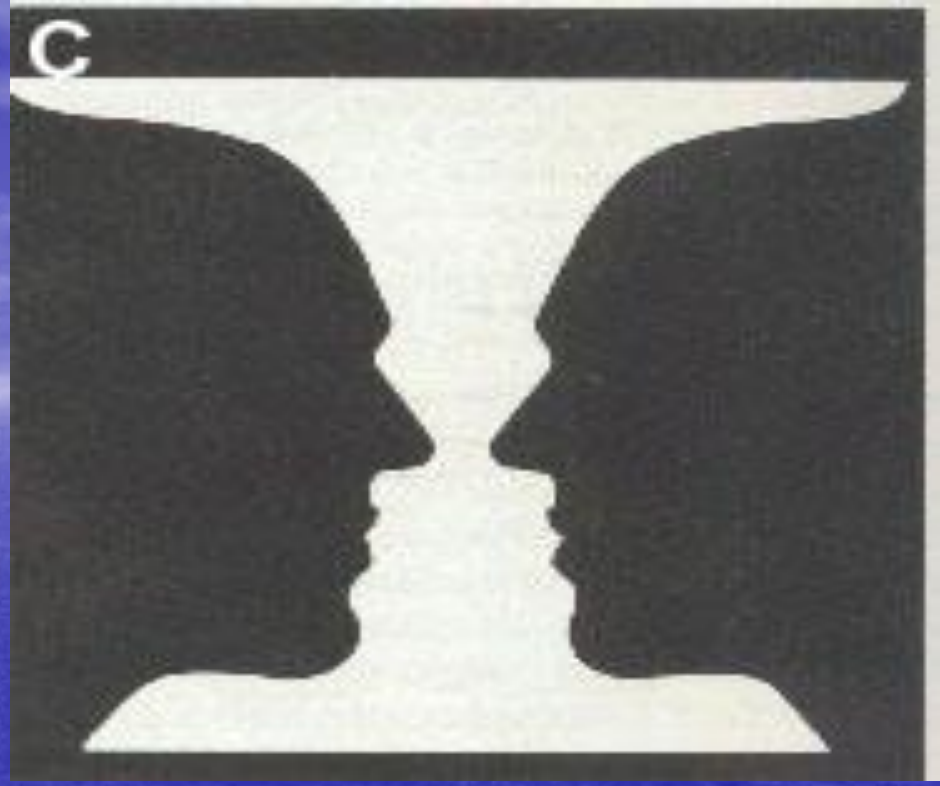
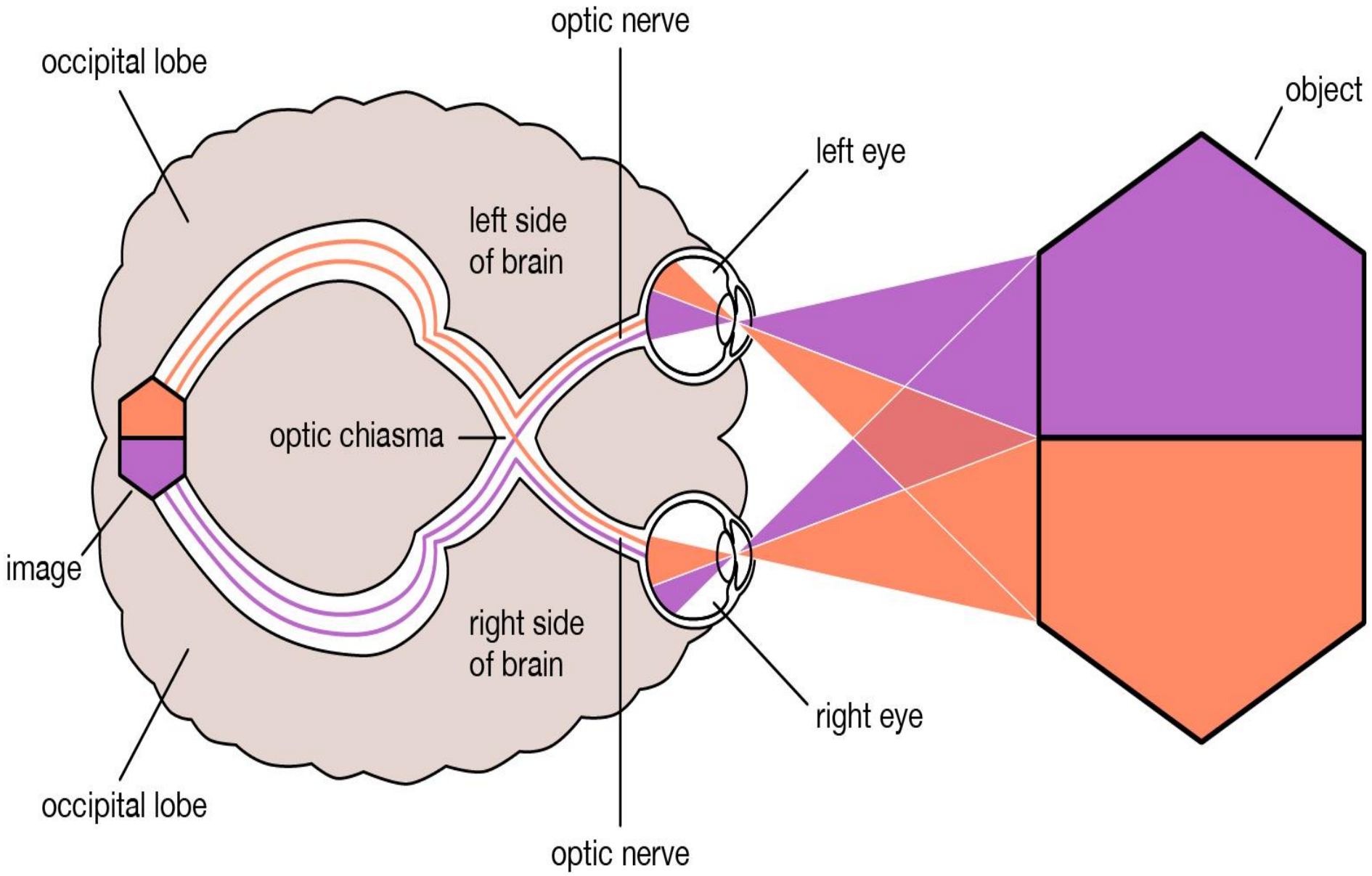
