8

Strabismus

EXTRAOCULAR MUSCLES

The important extraocular muscles are:

- *Four recti*: Superior rectus (SR), medial rectus (MR), inferior rectus (IR) and lateral rectus (LR)
- *Two obliques*: Superior oblique (SO) and inferior oblique (IO)

	Recti	Superior oblique	Inferior oblique
Origin	**Annulus of Zinn**[Q] (common tendinous ring at orbital apex, encircling optic foramina and medial part of superior orbital fissure)	**Body of sphenoid** [Q] at the apex of the orbit	Orbital plate of maxilla **at the floor of the orbit** [Q]
Insertion	Inserted into sclera at different distances away from the limbus. **The distances from limbus are MR: 5.5 mm IR: 6.5 mm LR: 6.9 mm SR: 7.7 mm**	First travels antero- medially, and then turns backwards at the trochlea. It then travels posterolaterally to insert in the sclera in the **upper temporal quadrant of the globe**[Q]	Travels backwards and laterally to insert into the **lower temporal quadrant of the globe**[Q]

Few important facts

- Rectus muscle closest to limbus: MR[Q]
- Rectus muscle farthest from limbus: SR[Q]
- Longest extraocular muscle: SO
- Shortest extraocular muscle: IO
- **The Spiral of Tillaux is the line joining the points of insertion of the rectus muscles**[Q]

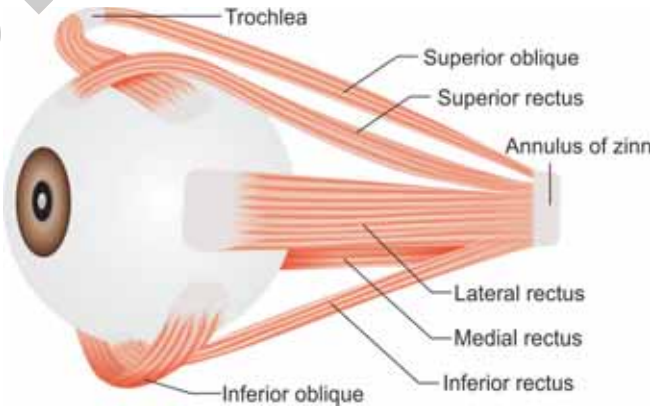


Fig. 1: Extraocular muscles

Nerve Supply

- LR is supplied by sixth cranial nerve
- SO is supplied by fourth cranial nerve
- MR, IR, SR, IO are supplied by third cranial nerve
- Remembered as **SO4 LR6** [Q]

Actions of the Extraocular Muscles

Muscle	Action			Nerve supply
	Primary	Secondary	Tertiary	
MR	Adduction			III
IR	Depression	Extorsion	Adduction	III
LR	Abduction			VI
SR	Elevation	Intorsion	Adduction	III
SO	Intorsion	Depression	Abduction	IV
IO	**Extorsion**	Elevation	Abduction	III

Points to Remember

- **SIN - Superiors are Intorters**[Q] (SR and SO)
- **RAD - Recti are Adductors**[Q] (SR and IR)
- The superior oblique functions **only as depressor in adducted position** and **only as intorter in abducted position**[Q]
- The inferior oblique functions **only as elevator in adducted position** and **only as extorter in abducted position**[Q]

OCULAR MOVEMENTS

- *Ductions*: These are monocular movements like adduction, abduction, elevation and depression
- *Versions*: These are binocular conjugate movements (in the same direction)
  - Dextroversion (right sided gaze)
  - Levoversion (left sided gaze)
  - Dextroelevation (up and right gaze)
  - Levoelevation (up and left gaze)
  - Dextrodepression (down and right gaze)
  - Levodepression (down and left gaze)
- *Vergence*: These are binocular disjugate movements (both eyes move in opposite directions) like convergence. Convergence is the ability of the two eyes to move inwards. It has two components: voluntary and reflex. Reflex convergence again has four components.
  - *Tonic convergence*: Due to basal tone of muscle
  - *Proximal convergence*: Induced by psychological awareness of a near object
  - Fusional convergence
  - *Accommodative convergence*: It is induced by the effort of accommodation. For each diopter of accommodation, a fairly constant increment in accommodative convergence occurs **(AC/A Ratio).** AC/A ratio denotes the amount of convergence measured in **prism diopter** per unit change in accommodation. **Normal value is 4:1 (1 D of accommodation is associated with 4 prism diopters of convergence)**[Q]. High AC/A ratio leads to excessive convergence and esotropia. Low AC/A ratio leads to exotropia.

