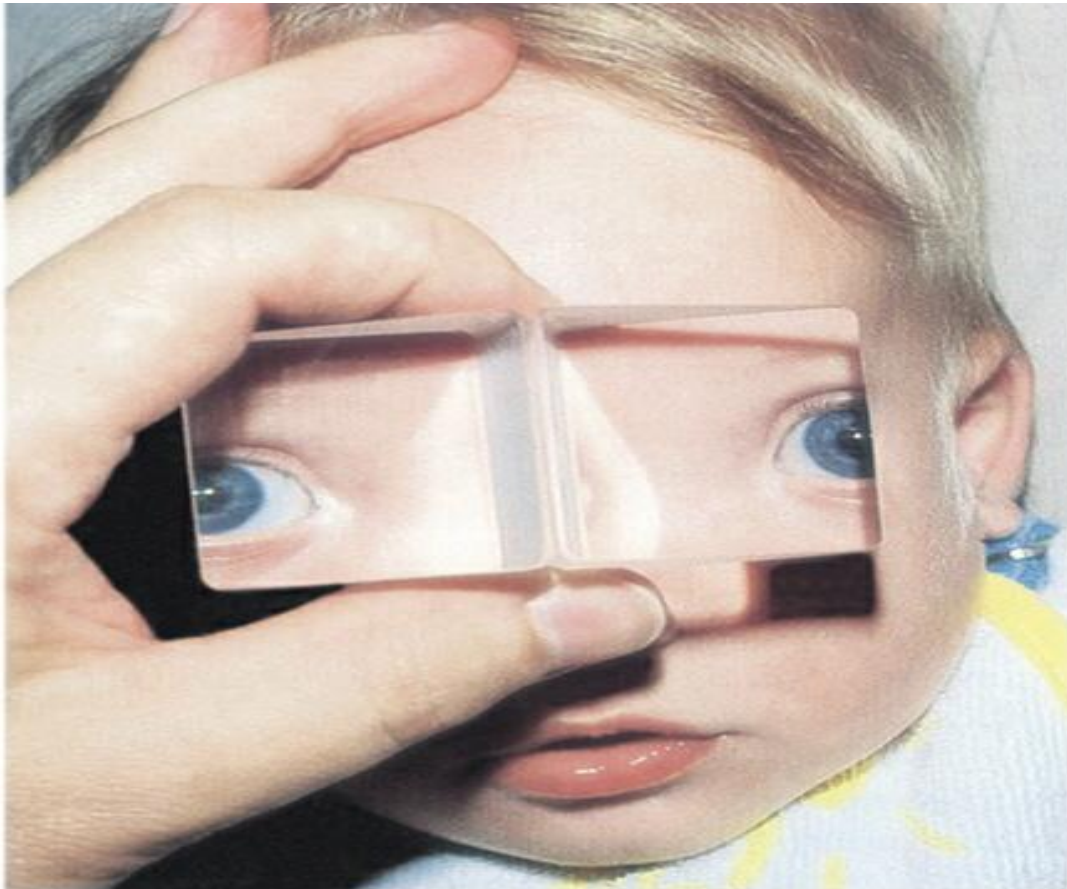


STRABISMUS



Squint(1)

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LEARNING OBJECTS

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Definitions

Eso- The eye is rotated so that it is deviated nasally, this state is also known as convergent strabismus, one type of horizontal strabismus.

Exo- The eye is rotated so that it is deviated temporally, this state is also known as divergent strabismus, another form of horizontal strabismus.

Hyper- The eye is rotated so that it is deviated superiorly. This describes one type of vertical strabismus.

Hypo- The eye is rotated so that it is deviated inferiorly. This describes another type of vertical strabismus.

Incylo- The eye is rotated so that the superior pole of the vertical meridian is rotated nasally. This state is known as intorsion.

Excyclo- The eye is rotated so that the superior pole of the vertical meridian is rotated temporally. This state is known as extorsion.

-phoria A latent deviation (eg, esophoria, exophoria, hyperphoria); the deviation is controlled by the fusional mechanism so that the eyes remain aligned under binocular conditions.

-tropia A manifest deviation (eg, esotropia, exotropia, hypertropia); the deviation exceeds the control of the fusional mechanism so that the eyes are misaligned under binocular conditions. Heterotropias can be constant or intermittent.

Comitant (concomitant) The size of the deviation does not vary by more than a few prism diopters in different positions of gaze or with either eye used for fixation.

Incomitant (noncomitant) The deviation varies in size in different positions of gaze or with the eye used for fixation.

