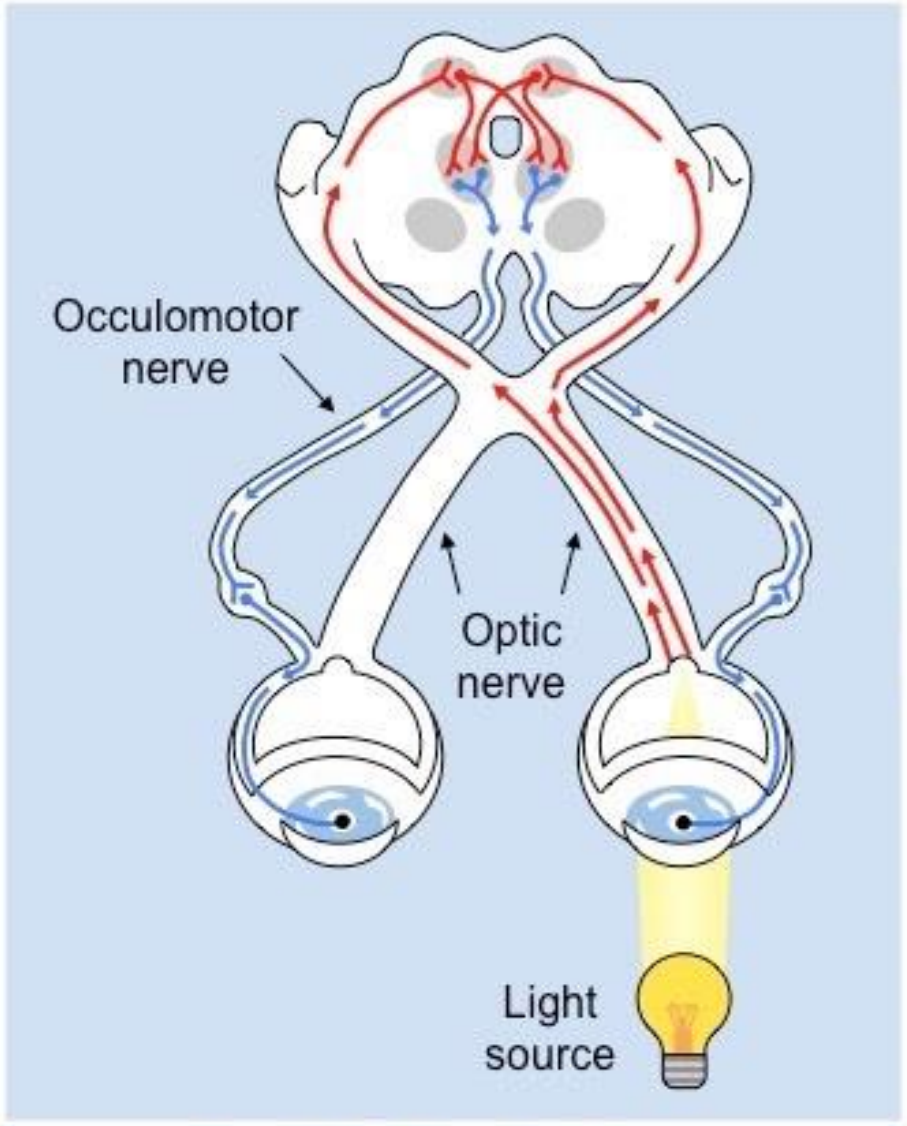
Pupillary reflexes



Pupil Reflex Pathway

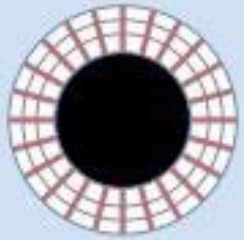
Pupil Response – Bright Light

Pupil Constricts

Circular Muscles Contract

Pupil Response – Dim Light

Pupil Dilates



Radial Muscles Contract

Normal pupil

- Functions:
  - Limits the amount of light reaching retina
  - Controls spherical & chromatic aberrations
- Number
- Location
- Size → 3-4 (bright)... 4-8 (dark)
  - The same for different genders & iris colours
  - Variation with age
  - Physiologic anisocoria