Points to Remember

- *Agonist-antagonist*: Muscles of same eye which have opposite functions, e.g. MR and LR of the same eye
- *Synergist*[Q]: Muscles of the same eye which move the eye in the same direction, e.g. SR and IO of the same eye are synergists in elevation
- *Yoke muscles*[Q]: A pair of muscles of opposite eyes which produce a conjugate ocular movement, e.g. LR of right eye and MR of left eye are yoke muscles for dextroversion

Laws of ocular motility

- *Herring's law of equal innervation*[Q]: During any conjugate movement, equal & simultaneous innervation flows to a pair of yoke muscles.
- *Sherrington's law of reciprocal innervation*[Q]: Increase in innervation and contraction of a muscle is associated with reciprocal decrease in innervation and relaxation of its antagonist

YOKE MUSCLES FOR CARDINAL POSITIONS OF GAZE

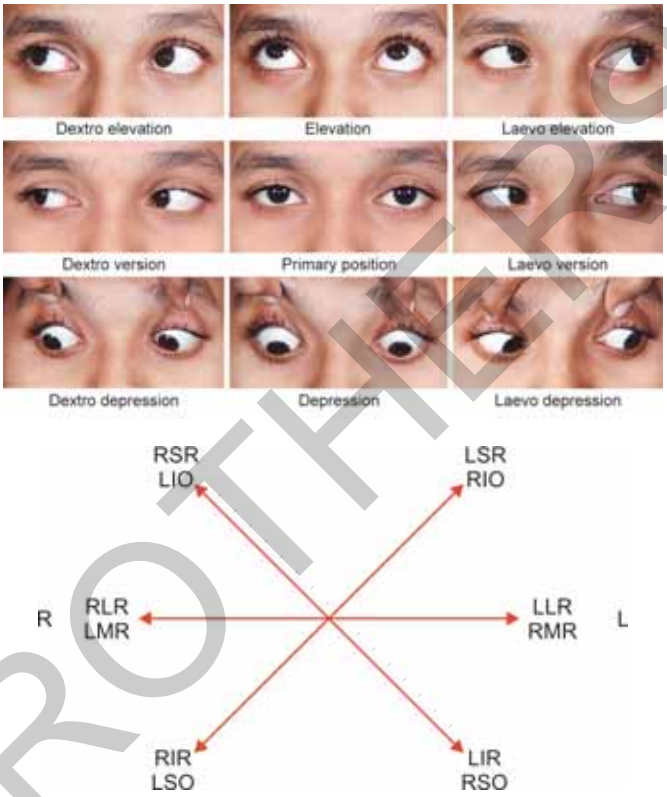


Fig. 2: Yoke Muscles

	Nature of movement	Yoke muscles
Dextroversion	Abduction for right eye Adduction for left eye	Right lateral rectus Left medial rectus
Dextroelevation	Elevation in abduction for right eye Elevation in adduction for left eye	Right superior rectus Left inferior oblique
Dextrode-pression	Depression in abduction for right eye Depression in adduction for left eye	Right inferior rectus Left superior oblique
Levoversion	Abduction for left eye Adduction for right eye	Left lateral rectus Right medial rectus
Levoelevation	Elevation in abduction for left eye Elevation in adduction for right eye	Left superior rectus Right inferior oblique
Levodepression	Depression in abduction for right eye Depression in adduction for left eye	Left inferior rectus Right superior oblique

Binocular single vision (BSV)

BSV is achieved by use of the two eyes together. By this, slightly dissimilar images arising in each eye are appreciated as a single image.

Grades of binocular vision

- *Grade I:* Simultaneous Macular Perception (SMP)[Q]
- *Grade II:* Fusion[Q]
- *Grade III:* ***Stereopsis[Q]:*** Ability to obtain an impression of depth

DOUBLE VISION/DIPLOPIA

The pre-requisite for binocular single vision is perfect ocular alignment. Strabismus or any ocular deviation hence may result in diplopia. But the individual undertakes certain adaptations in order to overcome this diplopia. The compensatory mechanisms vary according to the type of diplopia and the age of the individual.