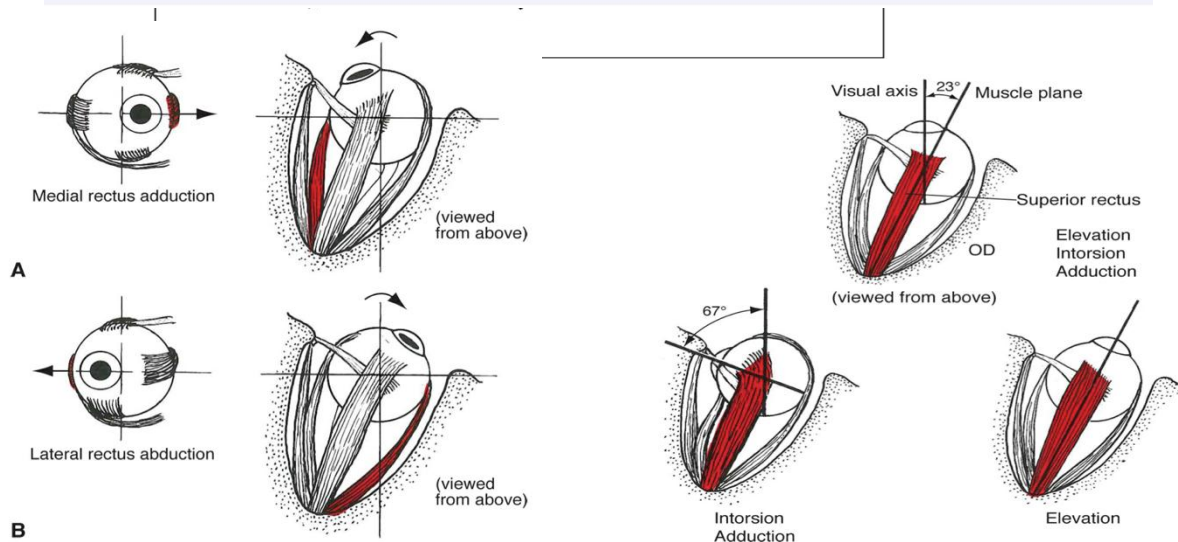
Extra ocular muscles anatomy & physiology

The primary action of a muscle is its major effect when the eye is in the primary position. Subsidiary actions are the additional effects, which depend on the position of the eye.

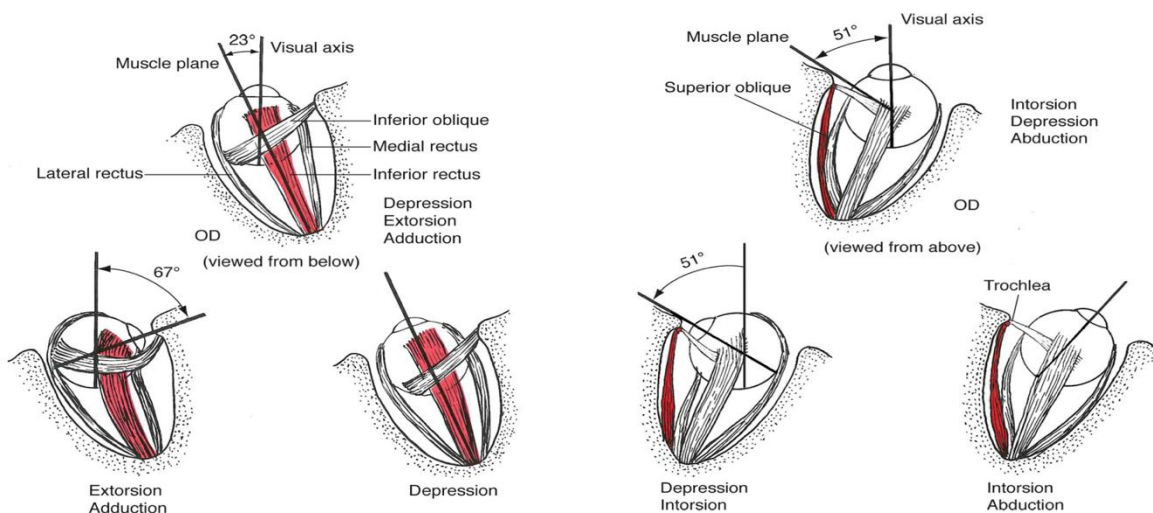
The Listing plane is an imaginary coronal plane passing through the centre of rotation of the globe. The globe rotates on the axes of Fick, which intersect in the Listing plane.