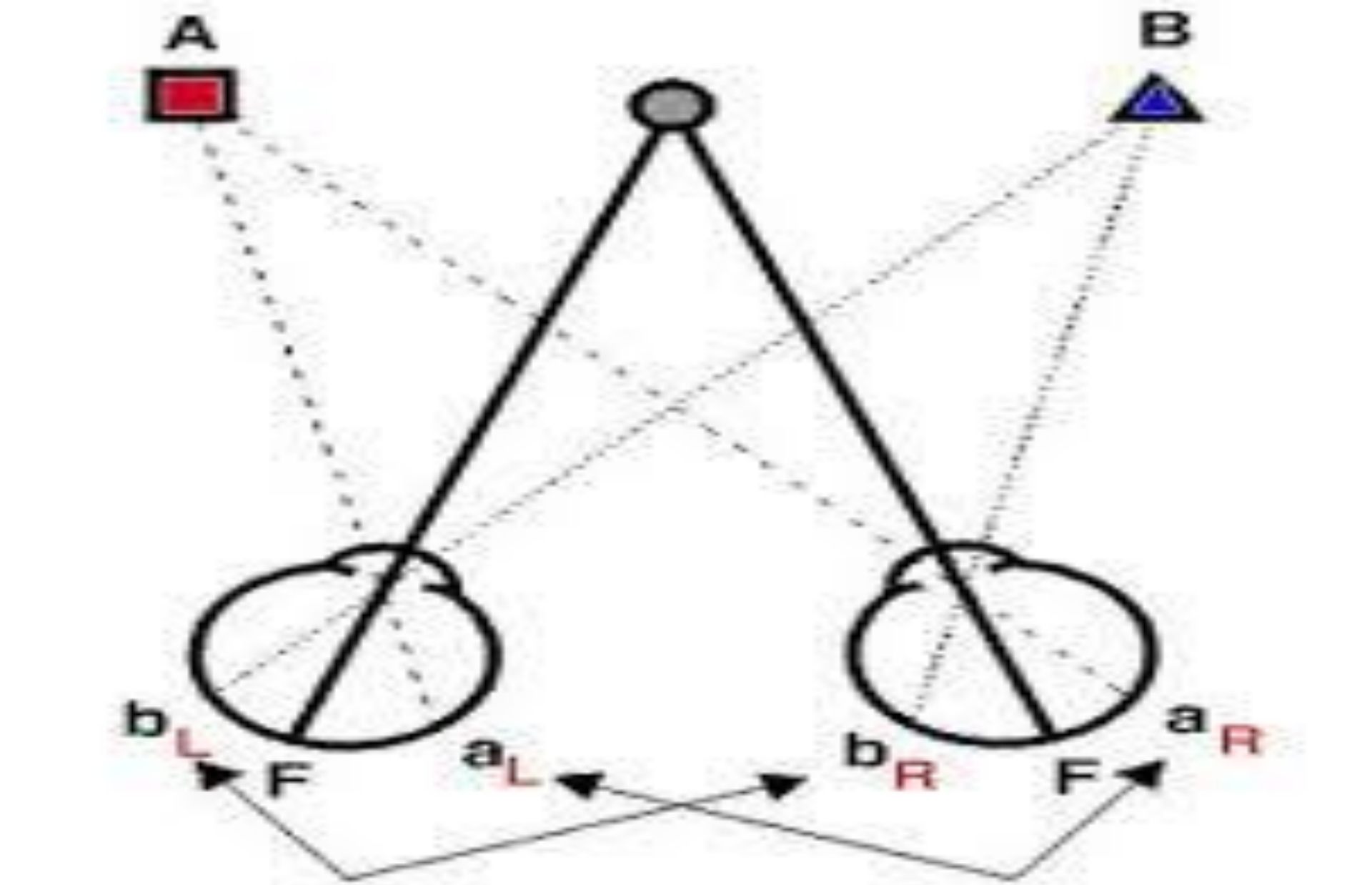


Strabismus & eye movement

Fawaz Sarayreh

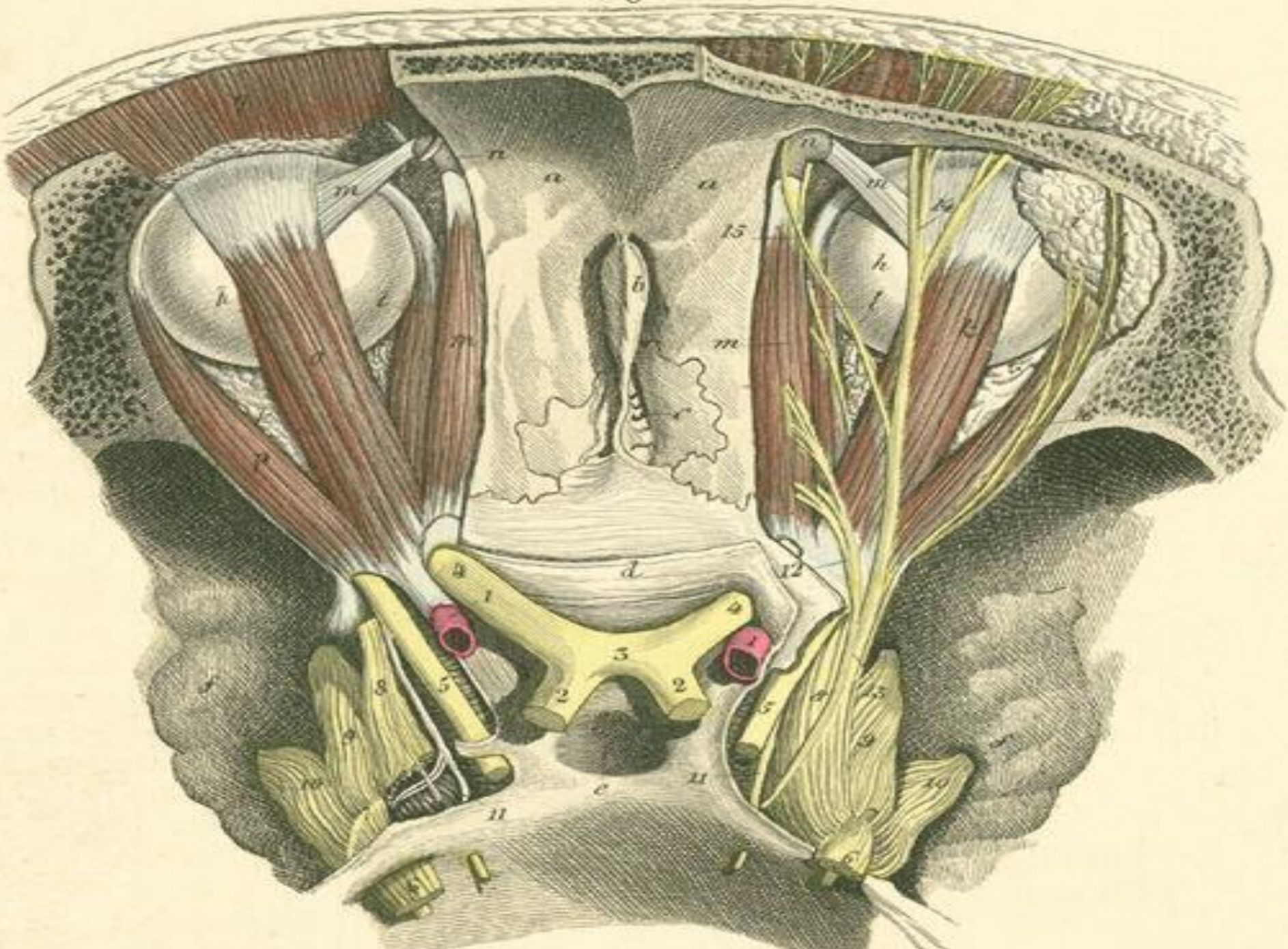