Adaptations in Strabismus

- *Suppression*: It occurs in children with squint where the image formed on the retina by the squinting eye is suppressed by the visual cortex. This leads to the development of **amblyopia**.
- *Abnormal retinal correspondence (ARC)*: This is an adaptation where non-corresponding retinal areas are paired together to achieve an anomalous binocular vision in the presence of small degrees of squint
- *Compensatory head posture*: This is a feature of paralytic strabismus where the head is turned in the direction of field of action of the weak/paralysed muscle. The type of head posture depends upon the type of diplopia and the muscle involved
  - For horizontal muscle palsy like LR palsy, the patient develops a **face turn[Q]**
  - For vertical muscle palsy like SR or IR, the patient develops **chin elevation or chin depression[Q]**
  - For oblique muscle palsy like SO, the patient develops a **head tilt[Q]**.

CLASSIFICATION OF SQUINT

- *Pseudostrabismus*: This is not actually a deviation but gives an impression of ocular deviation. It is seen in prominent **epicanthic fold, hyperteleorism** etc.
- *Latent squint (Phoria)*: In this condition, the tendency of the eyes to deviate is kept in check by the fusional ability of the individual. If the fusion is broken by prolonged occlusion of one eye, deviation becomes manifest. This is also called **phoria**, e.g. **Esophoria** (latent convergent squint) and **Exophoria** (latent divergent squint)
- *Manifest squint (Tropia)*: In this condition, the deviation of the eye is evident on observation, e.g. **Esotropia** (manifest convergent squint) or **Exotropia** (manifest divergent squint). It is of two types
  - *Concomitant squint*: The degree of deviation is the **same in all gazes[Q]**
  - *Incomitant squint*: The common type is **paralytic squint** where there is paralysis of one or more extraocular muscle. **The deviation is maximum in the direction of action of the paralysed muscle[Q]**.

	Concomitant squint	Incomitant squint
Deviation	Same in all gazes	**Maximum in the direction of gaze of the affected muscle[Q]**
Extraocular movements	Normal	Limitation in the direction of action of the affected muscle
Amblyopia	May be **present in children[Q]**	Absent
Head posture	Usually absent	Usually present
Primary(P) and **Secondary deviation(S)**	Both are same	**Secondary deviation> Primary Deviation[Q]**

Important points

- **Primary deviation is the deviation of the affected eye[Q].**
- **Secondary deviation is the deviation of the good eye under cover [Q]**
- Secondary deviation> Primary deviation in paralytic squint is explained by Herring's law

ESOTROPIA OR CONVERGENT SQUINT

- Essential infantile esotropia
- Accommodative esotropia - It is of three types:
  - Refractive
  - Nonrefractive
  - Mixed
- Non accommodative esotropia
  - Sensory deprivation
  - Divergence insufficiency
  - Convergence excess or spasm
  - Consecutive.

Infantile Esotropia

- It presents within the **first six months of birth**[Q]
- Common in children with hydrocephalus and cerebral palsy
- **Large and constant angle of squint**[Q]
- **Minimum refractive error**[Q]
- Alternate fixation in primary position and **cross fixation**[Q] in side gaze
- **Nystagmus**[Q]
- *Management is surgical.*

Accommodative Esotropia

It is esotropia associated with abnormality in the process of accommodation. **It usually manifests at the age of 2-3 yrs**[Q]**.**

- *Refractive*: It is associated with high **hypermetropia**[Q]**.** Due to excessive accommodative effort by the patient, there is excessive convergence leading to esotropia. **The angle of deviation is almost equal for both distance and near**[Q]
- *Non Refractive*: In this condition, there is minimum refractive error but an **abnormally high AC/A ratio**[Q]**.** This means that there is excessive convergence for a normal accommodative effort. **There is minimum deviation for distance but significant esotropia for near**[Q]
- *Mixed*: This is a combination of high hypermetropia and high AC/A ratio
- Management
  - Spectacles for refractive type
  - Surgery for non-refractive type.