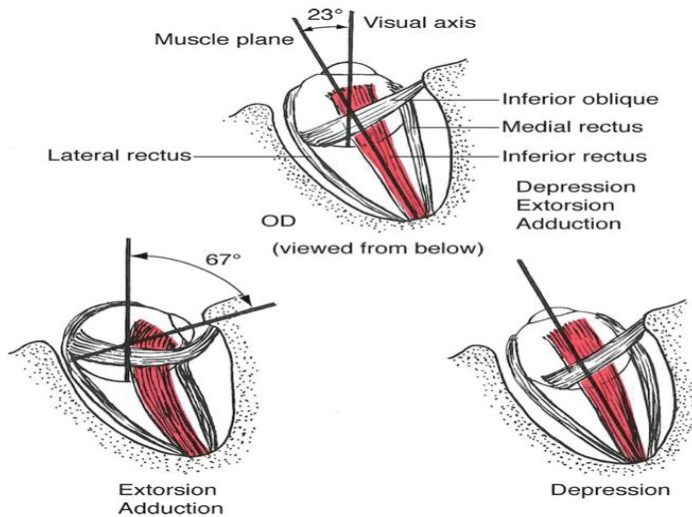
The globe rotates left and right on the vertical Z axis. The globe moves up and down on the horizontal X axis. Torsional movements (wheel rotations) occur on the Y (sagittal) axis which traverses the globe from front to back.

	In 1° position (subsidiary actions)	In abduction	In adduction
MR	Adduction	Adduction	Adduction
LR	Abduction	Abduction	Abduction
SR	Elevation (intorsion, adduction)	Elevation (isolated at 23° abduction)	Intorsion (isolated at 67° adduction)
IR	Depression (extorsion, adduction)	Depression (isolated at 23° abduction)	Extorsion (isolated at 67° adduction)
SO	Intorsion (depression, abduction)	Intorsion (isolated at 39° abduction)	Depression (isolated at 51° adduction)
IO	Extorsion (elevation, abduction)	Extorsion (isolated at 39° abduction)	Elevation (isolated at 51° adduction)



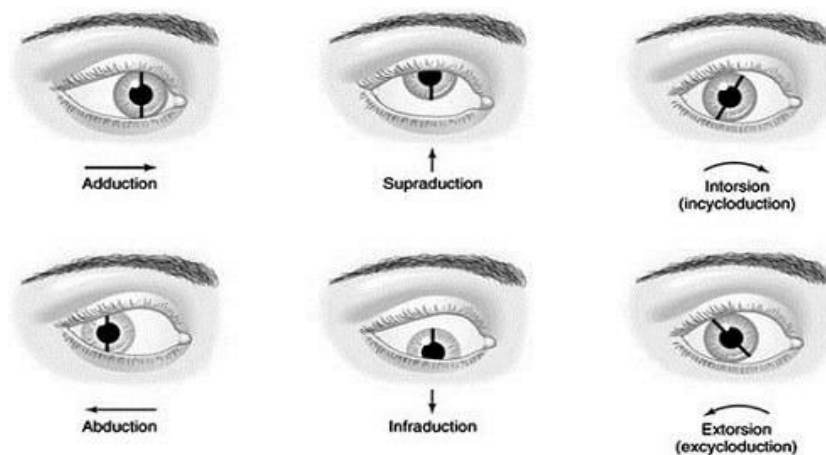
Actions of EOMs





Ocular movements

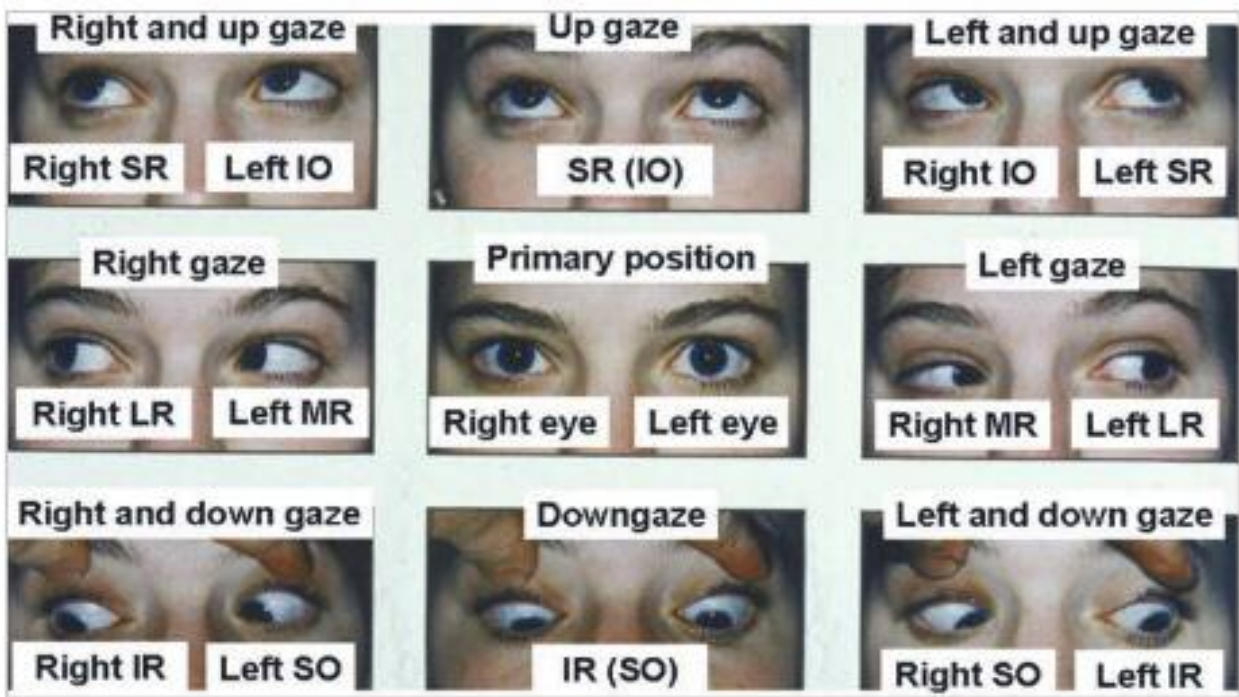
Ductions are monocular movements around the axes of Fick. They consist of adduction, abduction, elevation, depression, intorsion and extorsion. They are tested by occluding the fellow eye and asking the patient to follow a target in each direction of gaze.