- Pupillary unrest: constant symmetrical fluctuation… detected by magnification
  - Hippus: exaggerated.. Detected on visual inspection
  - No diagnostic significance
- Colour: depend on the structures behind it
  - Greyish black
  - Jet black
  - leukocoria

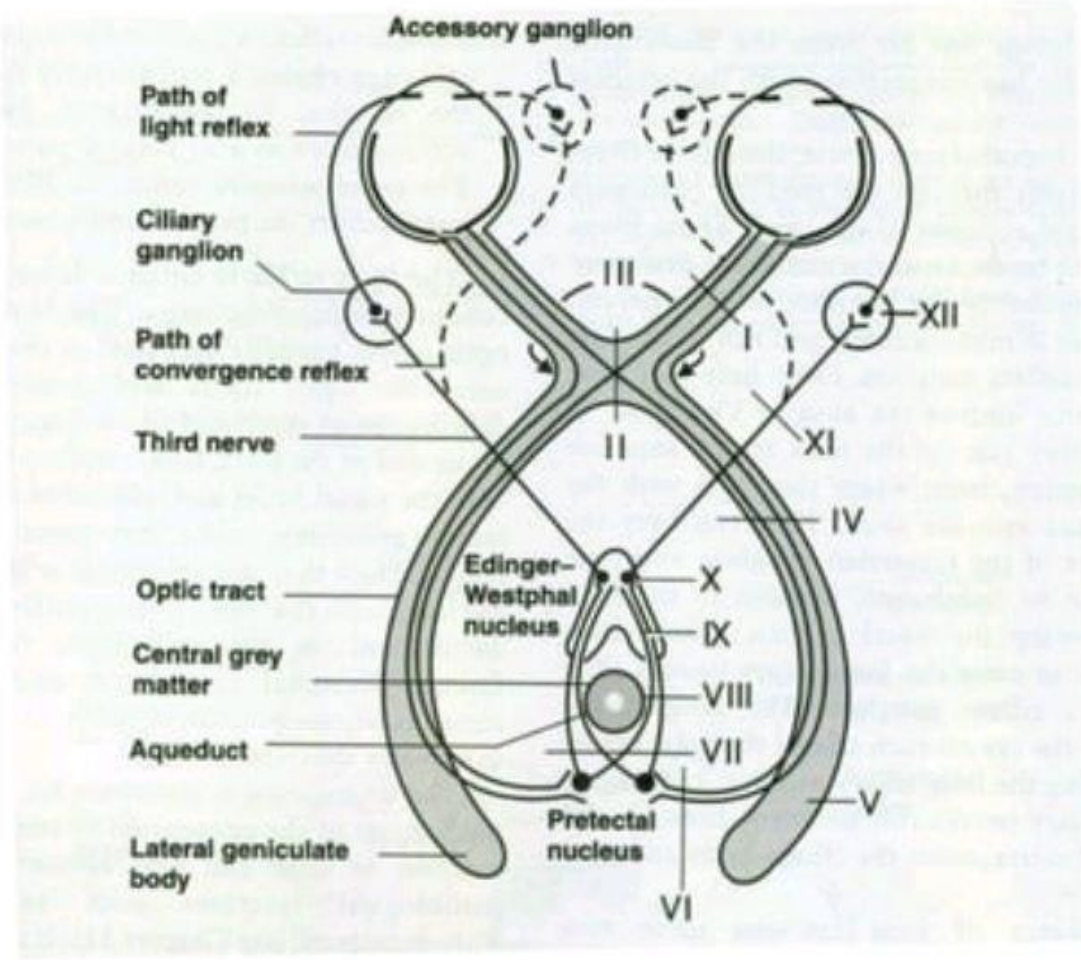
- Pupillary constrictor/ spincter-innervated by parasympathetic
- Pupillary dilator – innervated by sympathetic
- Evaluation of pupil- Diagnostic clue to ocular, neurological, medical, surgical and paediatric diseases