SPECIAL SQUINTS

Duanne's retraction syndrome

- It is a syndrome where there is failure of innervation of the lateral rectus by the sixth nerve and abnormal innervation of the lateral rectus by the third nerve. It has three types
  - TYPE I: Esotropia with limitation of abduction and relatively normal adduction[Q]
  - TYPE II: Exotropia with limitation of adduction and relatively normal abduction[Q]
  - TYPE III: Limitation of both abduction and adduction with minimal deviation[Q]
- On attempted adduction there is retraction of the globe and narrowing of the palpebral fissure
- Treatment is not needed in most cases because deviation is not much and there is no amblyopia

Brown's superior oblique tendon sheath syndrome: Limitation of elevation in adduction and normal elevation in abduction.

Mobius syndrome: Congenital aplasia of VI, VII, IX, XII cranial nerve nuclei.

Double elevator palsy: Paresis of SR and IO of the same eye.

PRINCIPLES OF SQUINT SURGERY

The basic principle of squint surgery is weakening of the stronger muscle and strengthening of the weaker muscle. The weakening and strengthening procedures are

- **Weakening Procedures**
  - *Recession*: The insertion of the muscle is moved posteriorly towards its origin.
  - *Marginal myotomy*
  - *Myectomy*: Muscle is severed from its insertion but not reattached
- **Strengthening Procedures**
  - *Resection*: Pull of muscle is enhanced by making it shorter
  - Tucking
  - *Advancement*: Muscle is disinserted and advanced closer to the limbus.

AMBLYOPIA

Amblyopia is a unilateral or bilateral reduction of best corrected visual acuity in the absence of any organic cause.

Clinical Features

- Unilateral or bilateral reduced vision
- *Crowding phenomenon*[Q] *may be seen*: The patient is able to identify a Snellen's chart character with the amblyopic eye when the character is presented in isolation. If the character is shown along with other letters, the patient may not be able to recognize it.
- *Neutral Density Filter Test (NDF)*: When the patient is asked to read through a NDF, the amblyopic eye shows no change, while in the normal eye, there is a drop in visual acuity
- Amblyopia treatment should be tried till the child is 12 years old. **Best results are seen between 5–8 years of age**[Q].

Types of Amblyopia

Strabismic amblyopia	Refractive amblyopia	Stimulus deprivation amblyopia
Caused by uncorrected squint where the protective mechanism of **suppression** leads to amblyopia	Caused by uncorrected refractive error	Caused by media opacity in the form of cataract or corneal opacity where amblyopia develops due to **visual form deprivation**.
Best prognosis[Q]	Good prognosis	**Worst prognosis**[Q]

Refractive Amblyopia

- *Anisometropic amblyopia*: It develops due to difference in refractive error between the two eyes. This leads to amblyopia in the eye with the larger refractive error if corrective glasses are not worn. **Hypermetropes are more prone to develop anisometropic amblyopia**[Q].
- Bilateral emetropic amblyopia can occur if the refractive error is high in both eyes and is not corrected
- Meridional amblyopia is the term used when amblyopia affects only one meridian due to high astigmatic error.

Treatment of Amblyopia

- *Occlusion*[Q]: Occlusion of the good eye forces the child to see with the amblyopic eye and helps in improving vision.
- *Penalization*[Q]: If a child is not co-operative to occlusion, penalization by instillation of atropine in the good eye is the next option
- Pleoptic therapy
- CAM stimulator.

Must Remember

- *Primary action of superior oblique:* Intorsion
- *Primary action of inferior oblique:* Extorsion
- *Test for latent squint/phoria:* Cover-uncover test
- *Hess chart:* Used in paralytic squint
- *Secondary deviation> Primary deviation:* Paralytic squint

QUESTIONS

Extraocular Muscles

1. Functions of superior oblique muscle are: *(PGI 2000)*
a. Intorsion b. Extortion
c. Abduction d. Adduction
e. Depression

2. Function of superior oblique muscle is: *(AIPG)*
a. Elevation with inward rotation
b. Elevation with outward rotation
c. Depression with inward rotation
d. Depression with outward rotation

3. Which of the following muscles is an intorter? *(AIIMS 2000)*
a. Inferior rectus b. Inferior oblique
c. Superior rectus d. Lateral rectus

4. The superior oblique is supplied by: *(AIPG 2005)*
a. IIIrd cranial nerve b. IVth cranial nerve
c. VIth cranial nerve d. Vth cranial nerve

5. Primary function of superior oblique is: *(APPG 2013)*
a. Elevation b. Depression
c. Intorsion d. Extortion

6. IIIrd cranial nerve supplies: *(PGI)*
a. Lateral rectus
b. Levator palpebrae superioris
c. Superior oblique
d. Superior rectus
e. Medial rectus