Visual pathways

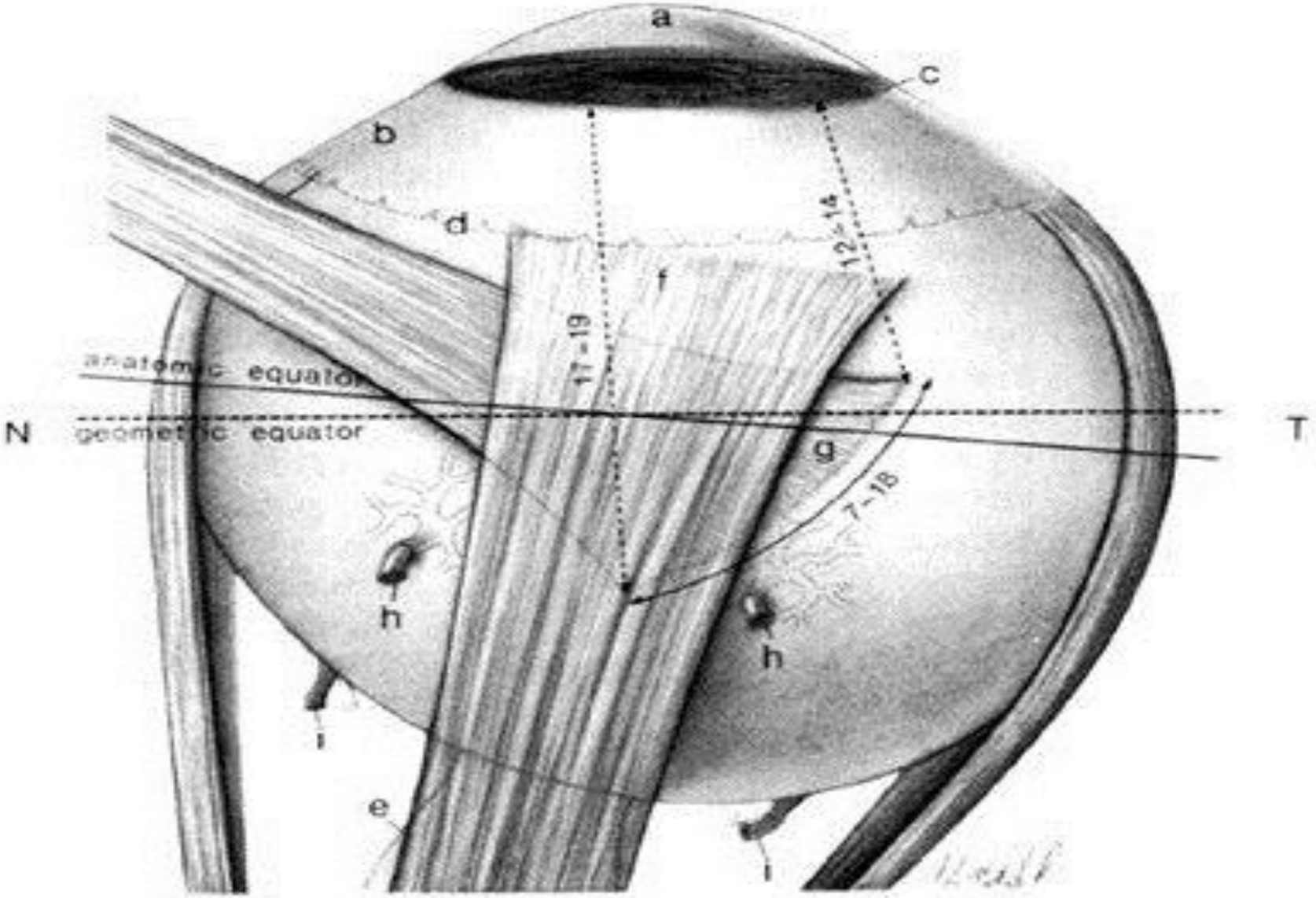




a_L and a_R are corresponding points