Light reflex

- When light is shown to one eye.. Both pupils constrict
- Direct vs consensual
  - Almost identical in time, course & magnitude
- If both pupils illuminated at once→ summation
- Dependant the state of adaptation of the retina, emotions, alertness, …
- Maximum frequency of stimuli is 5 Hz

Light reflex

- Initiated by retinal photoreceptors
- Transmitted along optic nerve
- Undergo a hemidecussation at the optic chiasma (nasal fibres cross over)
- Proceeds along optic tract
- Synapses at pre- tectal nucleus
- Ends in both Edinger westpal nucleui
- Any given pretectal neuron behaves functionally as though it recieves similar inputs from each eye & projects equally in each EW nucleus
  - Ipsilateral→ around periaqueduct
  - Contralateral→ via the posterior commissure



Light Reflex

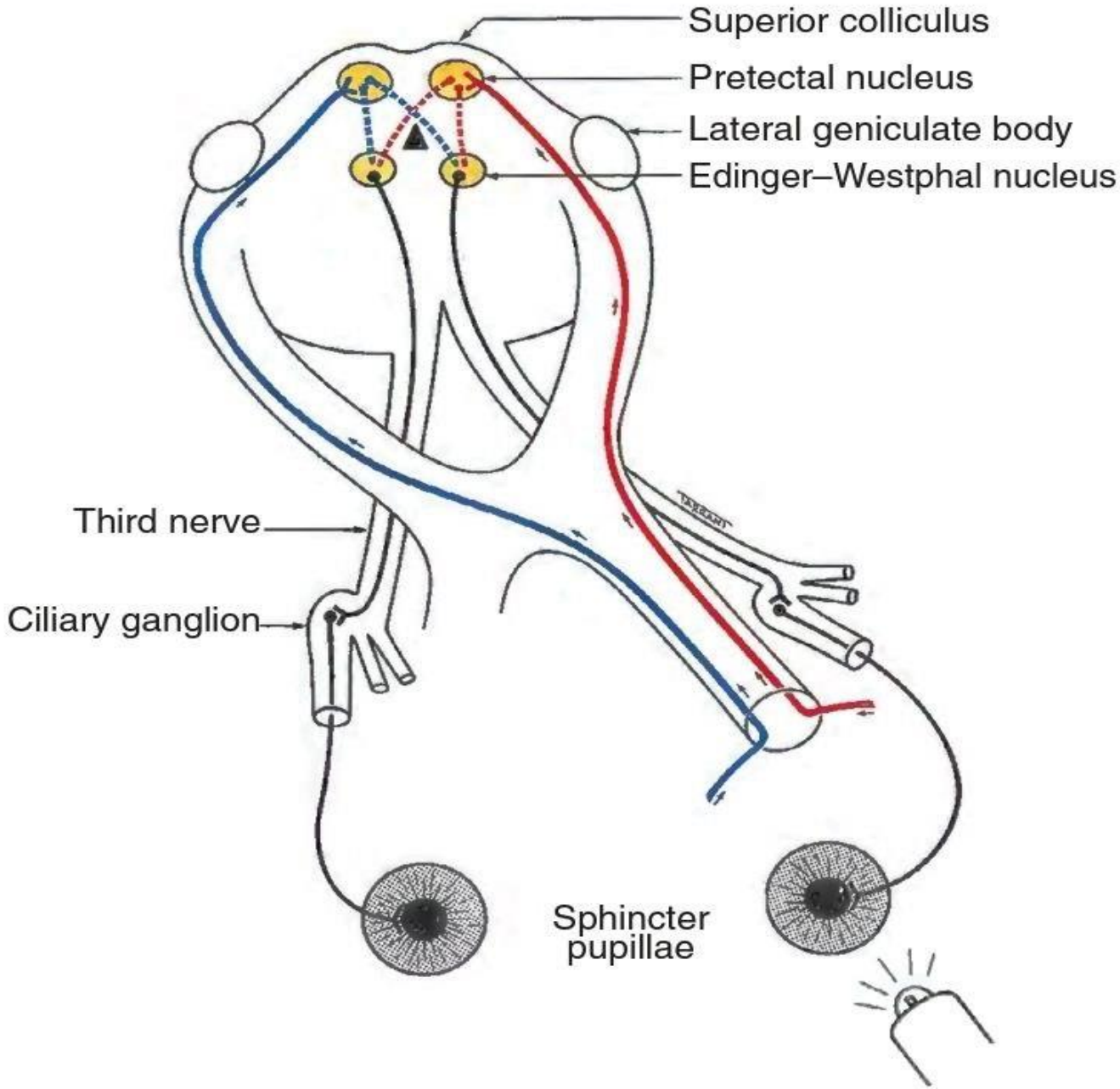


FIg. 19.36 Anatomical pathway of the pupillary light reflex

- Efferent fibers travel on the surface of CN-III
  - to inf. Obl.
  - &/ due to long course→ unilateral defecits can be of localizing significance in unilateral pathology
- Synapse & relay at ciliary ganglion

- Post ganglionic fibres reach ciliary muscle and iris spincter through short ciliary nerves to reach the sphincter pupillae

- Cerebral cortex sends inhibitory signals to EW nucleus→ absence leads to meiosis during sleep

- Functions:
  - Protects against excessive bleaching of the visual pigments
  - Light/Dark adaptation to maximize VA

Near reflex

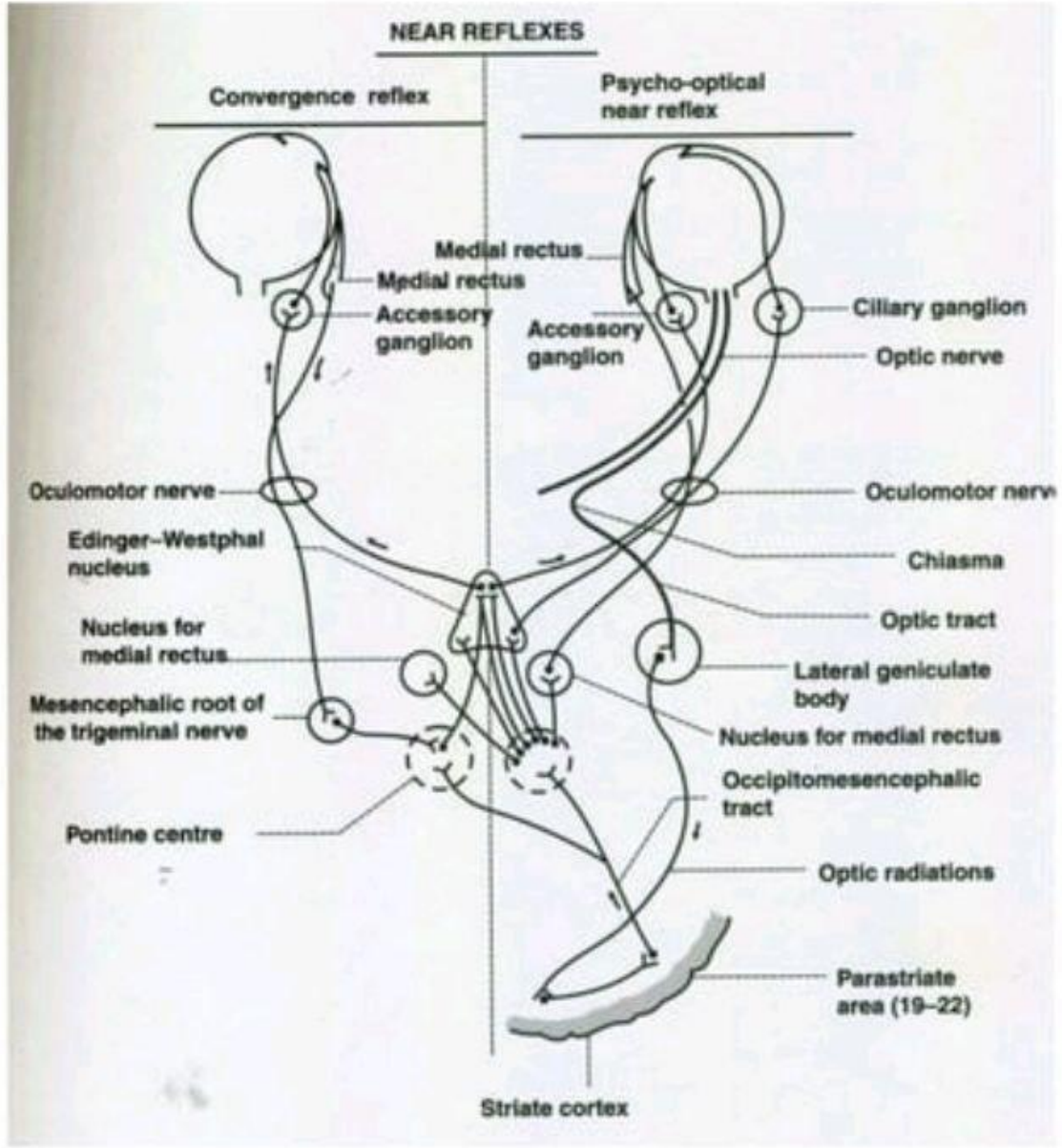
- Triad:
  - Inc. accomodation
  - Convergence of visual axes
  - Constriction of the pupils