7. Action of right superior oblique is: *(PGI)*
a. Dextroelevation b. Dextrodepression
c. Levodepression d. Levoelevation

8. Functions of superior rectus are: *(DNB 2012)*
a. Elevation, extorsion, adduction
b. Elevation, intorsion, adduction
c. Depression, intorsion, adduction
d. Depression, extorsion, adduction

9. Functions of superior oblique are: *(NEET 2016)*
a. Extorsion, depression, adduction
b. Intorsion, depression, abduction
c. Elevation, extorsion, abduction
d. Elevation, intorsion, adduction

10. Which of the following muscles does not have adduction function? *(WBPG 2012)*
a. Medial rectus b. Superior rectus
c. Inferior oblique d. Inferior rectus

11. The yoke muscle of right superior oblique is: *(DNB 2014/ NEET 2016)*
a. Right inferior oblique b. Left inferior oblique
c. Right inferior rectus d. Left inferior rectus

12. Left superior oblique and left inferior rectus are: *(Kerala PG 2014)*
a. Yoke muscles b. Agonists
c. Antagonists d. Synergists

13. Which of the following is not true about inferior oblique muscle: *(DNB 2016)*
a. It is the shortest muscle
b. Its primary action is extorsion
c. It originates from the annulus of Zinn
d. It is supplied by the third cranial nerve

14. Which muscle inserts closest to the limbus? *(CET JUNE 2017)*
a. Medial rectus b. Superior rectus
c. Lateral rectus d. Inferior rectus

15. The reciprocal inhibition of antagonist muscle is explained by: *(AIIMS 2008)*
a. Sherrington's law b. Laplace's law
c. Hick's law d. Herring's law

16. Equal and simultaneous innervation of yoke muscles is explained by: *(DPG 2009)*
a. Sherrington's law b. Fick's law
c. Herring's law d. Von Graefe's law

Evaluation of Squint

17. Which of the following is not a grade of binocular single vision? *(Maharashtra PG 2010)*
a. Simultaneous macular perception
b. Retinal correspondence
c. Fusion
d. Stereopsis

18. Stereopsis means: *(DNB 2015)*
a. Perception of different colours
b. Perception of depth
c. Perception of visual field
d. Perception of the size of an object

19. Hirschberg test is used to detect: *(APPG 2013)*
a. Diplopia b. Squint
c. Refractive error d. Glaucoma

20. Cover test is used to detect: *(DNB 2013)*
a. Manifest squint b. Paralytic squint
c. Latent squint d. Pseudosquint

Esotropia

21. Pseudo convergent squint is seen in: *(PGI)*
a. Thyrotoxicosis
b. Broad epicanthus
c. Abducens palsy
d. Narrow interpupillary distance

22. Features of infantile esotropia are: *(PGI)*
a. Present since birth b. Large angle esotropia
c. Inferior oblique overaction d. Surgery is the treatment
e. High refractive error

23. Which of the following are true about infantile esotropia? *(PGI 2015)*
a. Onset after 1 year of age
b. Amblyopia may develop
c. Angle of deviation is large and fixed
d. Surgery should be done only after 2 years
e. Minimum refractive error

24. Treatment of refractive accommodative esotropia is: *(AIIMS 2000)*
a. Surgery
b. Occlusion therapy
c. Convergence exercises
d. Correction of refractive error

25. True regarding accommodative esotropia: *(PGI)*
a. Glasses are used when miotics are ineffective
b. Miotics are used when glasses are ineffective
c. Miotics are used when AC/A ratio is high
d. Surgery is the only treatment

26. Most common type of squint seen in myopes is: *(DNB 2015)*
a. Intermittent exotropia
b. Intermittent esotropia
c. Esotropia hypotropia complex
d. Exotropia hypotropia complex

27. A 3-year-old child has esotropia in the right eye. On retinoscopy there is +4.5D hyperopia in right eye and +4D hyperopia in the left eye. The AC/A ratio is normal. What is the probable diagnosis? *(JIPMER)*
a. Infantile esotropia
b. Refractive accommodative esotropia
c. Non-refractive accommodative esotropia
d. Duane's retraction syndrome