Versions are binocular, simultaneous, conjugate movements (conjugate – in the same direction)

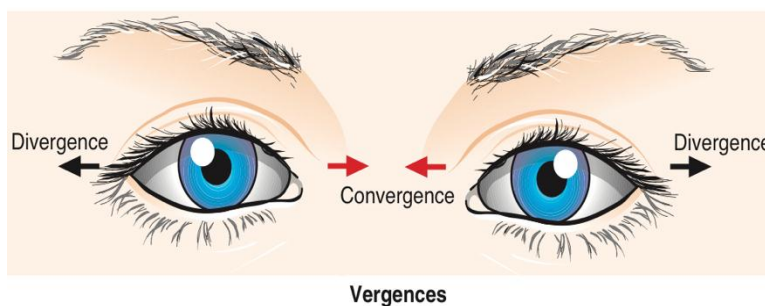
- *Dextroversion and laevoversion (gaze right and gaze left), elevation (upgaze) and depression (downgaze). These four movements bring the globe into the secondary positions of gaze by rotation around either the vertical (Z) or the horizontal (X) axes of Fick.*

- *Dextrolevation and dextrodepression (gaze up and right; gaze down and right) and laevoelevation and laevodepression (gaze up and left; gaze down and left). These four oblique movements bring the eyes into the tertiary positions of gaze by rotation around oblique axes lying in the Listing plane, equivalent to simultaneous movement about both the horizontal and vertical axes.*
- *Torsional movements to maintain upright images occur on*



tilting of the head; these are known as the righting reflexes.

Vergences are binocular, simultaneous, disjugate movements (disjugate – in opposite directions). Convergence is simultaneous adduction (inward turning) and divergence is outwards movement from a convergent position.