b_L and b_R are corresponding points

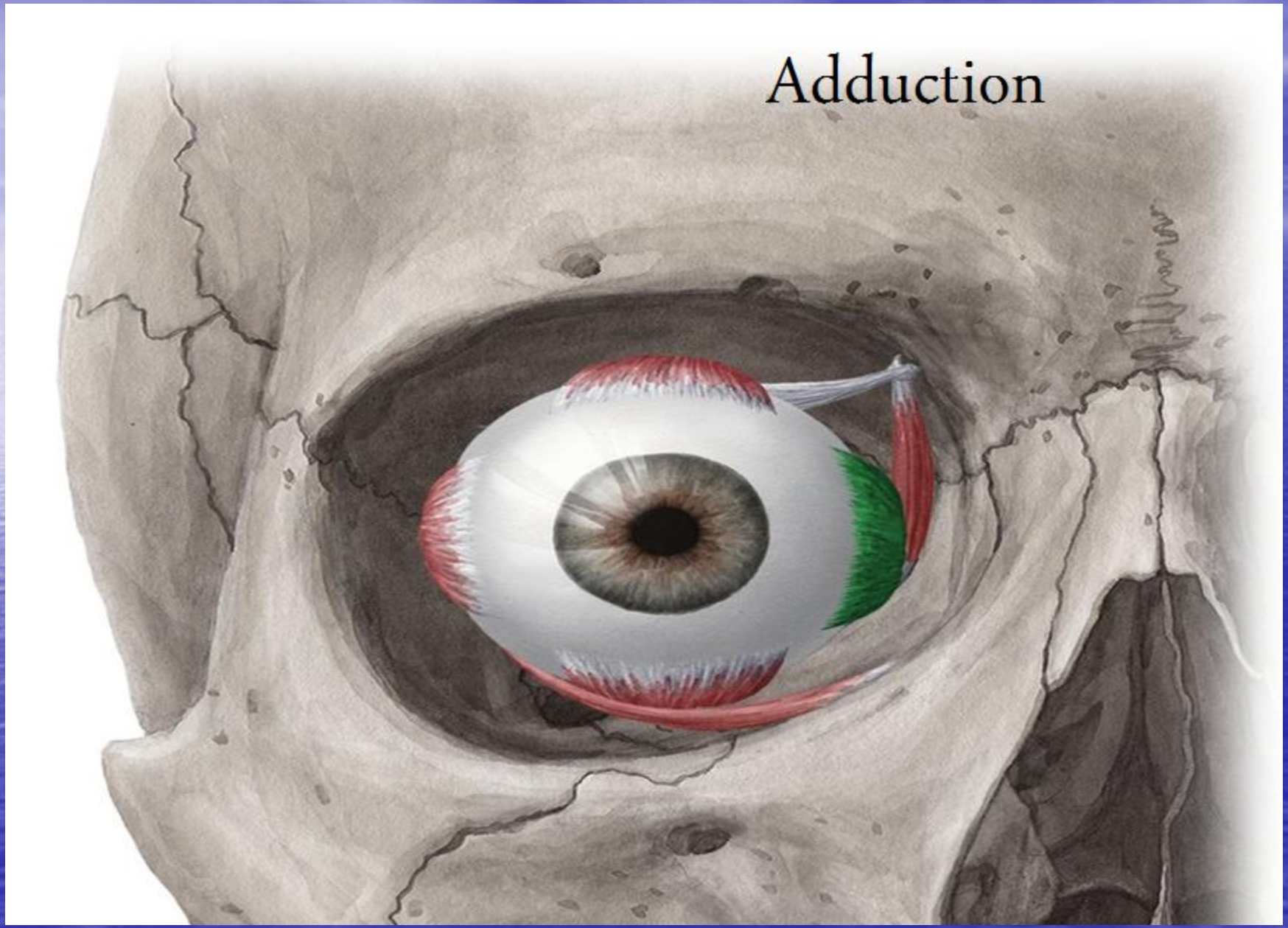