Miscellaneous

28. A 10-year-old complains of headache. His best corrected visual acuity in the right eye is 6/36 and in the left eye is 6/6. Retinoscopy shows +5D in right eye and +1D in left eye. All other ocular examination is normal. What is the possible diagnosis? *(DNB 2012)*
a. Optic neuritis
b. Cortical blindness
c. Amblyopia
d. Malingering

29. Secondary deviation> Primary deviation is a feature of: *(WBPG 2007)*
a. Accommodative squint
b. Paralytic squint
c. Infantile esotropia
d. Alternate exotropia

30. Secondary deviation > Primary deviation in paralytic squint is explained by which law? *(WBPG 2008)*
a. Sherrington's law
b. Herring's law
c. Park's law
d. Fick's law

31. Which of the following is not a feature of paralytic squint? *(DNB 2012)*
a. Diplopia
b. Compensatory head posture
c. Amblyopia
d. Secondary deviation is more than primary deviation

32. In squint surgery, muscle resection leads to: *(DNB 2015)*
a. Weakening of muscle
b. Strengthening of muscle
c. Paralysis of muscle
d. No effect

33. Amblyopia is best corrected by: *(AIPG)*
a. <5 years
b. <8 years
c. <15 years
d. <20 years

34. Treatment of choice for amblyopia is: *(AIIMS 2000)*
a. Occlusion therapy
b. Orthoptic exercises
c. Spectacles
d. Surgery

35. Which of the following is true regarding Duane's retraction syndrome Type? *(WBPG 2009)*
a. Defective abduction with normal adduction
b. Defective adduction with normal abduction
c. Both adduction and abduction are defective
d. Elevation is defective

36. Duanne's retraction syndrome is characterised by: *(CET JUNE 2017)*
a. Decreased function of 6th nerve with limitation of abduction
b. Increased intraocular pressure
c. Weakness of superior oblique
d. Increased corneal pigmentation

37. Limitation of both adduction and abduction is seen in: *(AIIMS)*
a. Duane's Type I
b. Duane's Type II
c. Duane's Type III
d. Double elevator palsy

38. A-V pattern squint: Which of the following is/are true? *(PGI 2015)*
a. The terms 'A' or V pattern squint are labeled when the amount of deviation in squinting eye varies by more than 10° and 15°, respectively, between upward and downward gaze.
b. The terms 'A or V pattern squint are labeled when the amount of deviation in squinting eye varies by more than 20° and 25° respectively, between upward and downward gaze.
c. Usually, over action of the inferior oblique or weakness of superior oblique leads to A pattern & over action of the superior oblique or weakness inferior oblique to V pattern
d. Usually, over action of the inferior oblique or weakness of superior oblique leads to V pattern & over action of the superior oblique or weakness of inferior oblique to A pattern
e. Oblique muscle dysfunction is the commonest cause of AV pattern

24. d. Correction of refractive error *(Ref: Yanoff & Duker 4th edition, p 1210)*

25. c. Miotics are used when AC/A ratio is high *(Ref: Yanoff & Duker 4th edition, p 1210)*

Miotics like pilocarpine may be used as a modality of management in non-refractive accommodative esotropia. But it is not a very popular method

26. a. Intermittent exotropia *(Ref: Yanoff & Duker 4th edition, p 1215)*

27. b. Refractive accommodative esotropia *(Ref: Kanski 6th edition, p 770)*

The question describes a patient with the following features

- Age 3 years
- Esotropia
- Hypermetropic refractive error
- Normal AC/A ratio

Hence the answer is refractive accommodative esotropia

In infantile esotropia, there is minimum refractive error and associated features like cross fixation, nystagmus will be present

In non- refractive accommodative esotropia, there will be minimum refractive error with high AC/A ratio

28. c. Amblyopia *(Ref: Kanski 6th edition, p 746)*

In this question, the patient has anisometropia because the refractive error in the right eye is +5D and in the left eye is +1D. The vision in right eye is 6/36 but the ocular examination is normal. This means that there is no organic cause for decreased vision in the right eye. Hence the answer is amblyopia. This is a type of refractive amblyopia (anisometropic)

29. b. Paralytic squint *(Ref: Yanoff & Duker 4th edition, p 1225)*

Paralytic squint is a type of incomitant squint. In incomitant squint secondary deviation is more than primary deviation

