can also be judged by measuring intraocular pressure in primary position and in eccentric gaze.

12. Hess Charting - It is a subjective test of ocular deviation. The fixating eye determines the innervational input, hence the excursion of the other eye. Cyclo deviations when present are seen as tilting of the squares.

Systemic Investigations

1. Blood sugar levels / HbA1C for Diabetes Mellitus

2. Test for myasthenia gravis – electromyography (EMG), nerve conduction studies with a repetitive stimulation test and anti-acetylcholine receptor antibodies

3. T3, T4, TSH for thyroid eye disease

4. CT scan / MRI of brain and orbit for thyroid eye disease, any intracranial or orbital pathology.

Treatment

1. Treat the underlying cause, wherever possible.

2. Correction of refractive errors if present.

3. Unilateral eye occlusion therapy with either an eye patch or by blurring one lens of the patient’s glasses with semi-opaque surgical tape.

4. Prisms are used for optical correction of symptomatic binocular diplopia. Fresnel prisms can be incorporated on to the patient’s existing glasses.
5. Surgery for strabismus can be done to restore ocular alignment after a period of observation for at least 06 months.

References
1. Albert Jakobiec’s; Principles and Practice of Ophthalmology; Third Edition; Elsevier Inc; Canada; 2008.
2. AAO; Basic and Clinical Science Course; Neuro-Ophthalmology; Section 5; LEO; Singapore; 2011-2012.

Proceeding Protocol for Monthly Clinical Meetings

1. The Host (usually the ophthalmic chief of the Hosting Institution) will welcome the DOS and request the President and Secretary of the DOS to come to the Dais and start the Meeting.

2. The President and the Secretary will take up their seats on the side of the Dais, which is opposite to the Lectern. (They would continue to be in the same position throughout the Meeting, including the Mini Symposium.) The Chairman of the Symposium will be invited to a third seat next to the President on the same table, after the ‘Clinical Talk’. The Speakers, who if they form a Panel would be seated on the same side as the Lectern.

3. The President will declare the Meeting open.

4. The President and the Secretary will then conduct the meeting.

5. The case presentations (2 in no.) will form the first part of the clinical meeting. Each presenter will be allotted 10 min. time for his/her presentation. This will be followed by discussion with the audience on both the cases (Total time allotted is 15 min.). The case presentation will be followed by a Clinical Talk of 15 min. duration. This will be followed by discussion with the audience on the topic for 10 min.

6. After the first part of the meeting is over, the President will introduce the subject of the Mini Symposium (which will be of 1 hour duration) and invite the Chairperson of the Symposium to the Dais to conduct the Symposium. All the speakers may be invited to assume their seats on the Dais at this time or one by one after they have presented their Talks (at the discretion of the chairperson of the symposium).

7. After the Symposium is over, the President will thank the Speakers and the Chairperson and request Secretary to make any Announcements, including the Prizes etc.

8. By the time, the Clinical Meeting is to be declared closed by the President, the Host or his representative would be at the Lectern to (take the floor immediately after the Meeting is closed) thank people, firms who had helped him in hosting the Meeting and invite the Members of the DOS for Refreshments.

9. Venue: The monthly clinical meeting will definitely be held in the premises of the allotted institution.

10. Day: The meeting shall be held on the last Saturday / Sunday of the month, whichever the institution deems feasible.

11. Presenter: The presenting faculty / resident / fellows should be from the same institute for clinical case presentations and the clinical talk.

12. One person will be allowed only one presentation for the award-winning session in the same academic year.

13. Exchange of dates: In case two institutions want to exchange the date of the meeting, it can be done with mutual agreement by the heads of the department and with information to the Secretary’s office, well in advance.

14. Mini Symposium: It shall be organized by the institution but other DOS members can be invited to participate, if required. There should not be more than 3 speakers in the mini symposium.

15. To qualify for the retention in the monthly meeting calendar, a minimum attendance of 70 members is required (inclusive of the members of the host institute).

16. For the Best Clinical Meeting award i.e. Bodhraj Sabharwal Trophy, the overall assessment of the meeting will be made purely on the overall marks by outside delegates and for Dr. Minoo Shroff Trophy the award will be given to the most popular meeting (based on total attendance including outside and inside delegates as per the attendance register).

17. The attendance will be marked in the register which will be at a separate counter and will be managed by the DOS Staff. At the close of the clinical meeting, the attendance register will be signed by the Secretary and the President on the same day.

18. Meetings in the month of May and June may be opened from the next year if there are applications for the same.

19. No alcoholic drinks will be served during or after the meeting; only refreshments / snacks / lunch will be served.