The examination of squint patient requires very few special equipments. Over the years the synoptophore, which for long symbolised this speciality, no more appears to be an essential outfit. Examination begins once a squint patient enters the clinic, by observing his head posture either in form of face turn, head tilt or chin position. Before taking history, the strabismologist must have a friendly conversation with the patient in order to make him feel comfortable.

**History of the patient**

Age at onset of squint is very critical and must be ascertained because it is very helpful in both diagnosis and prognosis. After developing a good rapport information about the patient’s symptoms such as asthenopia, double vision (uniocular or binocular), limitation of movement, oscillations or dim visions, must be asked. Also, it must be ensured whether the squint was first noticed by parents, relatives or any doctor.

**Questions in history**

Following points should be considered before evaluating patient of squint:

- **Age of onset**: Early age of onset corresponds with poorer prognosis.
- **Duration**: Shorter duration favours prognosis as it avoids suppression, ARC or amblyopia.
- **Type of squint**: Intermittent or constant; prognosis is better in case of intermittent squint.
- **Probable cause**: Fever, head injury, shock or eye disease before the onset of the squint. In older cases, history of hypertension, diabetes, thyroid or neurological problems should be collected.
- **Family history**: Whether parents or siblings had lazy-eye, squint or refractive error.
- **Previous treatments**: It is important to have knowledge about certain treatments that patient might have undergone prior to this treatment.
- **Spectacles**: Had the patient gone through cycloplegic refraction? Since how long he has been wearing the glasses and when did he last change?
- **Occlusion (in case of children)**: What type of occlusion the child used and for how long?
- **Orthoptic treatment**: Has the patient done any eye exercise and for how long?
- **Surgical treatment**: Has the patient undergone any facial, head or eye surgery and when?

**Methods of Examination**

Before starting the squint workup, following examinations must be carried out:

**Visual acuity examination**

Following common devices should be used to assess the vision:

- Snellen’s visual acuity chart (can be used with patients of all ages, who are literate)
- Illiterate E chart (used with illiterate patients)
- Catford Drum - Based on Oscillatory movements
- Teller’s acuity cards - Based on PLT [for children from 6 months to 2 years] (Figure 1).
- Cardiff vision chart - Based on vanishing optotypes [for children from 2-3 years] (Figure 2).
- Sheridan - Gardiner cards (useful in case of children
Diagnostics

Above 3 years:

- Angular visual acuity cards can be used to avoid the crowding phenomenon.

- Near vision should be assessed by near vision charts for each eye separately.

To assess the vision certain precautions must be taken:

- While checking the vision, the patient should maintain normal head posture. Make sure that while positioning the occluder the patient should not peep from the covered eye.

- Generally children tend to memorise the Snellen’s chart, so to avoid that we should check the vision by rotating the drum and check vision by different alphabetic charts.

- Vision tests should be done with and without glasses, with pin-hole & for near and distance.

- In case of Nystagmus, high power lens should be used as occluder to minimise the oscillations specially in case of manifest latent nystagmus.

- Test for reaction of pupil to light and convergence

- Ocular media and fundi examination to rule out the possible cause of defective vision.

- To check the fixation of each eye separately by ophthalmoscope or visuscope.

Proper cycloplegic refraction (appropriate for age)

Observation of the head posture

Patient may adopt head posture to overcome diplopia, to minimise oscillations, to increase field of vision (one-eyed patients) or to overcome astigmatism.

Detection of squint

a) The type and approximate amount of squint can be detected by shining a torch in front of the eyes and looking for corneal light reflex (Hirschberg/Krimsky).

b) Cover test: For near at 33 cm and for distance at 6 mts. An opaque occluder can be used as dissociating device. A pencil torch or 6/9 letter of Snellen’s chart can be used as fixation target.

- The cover test to detect the presence of manifest squint.

- To analyse whether squint is concomitant or nonconcomitant (by comparing the secondary deviation and the primary deviation).

- Cover test indicates the type of fixation.

- It reveals the presence of latent nystagmus.

Apparent Squint

- The presence of broad epicanthic folds - produce a pseudo convergent squint.

- A narrowing of lateral canthi – causes a pseudo divergent squint.

- Large angle Kappa – large positive (nasal) angle Kappa produces pseudo divergent squint whereas negative (temporal) angle Kappa produces pseudo convergent squint.