30. b. Herring's law

31. c. Amblyopia *(Ref: Yanoff & Duker 4th edition, p 1225)*

32. b. Strengthening of muscle *(Ref: Yanoff & Duker 4th edition, p 1247)*

33. b. <8 years *(Ref: Yanoff & Duker 4th edition, p 1242)*

34. a. Occlusion therapy *(Ref: Yanoff & Duker 4th edition, p 1242)*

35. a. Defective abduction with normal adduction *(Ref: Yanoff & Duker 4th edition, p 1211)*

36. a. Decreased function of 6th nerve with limitation of abduction *(Ref: Yanoff & Duker 4th edition, p 1211)*

37. c. Duane's Type III *(Ref: Yanoff & Duker 4th edition, p 1211)*

38. a. The terms 'A' or V pattern squint are labeled when the amount of deviation in squinting eye varies by more than 10° and 15°, respectively, between upward and downward gaze.

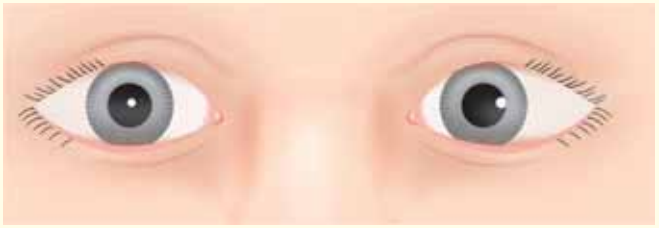
d. Usually, over action of the inferior oblique or weakness of superior oblique leads to V pattern & over action of the superior oblique or weakness of inferior oblique to A pattern

e. Oblique muscle dysfunction is the commonest cause of AV pattern

The above described features are seen in pattern strabismus *(Ref: Yanoff & Duker 4th edition, p 1221)*

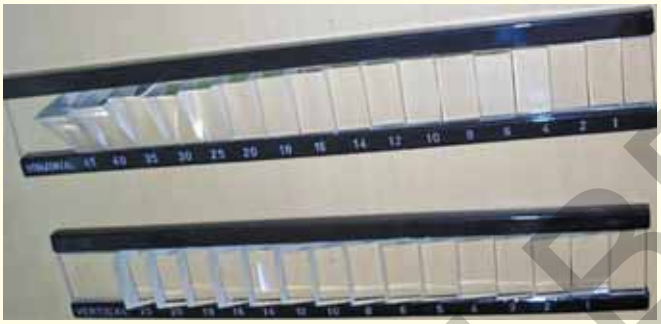
IMAGE BASED QUESTIONS

1. From the picture, estimate the grade of squint:



a. 15 degrees Esotropia
b. 15 degrees Exotropia
c. 30 degrees Esotropia
d. 30 degrees Exotropia

2. What is the device in the picture used for?



a. Hirschberg test
b. Prism bar cover test
c. Worth's four dot test
d. Stereopsis test

3. What does the picture in the test indicate?

Fig. 1

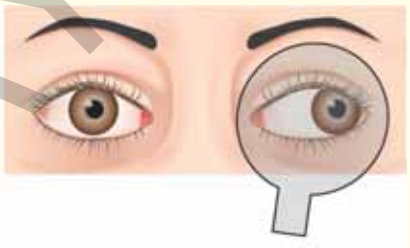


Fig. 2

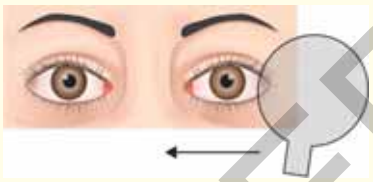


Fig. 3

a. Cover-uncover test indicating exophoria
b. Cover-uncover test indicating esophoria
c. Alternate cover test indicating esotropia
d. Alternate cover test indicating exotropia

4. What does the picture in the question indicate?

Fig. 1

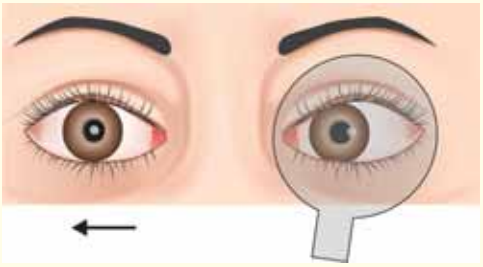


Fig. 2

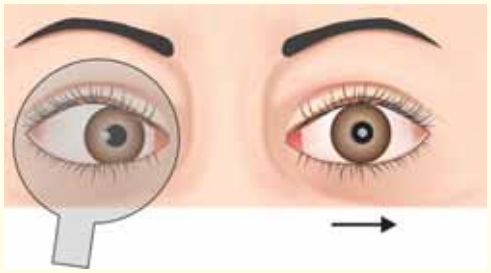


Fig. 3

a. Cover-Uncover test
b. Alternate cover test showing right esotropia
c. Alternate cover test showing right exotropia
d. Alternate cover test showing alternate esotropia