Near reflex

- Accomodation reflex:
- Stimulus : Blurring of retinal images when object is near
- Retina- Optic nerve – Optic chiasma- Optic tract- Optic radiations- Lat geniculate body- visual cortex – cortical association areas- occipito mesencephalic tract- mid brain- E.W. nucleus- 3rd nerve- accessory ciliary ganglion along short ciliary nerves- ciliary muscle and pupil constrictor

Near reflex- convergence reflex

- Co contraction of both medial recti
- Proprioceptive impulses originate and travel along 5th nerve
- Reach mesencephalic root of 5th nerve
- Transmitted to EW nucleus in midbrain via convergence centre (in the tectal or pretectal area)
- From EW efferent pathway same as accomodation reflex



Accomodation Reflex

Darkness reflex

- From lighted to dim environment
- Physiology
  - Abolition of light reflex→ relaxation of sphincter pupillae
  - Contraction dilator pupillae

Psychosensory reflexes

- Dilation in response to psychological stimuli
- Not seen in newborn
- Fully developed at 6 months of age
- Cortical mechanism

Ciliospinal reflex

- Pupil dilation in response to painful stimulus in the neck
  - Indicates that some of the psychosensory reflex is mediated at the spinal cord

Lid-closure reflex

- Nonspecific term

1. Meiosis with blinking
   - Constrict transiently with blinking
   - Absent in darkness→ maybe darkness reflex
1. Homolateral meiosis with lid closure
   - Constrict with forced prohibited lid closure
   - Absent if distant gaze→ unconscious attempt at near gaze
1. Oculopupillary reflex (mydriasis on corneal touch)

Abnormalities of pupillary reflexes

Afferent pathway defects

1. TAPD (amaurotic pupil)
   - Complete retinal or nerve lesion
   - Total blindness
   - -ve ipsilateral direct & contralateral consensual light reflex
   - Isocoria in diffuse illumination
   - Near reflex is preserved

2. RAPD (marcus gunn pupil)

- Severe retinal or incomplete optic nerve lesion
- Swinging flashlight test
- Paradoxical response of the affected pupil by Swinging flashlight test
- Earliest sign of optic nerve disease
- VA maybe preserved

Eye movement

Eye movement is the voluntary or involuntary movement of the eyes, helping in acquiring, fixating and tracking visual stimuli. It may also compensate for a body movement, such as when moving the head. In addition, rapid eye movement occurs during (REM) sleep.