Fig. 19.

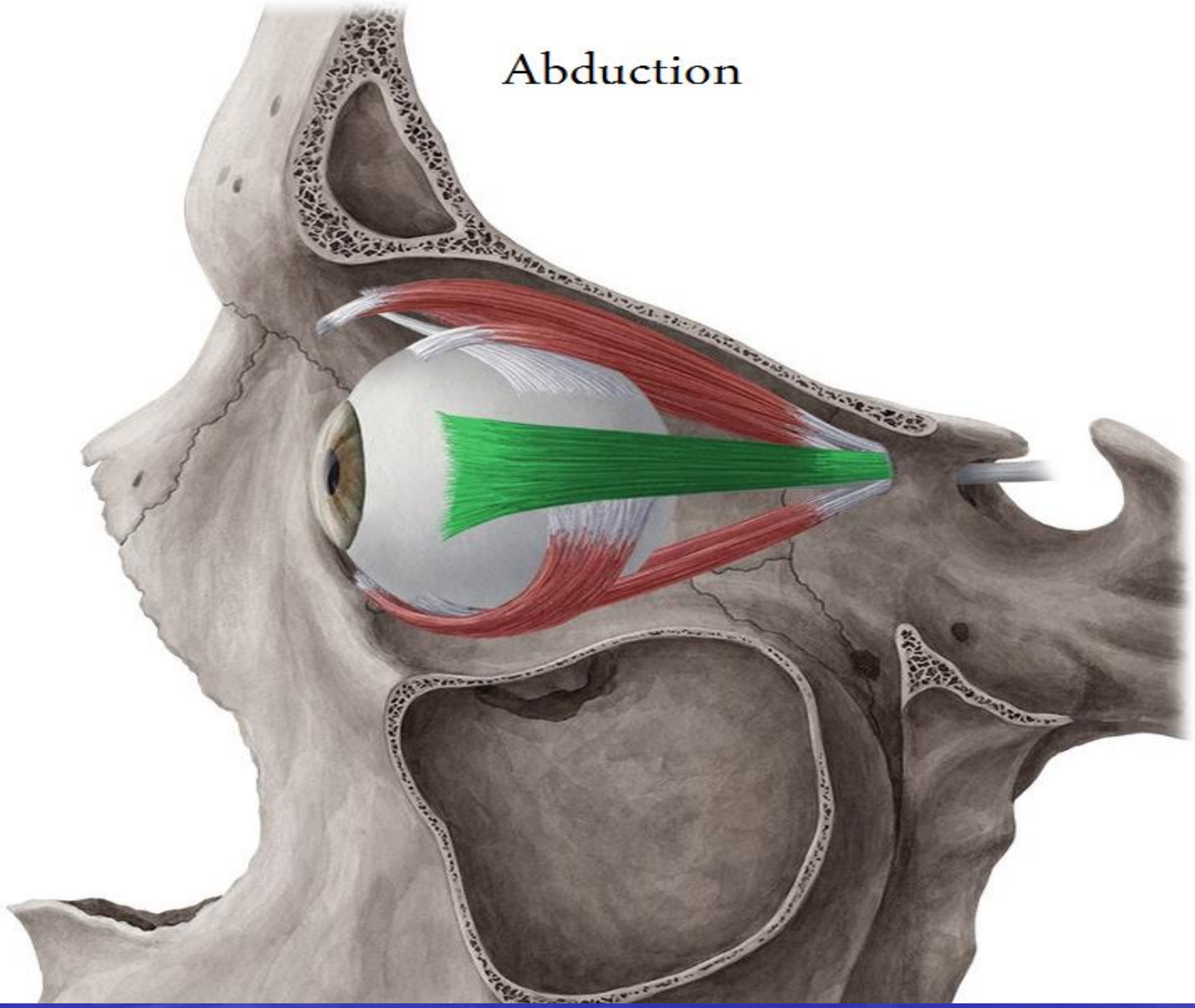



a
b
c
d
f
12-14
17-19
anatomic equator
geometric equator