Examination of Ocular Movements:-

- The test can be done with bright object/torch light and the object should be moved from primary straight head position to nine cardinal positions. Limitation and over-action of the muscle/muscles maybe checked by Hirschberg. Widening or narrowing of palpebral aperture, up-shoot or down-shoot of eye ball indicates the restrictive squint. Movement of each eye [ductions] should be also checked separately.
Measurement of a) Near point of accommodation - It can be assessed by RAF near point ruler (each eye individually). N8 size letters are used as target.
b) Near point of convergence - A vertical line with centred dot is moved closer to the eyes till the point there is diplopia.
c) IPD – can be measured by ordinary scale, Pulzone-Hardy ruler or by synoptophore

Measurement of Angle of Squint:
• Maddox wing test:- based on mechanical dissociation used to know the type and amount of deviations in prism dioptre specially in case of phoria.
• Maddox rod test:- the test is carried out for 33cm and 5mts along with Maddox tangent scale. Position of red line (viewed through Maddox rod) the scale indicates the degree of deviation. Cyclo-deviation can be measured by double Maddox rod (Figure 3).
• By Hirschberg:- by holding a torch light at 33cm and the position of light reflects on the cornea indicates the angle of squint. On the margin of pupil 15 degree In between the pupil and limbus 30 degree On the limbus 45 degree
• By perimeter method:- a spot light is moved on the arc of the perimeter till the light reflects falls in the center if the pupil. Amount of deviation can be measured by numbers of the arc.

Prism and cover test method
The test is carried out at the distance 33cm for near and 6mt for distance and it should be measured in 9 cardinal positions fixing each eye separately. A glass or plastic prisms can be used with opaque occluder and the test must be repeated with and without glasses.

• Base in position for exo-deviation.
• Base out for eso-deviation.
• Base up for hypo-deviation of same eye.
• Base down for hyper-deviation of same eye.

By synoptophore method:-
The test is carried out while patient is sitting on the synoptophore with right head posture and with corrected interpupillary distance.
• Dissimilar slides (simultaneous perception) should be used fixing each eye separately.
• The tube carrying the hollow object (cage) should be moved till there is no deviation of non fixing eye while using the auto switches as dissociation.
• The amount of deviation can be noted in degree or prism dioptre from the vertical and horizontal scale by objective method where the deviation is neutralized by doctor or by subjective method where patient superimposes both pictures (lion in the cage).
• The cyclo deviation can be checked subjectively by special slides (printed with vertical and horizontal line with black background) The angle of squint can be measured in 9 cardinal positions to find out the affected muscles in paralytic squint.

Examination of sensory status
1] Bagolini striated glass – These are most physiological and least dissociated device to test suppression. The glasses are kept on patients eye and eyes are fixed on the spot light. The interpretation given by patient reveals the result.
• Appreciates one line only - suppression of other eye.
• Appreciates two lines and Two spot lights - double vision.
• Appreciates crossed lines (with straight eyes) - binocular single vision.
• Appreciates crossed lines (with squinting eyes) – ARC
• Appreciates crossed lines with central gap in one line – Central scotoma
2] Worth’s four dot test:- keeping red glass on right eye.
• Two red lights - left suppression
• Three green lights - right suppression
• Five lights - diplopia
• Four lights - binocular single vision(NRC)
3] A.R.C. Test (with Bielschowsky’s slides) (Figure 4).
Stereo-acuity test

Principle of stereotests

Haploscopic principle

In this principle the dissociation is achieved by placing angled mirror in front of each eye so that right eye sees the right temporal field while left eye sees the left temporal field. This principle is used in synaptophore and stereoscopes.

Anaglyph

A stereogram in which dissociation of image is produced by using colour is known as anaglyph. The anaglyph consists of stereo paired object formed by using conjugate colours like red and green (Figure 5). These objects when viewed with special glasses, one lens being coloured red and the other coloured green a three-dimensional scene is perceived. The test based on this principle is TNO test.

Vectographic principle

The vectograph permitted two stereo paired pictures developed in such a way that light passing through one is polarized in one direction while light passing through the other is polarized in the other direction. This permits a viewer to use special glasses consisting of Polaroid filters to see the three-dimensional scene. Vectography has the advantage over anaglyphic photography that avoids the annoyance of seeing the red-blue tint in the scene. This principle is used in tests like Titmus fly test (Figure 6) and Randot stereopsis test (Figure 7).
Panographic principle

This stereogram is real depth stereogram, which incorporates cylinder or prism, in its pattern, that will cause the deviation of the image to give real time depth perception. Lang’s test is based on this principle. It is composed of fine cylinder grating on which random dots are imprinted. There are three stereoscopic shapes, cat, star and car which measure stereopsis of 1200, 600, 550 seconds of arc respectively. In the new Lang II test, the random dots are smaller and less dense. This disparity is finer, namely 200 seconds of arc for the moon and the star, 400 for the car, and 600 for the elephant.