There are three main basic types of eye movements:

1-Vergence Movements or Convergence, are the movements of both eyes to make sure that the image of the object being looked at falls on the corresponding spot on both retina. This type of movement helps in the depth perception of objects.
2- Saccades, are the rapid movement of eyes that is used while scanning a visual scene
3-Pursuit Movements, are the movements that the eyes make while tracking an objects movement, So that it's moving image can remain maintained on fovea.
* The brain exerts ultimate control over both voluntary and involuntary eye movements.

The Extraocular muscles

Each eye has six extraocular muscles (EOM) that bring about the various eye movements, three cranial nerves carry signals from the brain to control the extraocular muscles (C.N.):
1- Inferior rectus (IR) (supplied by Oculomotor nerve_ III)
2- Medial rectus (MR) (supplied by Oculomotor nerve_ III)
3-Superior rectus (SR) (supplied by Oculomotor nerve_ III)
4- Lateral rectus (LR) (supplied by Abducens nerve_ VI)
5-Inferior oblique (IO) (supplied by Oculomotor nerve _III)
6-Superior oblique (SO) (supplied by Trochlear nerve _IV)

Muscle movements

A given extraocular muscle moves the pupil, at the front of the eye, in a specific
direction or directions, as follows:
• **medial rectus** (MR)—
o moves the eye inward, toward the nose (adduction)
• **lateral rectus** (LR)—
o moves the eye outward, away from the nose (abduction)
• **superior rectus** (SR)—
o primarily moves the eye upward (elevation)

o secondarily rotates the top of the eye toward the nose (intorsion)
o tertiarily moves the eye inward (adduction)
• **inferior rectus** (IR)—
o primarily moves the eye downward (depression)
o secondarily rotates the top of the eye away from the nose (extorsion)
o tertiarily moves the eye inward (adduction)
• **superior oblique** (SO)—
o primarily rotates the top of the eye toward the nose (intorsion)
o secondarily moves the eye downward (depression)
o tertiarily moves the eye outward (abduction)
• **inferior oblique** (IO)—
o primarily rotates the top of the eye away from the nose (extorsion)
o secondarily moves the eye upward (elevation)
o tertiarily moves the eye outward (abduction)

The primary muscle that moves an eye in a given direction is known as the **"agonist."** A muscle in the **same eye** that moves the eye in **the same direction** as the agonist is known as a **"synergist,"** while the muscle in the same
eye that moves the eye in **the opposite direction** of the agonist is the **"antagonist."**
According to **"Sherrington's Law,"** increased innervation to any agonist muscle is accompanied by a corresponding decrease in innervation to its antagonist muscle(s).

STRABISMUS

Occurs when both eyes do not look at the same place at the same time; the eyes are unable to align properly under normal conditions

- Eye(s) may turn in, out, up, or down
- Can be present in one or both eyes
- Often referred to as: cross-eyed, crossed eyes, wall-eyed, wandering eyes, and/or eye turn

CAUSES OF STRABISMUS

- result of the **lack of coordination** between the muscles of the eye responsible for eye movement
- problems with **the nerves** that transmit information to the eye muscles
- problems with **the control center** in the brain that directs eye movement
- the lack of coordination prevents proper **binocular vision** and keeps both eyes from gazing at the same point

note: **in adults**, can be caused by stroke, thyroid problems,brain injury, or other trauma which disrupts the ability of the eye muscles to work properly

RISK FACTORS

- **Family history—if** relatives have strabismus, a person is more likely to develop it
- **Refractive errors**—extreme far sightedness (hyperopia) can develop strabismus due to the amount of eye focusing necessary to keep vision clear
- **Medical conditions**—people with Down syndrome or cerebral palsy and people who have suffered a stroke or head injury are at higher risk for developing strabismus

TYPES OF STRABISMUS

- **Esotropia**—inward turning of the eye
- **Exotropia**—outward turning of the eye
- **Hypertropia**—upward turning of the eye
- **Hypotropia**—downward turning of the eye

ADDITIONAL CLASSIFICATIONS

- **constant or intermittent**—the frequency it occurs
- **bilateral**—both eyes converge or diverge at the same time
- **unilateral**—if it always involves the same eye
- **alternating**—when the turning is sometimes the right and other times the left eye

WHEN DOES IT OCCUR?