Answer Key: 1. a 2. b 3. a 4. d

ANSWERS AND EXPLANATIONS

1. Answer: a. 15 degrees Esotropia

(Ref: Yanoff & Duker 4th edition p 1193)

The picture represents the **Hirschberg test**ǫ. It is used to detect **manifest squint** ǫ and get a rough **estimate of the degree of squint**.

When a torch is shown in front of the eye, the reflex of the torch falls at the centre of the pupil in both eyes, if there is no squint (Fig. 1).

If there is a convergent squint or **esotropia**, the reflex in that eye will be moved **temporally** (as the eye is shifted inwards).

If there is a divergent squint or **exotropia**, the reflex in that eye will be moved **nasally** (as the eye is shifted outwards).

The basic rules of Hirschberg test are

- If the reflex falls at the edge of the pupil in the squinting eye, the deviation is 15 degrees (Fig. 2)
- If the reflex falls at the limbus of the squinting eye, the deviation is 45 degrees (Fig. 4)
- If the reflex falls in between the edge of pupil and the limbus, the deviation is around 30 degrees (Fig. 3)

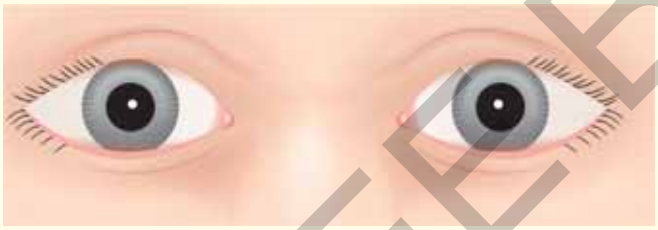


Fig. 1

Fig. 2

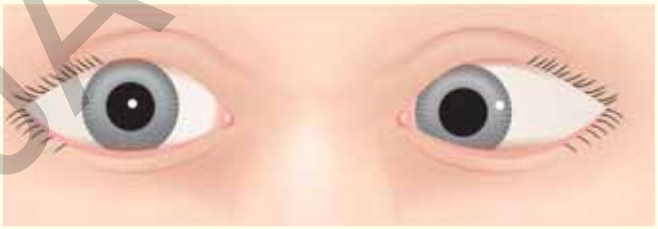


Fig. 3

Fig. 4

From the picture in the question, it is evident that the left eye is deviated inwards and the reflex falls at the margin of the pupil. So the left eye has esotropia or convergent squint of about 15 degrees.

2. Answer: b. Prism bar cover test

(Ref: Yanoff & Duker 4th edition p 1193-95)

The picture shows horizontal and vertical prism bars.

Prism bar cover test (PCT) is used for **quantitative evaluation of manifest squint.**

Prisms of increasing power are placed in front of the eye till the deviation is neutralized.

About **1 degree of squint** = **2 prism diopters**

3. Answer: a. Cover-uncover test indicating exophoria

(Ref: Peyman's Principles and Practice of Ophthalmology. 2nd edition, p 1310–13)

Cover-uncover test

- It is very useful to detect **latent squint** or **phoria**
- The occluder is placed in front of one eye and then removed. (Cover-uncover). As the occluder is removed, the behavior of the eye which was occluded is observed.
- If there is a phoria, the occluded eye deviates under cover and regains fixation when the occluder is removed.

Figure 1 shows that there is no manifest squint as both eyes are straight.

Figure 2 shows that on occluding the left eye, it deviates outward under cover.

Figure 3 shows that when the occluder is lifted from the left eye, it moves inwards to regain fixation.

So the test depicts latent divergent squint or exophoria of the left eye detected on cover-uncover test.

4. Answer: d. Alternate cover test showing alternate esotropia

(Ref: Peyman's Principles and Practice of Ophthalmology. 2nd edition, p 1310–13)