N
T
g
7-18
h
h
i
i
e

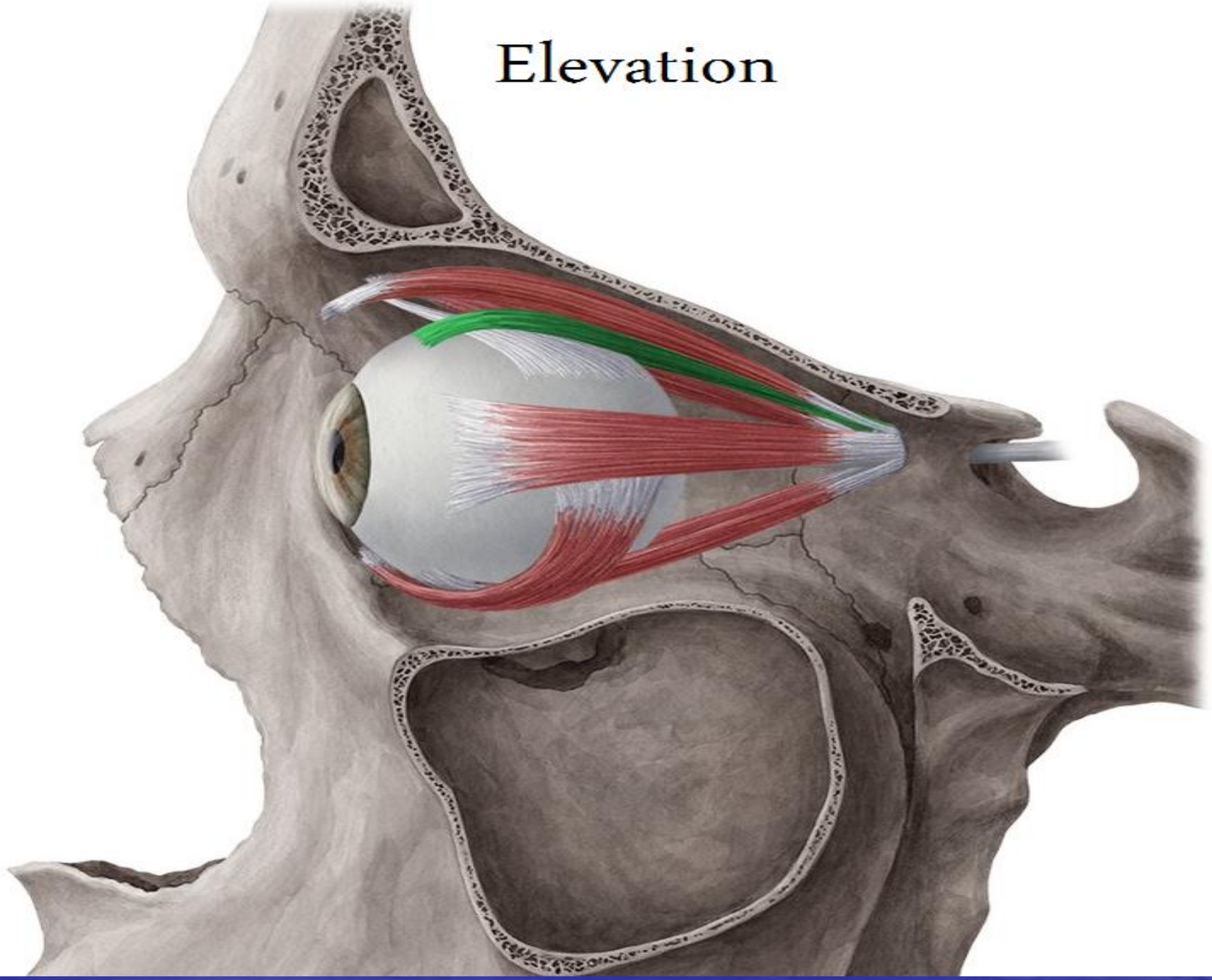
Anatomy