- **congenital**—developing during infancy; 50% of children with strabismus are born with it
- **acquired**—developing in adulthood; can also develop as a result of lack of treatment during childhood

WHAT IT'S *NOT*

• Strabismus is ***NOT*** the same as Amblyopia!!
• Amblyopia is also called "lazy eye" and is a condition where vision does not develop normally during childhood
• Child may have one weak eye with poor vision and one strong eye with normal vision
• Amblyopia DOES occur commonly with Strabismus, but is a ***vision*** problem, where strabismus is a ***muscle*** problem

DEVELOPMENT IN INFANTS

• a newborn's eyes will typically move independently and even **drift outward**
• it is **not** normal for an infant's eyes to **cross** constantly
• **by 3 to 4** months old, an infant should be **able to focus** on objects and eyes should be straight, with no turning
• **30-50% of children** with **strabismus** develop secondary vision loss **(amblyopia)**
• the onset of strabismus is most common in children **at 18 months to 6** years old
• if a parent notices their child's eyes moving inward or outward, the eyes seem to be crossed, or the child is not focusing on objects, they should **seek medical attention**

DEVELOPMENT IN ADULTS

• most likely to develop as a result of injury or disease
• adult will most likely experience double vision, eye fatigue, overlapped or blurred images, a pulling sensation around the eyes, difficulty with reading, and/or a loss of depth perception
• if loss of vision occurs, it is typically due to exotropia (eye turns outward) rather than amblyopia because vision is already developed in the adult brain and the adult brain will not compensate for deviation the way a child's brain will.

DIAGNOSIS

A comprehensive eye exam is necessary with focus on the following:
• **patient history**—a comprehensive history is necessary to assess symptoms, health problems, and medications
• **visual acuity**—measurements are taken to assess extent(level) to which vision is affected
• **refraction**—conducted to determine the lens power necessary to compensate for any refractive error
• **alignment and focusing**—assessing how well your eyes focus, move, and work together

• **eye health exam**—assessing the structures of the eye (internal & external) to rule out possible disease

TREATMENT

1-Eye Patch

The stronger eye is patched to force the brain to interpret images from the strabismic eye. Eye patches will not change the angle of the strabismus. Typically, eye patching is used only if amblyopia is present.

2-Eyeglass or Contacts

Eyeglasses or Contacts are used to improved the positioning of the eye(s) by modifying the patient's reaction to focus. Eyeglasses and Contacts can also redirect the line of sight, which can help straighten the eye.

3-Prisms

Prisms are used to modify the way light and images hit the eye. The lenses provide comfort and can help prevent double vision from developing.

4-Vision Therapy

A non-surgical method of therapy that treats the eye and the brain. An optometrist will oversee the therapy, which is designed to strengthen or develop visual skills. The optometrist may also use eyeglasses, prisms, eye patches and computerized medical devices during the therapy.

5-Eye Surgery

Surgery may be necessary in an attempt to align the eyes by modifying one or more muscles in the eye. During surgery, **the muscle positions will be changed or the length of the muscles will be changed**. Surgery may follow a period of eye patching and then eyeglasses may be used after surgery to help treat strabismus.

6-The Bates Method

An alternative form of treatment that uses natural remedies to correct vision problems such as: relaxation, exercise, games, and other activities. The Bates Method claims to improve or restore vision through the elimination of mental strain. This is a very controversial method in the medical field.

7-Botox Therapy

Used as an alternative to eye muscle surgery. The idea is that the drug will temporarily relax the eye muscle, which will allow the opposite eye to tighten and straighten. The effects are shortterm— about 3 weeks. Eye muscle exercises and eyeglasses may also be used to help strengthen the eye.

there is no cure for strabismus

• with treatment, the effects of strabismus may be corrected

• the goal of treatment is to help the patient achieve as close to normal binocular vision as possible in every direction of gaze and at all distances