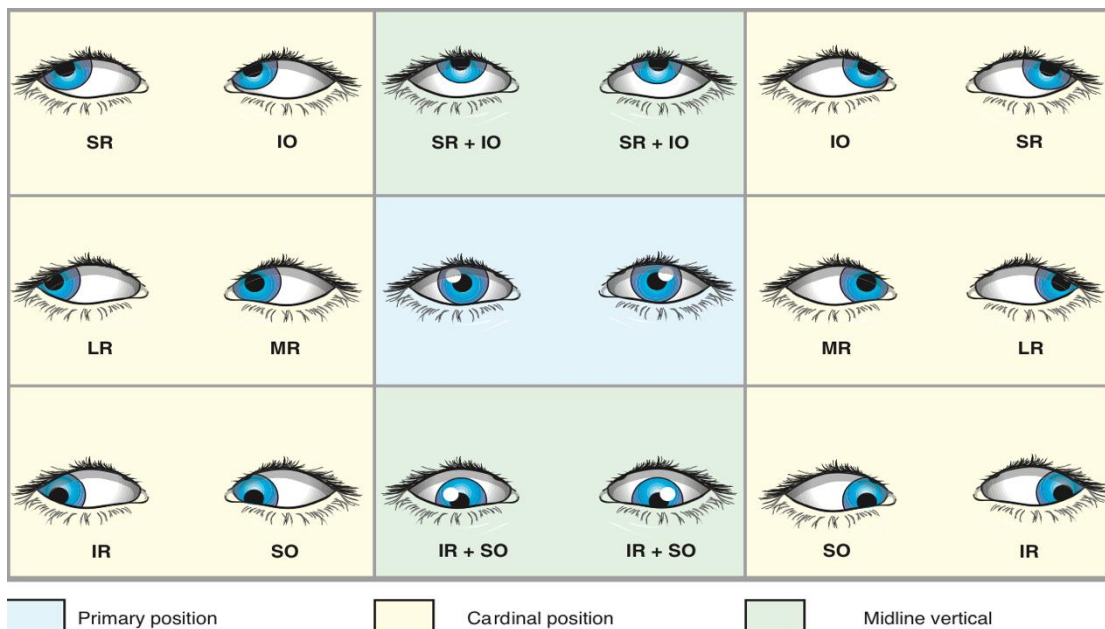


Positions of gaze

• **Six cardinal positions** of gaze are identified in which one muscle in each eye is principally responsible for moving the eye into that position as follows:

- *Dextroversion (right lateral rectus and left medial rectus).*
- *Laevoversion (left lateral rectus and right medial rectus).*
- *Dextroelevation (right superior rectus and left inferior oblique).*
- *Laevoelevation (left superior rectus and right inferior oblique).*
- *Dextrodepression (right inferior rectus and left superior oblique).*
- *Laevodepression (left inferior rectus and right superior oblique).*

• **Nine diagnostic positions** of gaze are those in which deviations are measured. They consist of the six cardinal positions, the primary position, elevation and depression.



Assessment of Squint

Hx taking:

- ✓ *Age of onset.*
- ✓ *The longer the duration of squint in early childhood the greater the risk of amblyopia.*
- ✓ *Symptoms.*
- ✓ *Variability of squint, constant or intermittent, one eye or alternating.*
- ✓ *General health or developmental problems may be significant (e.g. children with cerebral palsy have an increased incidence of strabismus).*
- ✓ *Family history is important because strabismus is frequently familial.*
- ✓ *Previous ocular history including refractive prescription and compliance with spectacles or occlusion, previous surgery or prisms.*

VA & refraction

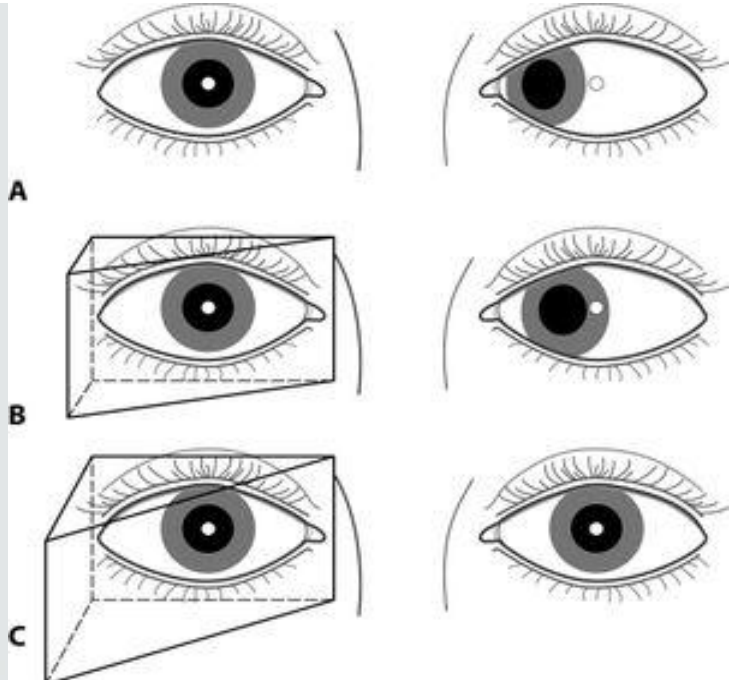
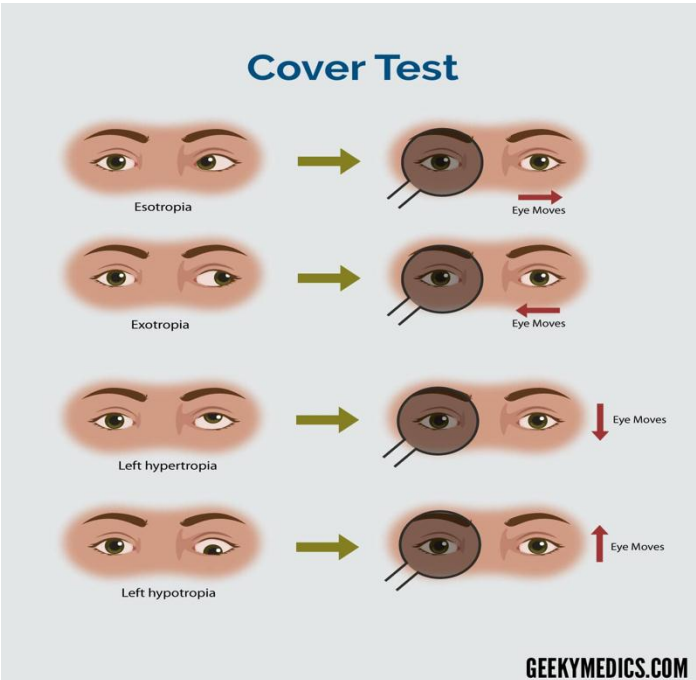
Measurement of deviation