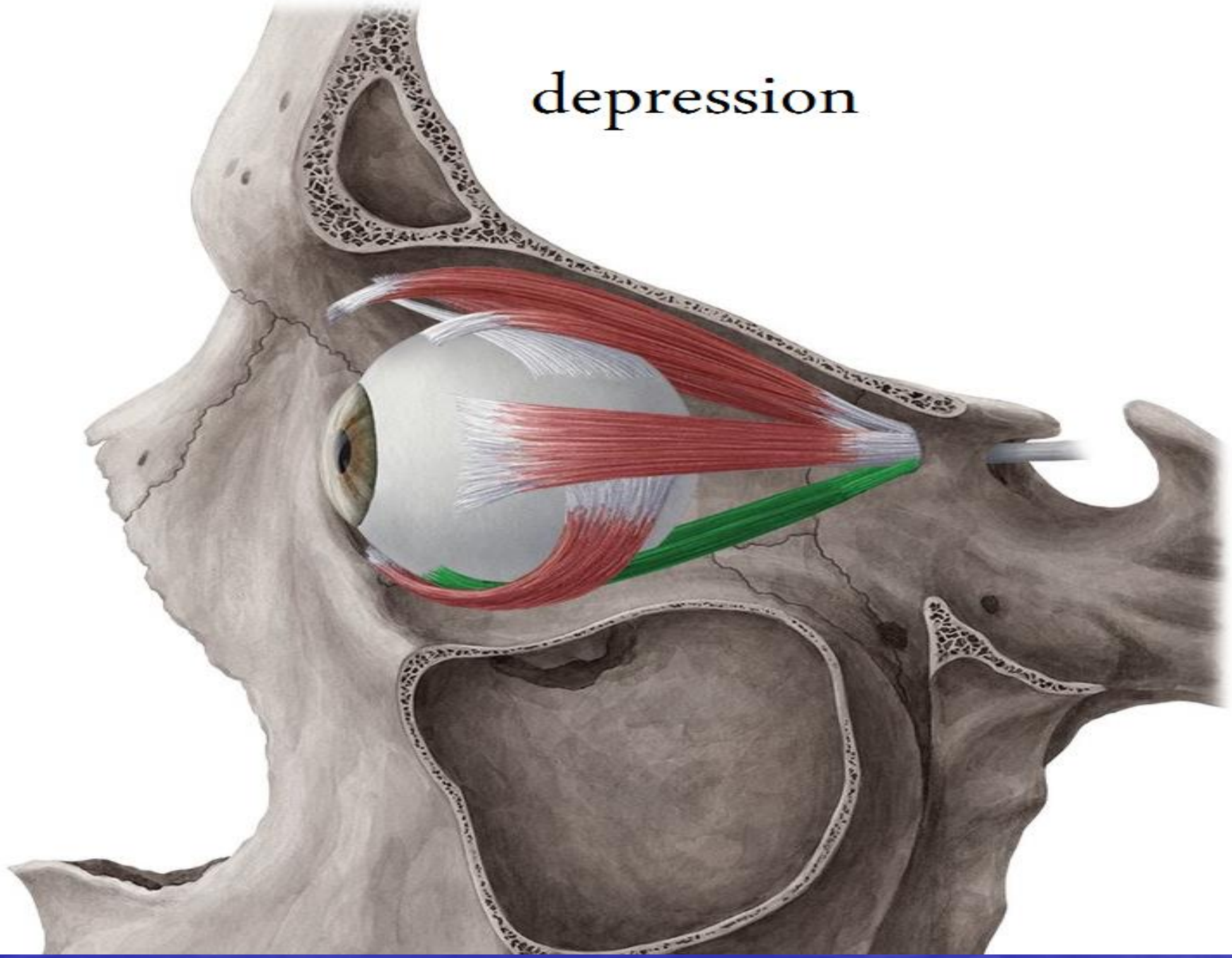
- The 6 EOM
- Nerve supply
- Relation to the globe and orbit