Stereoscopic stimuli

Line or contour stereogram These targets have monocular edges that are separated on a background to produce disparity. They measure local stereopsis, e.g Titmus fly test.

Random dot stereograms Julesz proposed the concept of random dots forming a vectograph. The stereogram consists of randomly arranged dots in such a way that there is a lateral shift of central core of dots (Figure 8), lines, patterns, which give rise to stereoscopic view while the stereoscopic form or background itself has no edge differentiation. Any shape can be generated with random dots. These stereograms measure global stereopsis. The random dot stereograms are used in Lang’s stereopsis test, TNO test, Randot tests.

Real Stereopsis test

Frisby Davis test (Figure 9)

The Frisby test is different from previous stereotests since presented targets actually vary ‘in depth’. The targets are printed on the two sides of transparent plexiglass plates of different thicknesses. There are three plates, 1mm, 3mm and 6mm thick respectively. Each plate has printed on it four random-texture patterns and ‘hidden’ in one of these is a circular shape. The patient has to decide in which pattern the hidden shape lays a task that can be done successfully only if stereopsis is present. The test can be held at any of six distances, from 30cm to 80cm, the distance being controlled by the use of a tape attached to the test and held by the patient against the check. The six positions, combined with the three thicknesses of plates, provide 18 values of stereo acuity, ranging from 880 seconds of arc to 20 seconds.

Advantages over other tests

• No special glasses are required.
• There are no monocular clues [although the motion parallax is a limiting factor]
• Large stereo acuity range.
• Suitable for a wide age range, even young pre-schoolers.
• Good visual acuity is not essential.

Stereotests for Distance

Distance stereoacuity is reduced in X(T) to a greater extent than the near stereoacuity and both improve after surgery. FD2 is useful for deciding timing of surgery and a stereoacuity worse than 20 arcsec is an indication for surgical intervention. A preoperative distance stereoacuity which is worse than 70 arcsec implies a poor prognosis for stereoacuity improvement after surgery. The following test can be used for distance stereoacuity.

AO Vectographic

Project-O-Chart Slide test: Uses polarising lenses on a phoropter, generating disparities from 480–30 seconds of arc. It has disadvantage of being based on principle of lateral displacement which provided monocular clues.

Mentor BVAT system

It uses graphic capacity of a high-frequency microprocessor and liquid crystal binocular glasses. Images are alternately presented at a frequency of 60 cycles per second to each
eye, using synchronized liquid crystal shutter glasses. The rapid alteration of these images allows simultaneous perception. The amount of disparity in the stereo patterns can be altered to allow a measurement as refined as 15 seconds of arc. Mentor BVAT system has provision of measuring both global and contour stereoacuity.

**Distance Randot test**
This test is designed to evaluate 3 levels of disparity (800, 200 and 60 arc sec) using vectographic random dot stimuli and are mounted on books to be viewed through polarizing glasses. The test consists of 6 books (2 books for each level of disparity; each book containing 2 vectographs). For each disparity level, there are 3 vectographs that contain a stereotarget and 1 vectograph is blank. The stereotargets are simple geometric shapes. The subjects have to view the books at a distance of 3 m. Testing is started with the coarse disparity (800 sec of arc) and proceeded to progressively smaller disparity. To enhance testing in small children, matching cards can be provided. If the subject identifies or matches 2 out of 3 of the stereotargets, the level is passed.

**Frisby Davis Distance Test**
The FD2 test comprises a box containing four back illuminated and differently shaped plastic objects mounted on rods. These are either four animal or four geometric shapes set in a transparent frame pointing towards the observer. The amount of disparity presented can be altered by the depth differences provided in the test which ranges from 1cm to 13.4 cm, and by the distance of the observer from the targets. These two features provide the disparities ranging from 200–4 seconds of arc.

1. Limitation of the movement in the field of action of muscle.
2. **Incomitance** – Variable ocular deviation in different eye position.
3. **Primary vs Secondary deviation** – according to the Herring’s law of equal innervation, innervation flowing to the yoke muscles of both eyes is always determined by the fixating eye. When sound eye fixates the deviation measured is the primary deviation and with paralytic eye fixating the deviation is secondary deviation which is always greater than primary deviation.

**Diplopia Chart**
A vertical bar of light is viewed through red and green goggles at a fixed distance from the eye. The bar light is moved into each direction of gaze, and the patient describes the image separation and appearance. The image separation can be measured. By convention, the red filter is always placed before the right eye. The symbol `$\prime$' is used to describe the two lines as superimposed. The most distal image belongs to the under-acting eye. The position of the image is the reverse of the position of the eye.