- 1. Hirschberg test :** *gives a rough objective estimate of the angle of a manifest strabismus and is especially useful in young or uncooperative patients.*
- 2. Cover–uncover test:** *detect squint and type of squint.*
- 3. The Krimsky test:** *involves placement of prisms in front of the fixating eye until the corneal light reflections are symmetrical.*
- 4. Prism cover test:** *measures the angle of deviation and includes the alternate cover test with prisms.*

Ocular motility test

Slit lamp & fundus examination

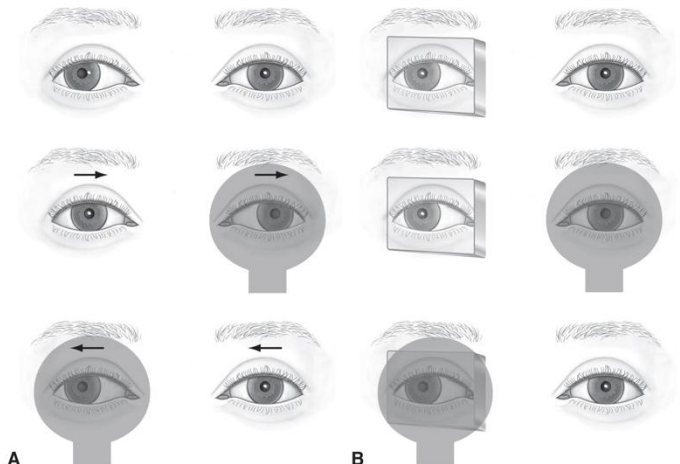
Hirschberg test



Hirschberg test: left pic ,test technique / Right pic, test result.

Left pic : cover test. Right pic: krimsky test.

Left pic :Prism cover test technique. Right pic: test result.



Pseudo-strabismus

Pseudo-strabismus is the clinical impression of ocular deviation when no squint is present.

Causes

1.Pseudoesotropia : It caused by a flat and broad nasal bridge, prominent epicanthal folds, a narrow inter pupillary distance, enophthalmos, facial asymmetry. Less than the expected amount of sclera is seen nasally, creating the impression that the eye is deviated inward .Because no real deviation exists, results of both Hirschberg test and Cover–uncover test are normal.

2.Pseudoexotropia : much less common than pseudoesotropia and may occur when there is a wide inter pupillary distance,



proptosis ,facial asymmetry.

Pseudo strabismus. (A) Prominent epicanthic folds simulating esotropia; (B) wide inter pupillary distance simulating exotropia.

Amblyopia

Amblyopia is a unilateral or, less commonly, bilateral reduction of best-corrected visual acuity that cannot be attributed directly to the effect of any structural abnormality of the eye or visual pathways. Amblyopia signifies a failure of normal neural development in the immature visual system and is caused by abnormal visual experience early in life.

Causes & classification

1. **Strabismic amblyopia** results from abnormal binocular interaction where there is continued monocular suppression of the deviating eye.
2. **Anisometropic amblyopia** is caused by a difference in refractive error between the eyes and may result from a difference of as little as 1 diopter. The more ametropic eye receives a blurred image, in a mild form of visual deprivation.
3. **Stimulus deprivation amblyopia** results from vision deprivation. It may be unilateral or bilateral and is typically caused by opacities in the media (e.g. cataract) or ptosis that covers the pupil.
4. **Bilateral ametropic amblyopia** results from high symmetrical refractive errors, usually hypermetropia.
5. **Meridional amblyopia** results from image blur in one meridian. It can be unilateral or bilateral and is caused by uncorrected astigmatism (usually >1 D).

Diagnosis

1. Decreased VA: defined as loss of VA of two or more lines on Snellen chart
2. Crowding phenomenon :VA better for single letter than multiple letters.
3. Normal ocular exam and no RAPD.
4. Search for the cause & exclude other causes of decrease vision.

Treatment

The sensitive period during which acuity of an amblyopic eye can be improved is usually up to 7–8 years in strabismic amblyopia and may be longer (into the teens) for anisometropic amblyopia.

1. Remove obstacles to clear vision: *Refractive correction, cataract surgery.*

2. Occlusion therapy (gold standard):

Amount of occlusion depends on age of patient, cause of amblyopia and severity of amblyopia. Best achieved with adhesive patches. Patching should be started as soon as amblyopia is detected.

a) part-time occlusion.

b) Full-time occlusion.

Patching should be continued till VA reaches and maintains a plateau for 3–6 months. Regular follow-up to ensure that vision remains stable until 9 years of age when visual system is assumed to have “matured”

3. Penalization: *Usually reserved for patching failure or noncompliance with patching*

a) Pharmacologic: 1% atropine placed in good eye to blur eye for near vision.

b) Optical: Under correcting the refractive error in better eye or wearing plus lens .

N.B:

Strabismic amblyopia :Occlusion therapy should be instituted prior to surgery.

Amblyopia related to refractive errors :Correct refractive error first before occlusion therapy.

Stimulus deprivation amblyopia: Remove barriers to vision preferably within first 6 weeks of life

Concomitant Esotropia

Early onset esotropia (Congenital, infantile, essential)

Up to the age of 4 months, infrequent episodes of convergence (small angle) are normal but thereafter ocular misalignment is abnormal.

Clinical features

- *Presents at 6 months of birth.*
- *Normal infant.*
- *no limitation of ocular movements.*
- *Family history common.*
- *Large angle (> 30 prism D) & Stable.*
- *Angle at distance = near*
- *The refractive error is usually normal for the age of the child (about +1 to +2 D).*
- *Alternating fixation in primary position.*
- *Latent nystagmus, dissociated vertical deviation, IO over-action.*
- *There is cross-fixating in side gaze, so that the child uses the left eye in right gaze and the right eye on left gaze. Such cross-fixation may give a false impression of bilateral abduction deficits, as in bilateral sixth nerve palsy. Abduction can usually be demonstrated, either by the doll's head manoeuvre or by rotating the child. If these fail, unocular patching for a few hours will often unmask the ability of the other eye to abduct.*



Alternating fixation in early-onset esotropia (A) Fixating with right eye; (B) fixating with left eye.



Cross-fixation in early-onset esotropia. (A) Left fixation on right gaze; (B) right fixation on left gaze.



Bilateral inferior oblique over-action. (A) Straight eyes in the primary position; (B) left inferior oblique over-action on right gaze; (C) right inferior oblique over-action on left gaze.



(C) right inferior oblique over-action on left gaze.

Dissociated vertical deviation. (A) Straight eyes in the primary position; (B) up-drift of left eye under cover; (C) up-drift of right eye under cover.

Management

Early ocular alignment gives the best chance of the development of some degree of binocular function.

- *Correct amblyopia & refractive error.*
- *Timing of surgery: 6 months to 2 years (usually before 1st birthday).*
- *Type of surgery: Bilateral MR recession aiming for 10 prism D of residual ET.*
- *Subsequent management: Manage amblyopia (develops in 40% of congenital ET after surgery).*

Accommodative esotropia

Near vision involves both accommodation and convergence. Accommodation is the process by which the eye focuses on a near target. Simultaneously the eyes converge, in order to fixate bifoveally on the target. Both accommodation and convergence are quantitatively related to the proximity of the target and have a fairly constant relationship to each other (the AC:A ratio is a measure of accommodative convergence per unit of accommodation and varies between individuals normally range 3-5/1).

Features of accommodative esotropia

1. *Presents at 2.5 years (between 1 and 5y of age).*
2. *Usually intermittent in onset early on then becomes constant.*
3. *Family history is common.*
4. *May be precipitated by trauma or illness.*
5. *Amblyopia is common.*
6. *Diplopia is uncommon.*
7. *The measured angle of esodeviation is usually moderate (20- to 30-prism diopters).*

Types of Accommodative esotropia:

1.Refractive accommodative esotropia:

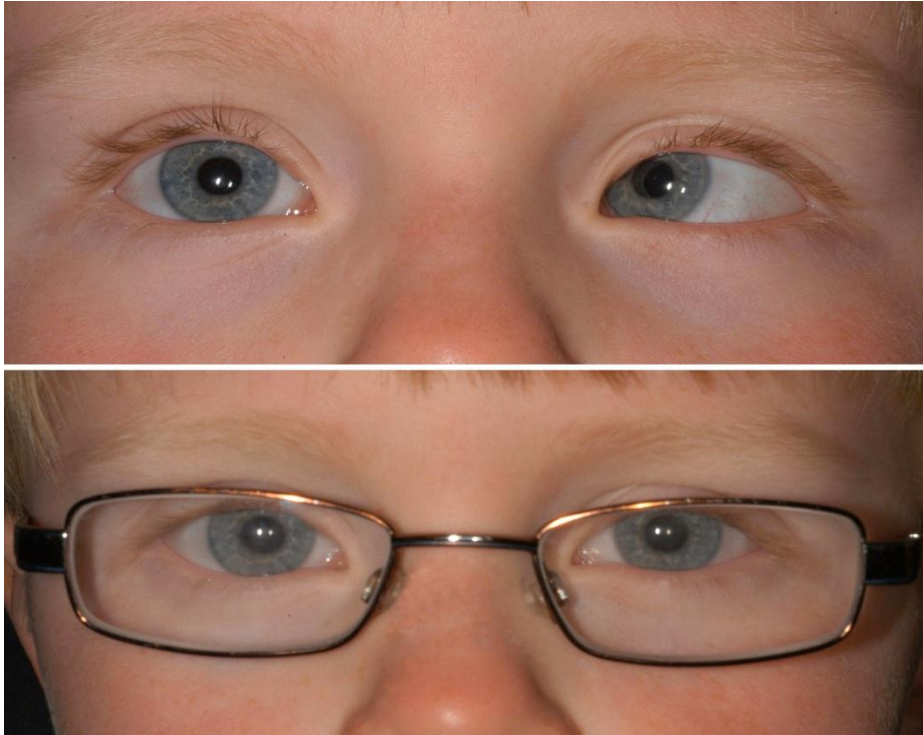
In this type, the AC/A ratio is normal and esotropia is a physiological response to excessive hypermetropia, usually between +2.00 and +7.00 D & Deviation same near and distance.It is divided into :

A.Fully accommodative esotropia: *The deviation is eliminated following optical correction of hypermetropia (fully corrected with glasses).*

Mx involve : correction of hypermetropia & amblyopia first then gradually weaning the patient from glasses by decreasing it. Surgery not necessary. Reassure patient that the hypermetropia and ET will lessen as they grow older.

B. Partially accommodative esotropia is reduced but not eliminated by full correction of hypermetropia (ET partially corrected with glasses).

Mx involve: correction of hypermetropia & amblyopia first then consider surgery for the deviation that not corrected by



glasses. The patient will still require glasses post-surgery.

Fully accommodative esotropia. Above: left esotropia without glasses; below: squint is eliminated with glasses.

Partially accommodative esotropia. (A) Right esotropia without

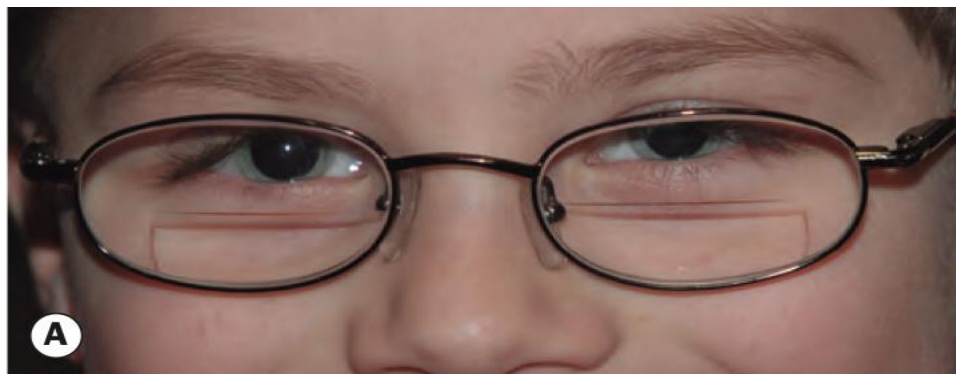


glasses; (B) angle is reduced but not eliminated with glasses.

2. Non-refractive accommodative esotropia:

In this type, the AC/A ratio is high so that a unit increase of accommodation is accompanied by a disproportionately large increase in convergence. This occurs independently of refractive error, although hypermetropia frequently coexists. Deviation greater for near compared to distance.

Mx involves: correction of hypermetropia(using bifocals) & amblyopia first then then gradually weaning the patient from



glasses by decreasing it. Patient may require surgery.

(A) Eyes straight for distance; (B) right esotropia for near; (C) eyes straight when looking through bifocals.

Sensory (secondary) esotropia

Secondary esotropia is caused by a unilateral reduction in VA that interferes with or abolishes fusion. Causes can include cataract, optic atrophy or hypoplasia, macular scarring or retinoblastoma. Fundus examination under mydriasis is therefore essential in all



children with strabismus.(fig.)

Right esotropia secondary to a retinoblastoma.

Consecutive esotropia

Consecutive esotropia follows surgical over-correction of an exodeviation.

Incomitant esotropia

1. Neurogenic squint (paralytic)

6th cranial nerve palsy ,

2. Mechanical squint

thyroid disease, medial orbital wall fracture with entrapment.

3. Myopathy

myasthenia gravis ,myositis.

4. Restriction



Duane syndrome.

left sixth nerve palsy in a child. (A) Left esotropia in the primary position; (B) marked limitation of left abduction; (C) normal left adduction.