**Hess chart/ Lees screen**
The patient should be seated squarely facing the screen being plotted, with the head centred on the central fixation spot. The electrically operated Hess Screen has largely replaced the original Hess screen in most clinics. This has a wooden screen with small red lights forming fixation points and a movable illuminated green indicator. A light source is present behind each red light aperture, the illumination of which is controlled from a control unit. Each of the red fixation spot lights can be switched on. The patient holds a green spotlight color, the color of which is identical with that of the green eyepiece of red green glasses for interpreting the results of the Hess test, it is important to be aware of the muscle sequelae that follow paralytic squint.

**Basic rules for interpreting a Hess chart**
1. The smaller field belongs to the eye with the defect.
2. Neurogenic pareses will show the muscle sequelae to a greater or lesser extent (dependent on the duration). The largest underaction is normally in the direction of action of the paretic muscle and the largest overaction is normally the contralateral synergist.
3. Mechanical defects show a compressed field. The most obvious feature of a mechanical defect is normally the marked overaction of the contralateral synergist.

**Maddox double rod test**
Maddox rods at the same orientation in front of each eye (normally vertically orientated to produce a horizontal streak) can be used to assess the angle of torsion. If the
streaks seen by each eye are not parallel, then the rods can be rotated until the streaks become parallel and horizontal, thus giving a measure of the rotation required and hence the torsion. This test is maximally dissociating and can produce erroneous results (possibly as a result of small angles of head tilt).

**Bielschowsky’s head tilt test**

Due to the development of the muscle sequelae, the eye movement pattern in a longstanding SO palsy in one eye can be difficult to differentiate from a SR palsy of the other eye. A positive Bielschowsky head tilt test can confirm the culprit as the SO, but a negative result is inconclusive. Normally, as the head is tilted towards the right shoulder, for example, the right SR and right SO work in partnership to intort the eye, the opposing vertical actions of the two muscles cancelling out. If a patient has a SO palsy, as the head is tilted towards the affected side, the SR acts unopposed, so it not only intorts the eye but also elevates it. To perform the test, seat the patient upright, maintaining steady fixation straight ahead at a distance of 3m, so that fixation doesn’t favour either the SO or SR. Tilt the head towards the eye with the suspected SO palsy (the hypertropic eye) and if the vertical angle of the deviation increases, the defective muscle is confirmed as the SO. Parks used this information to devise a three step test for differentiating the four vertically acting extra-ocular muscles. Parks 3-step test helps to elucidate which of the 4 extraocular muscles responsible for vertical eye movements may be weak, thereby causing vertical diplopia. To simplify, determine which eye appears higher with the head in a normal position, with the head turned to the left and to the right, and with the head tilted left and tilted right.

**Fusional Reserves**

Measurement of fusional reserves can be of diagnostic value when differentiating a long standing vertical muscle palsy from one of recent onset. Congenital SO palsies, for example, can have vertical fusional reserves in excess of 10D, whereas a recent onset deviation will usually have a normal vertical fusion range (4D - 6D). Vertical fusion ranges can also increase over a long period of gradual change in the direction of the visual axes, such as in dysthyroid eye disease.

**Field of binocular single vision (BSV)**

The field of BSV is a test used to describe the areas of BSV, and hence diplopia in incomitant squint. It is very simple to do using a kinetic perimeter, or to approximate from ocular motility. The patient is asked to seat in front of perimeter, with the chin central to fixation. The target is moved outwards until the patient recognizes diplopia, and the point is marked. The target is then moved further until one image disappears, normally due to occlusion by facial contours, and this point is marked. The inner ring describes the area of BSV, the outer ring describes the limits of the binocular field of fixation.

**Forced Duction Test**

It is used for diagnosing the presence of mechanical restriction of ocular motility. Conjunctiva is anaesthetized with topical anesthetic drops. The eyes are grasped with toothed forceps near the limbus in the direction opposite to which mechanical restriction is suspected. If no resistance is encountered the mobility defect is due to paralysis if resistance is encountered mechanical restriction exist. It is important not to press the globe into the orbit during the test since it may become false negative. Exaggerated force duction test- This is done for knowing the tightness of oblique muscles. It was first described by Guyton. For this test eye must be pushed inside the orbit and then rocked back and forth by extorting and intorting the globe.

**Conclusion**

Although examinatin of squint patient requires very few special equipments appropriate understanding of the available examination techniques and investigation is necessary to make a correct diagnosis and hence to decide proper management.

**References**