- Cortex and brain stem connection


Adduction

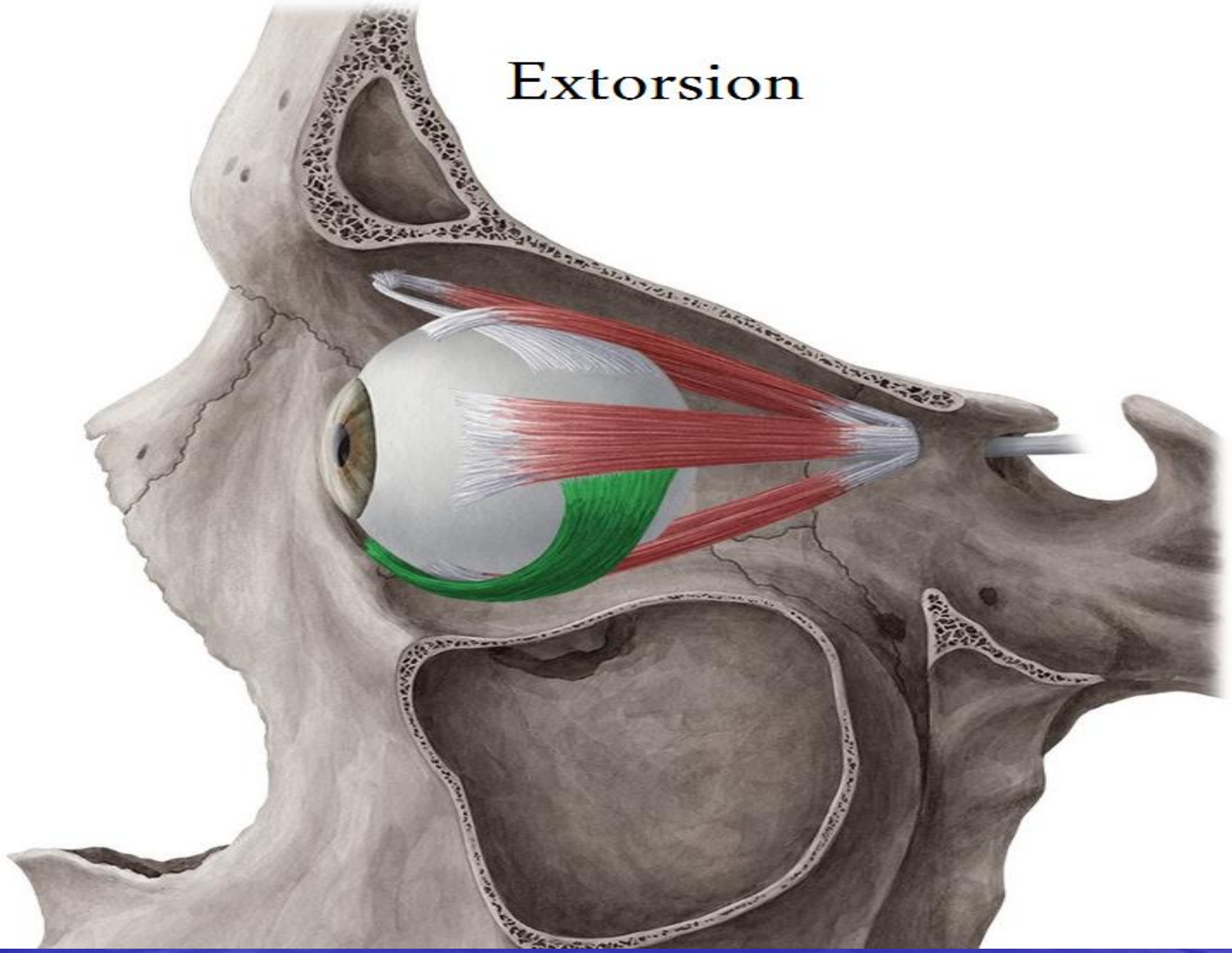

Abduction

Elevation

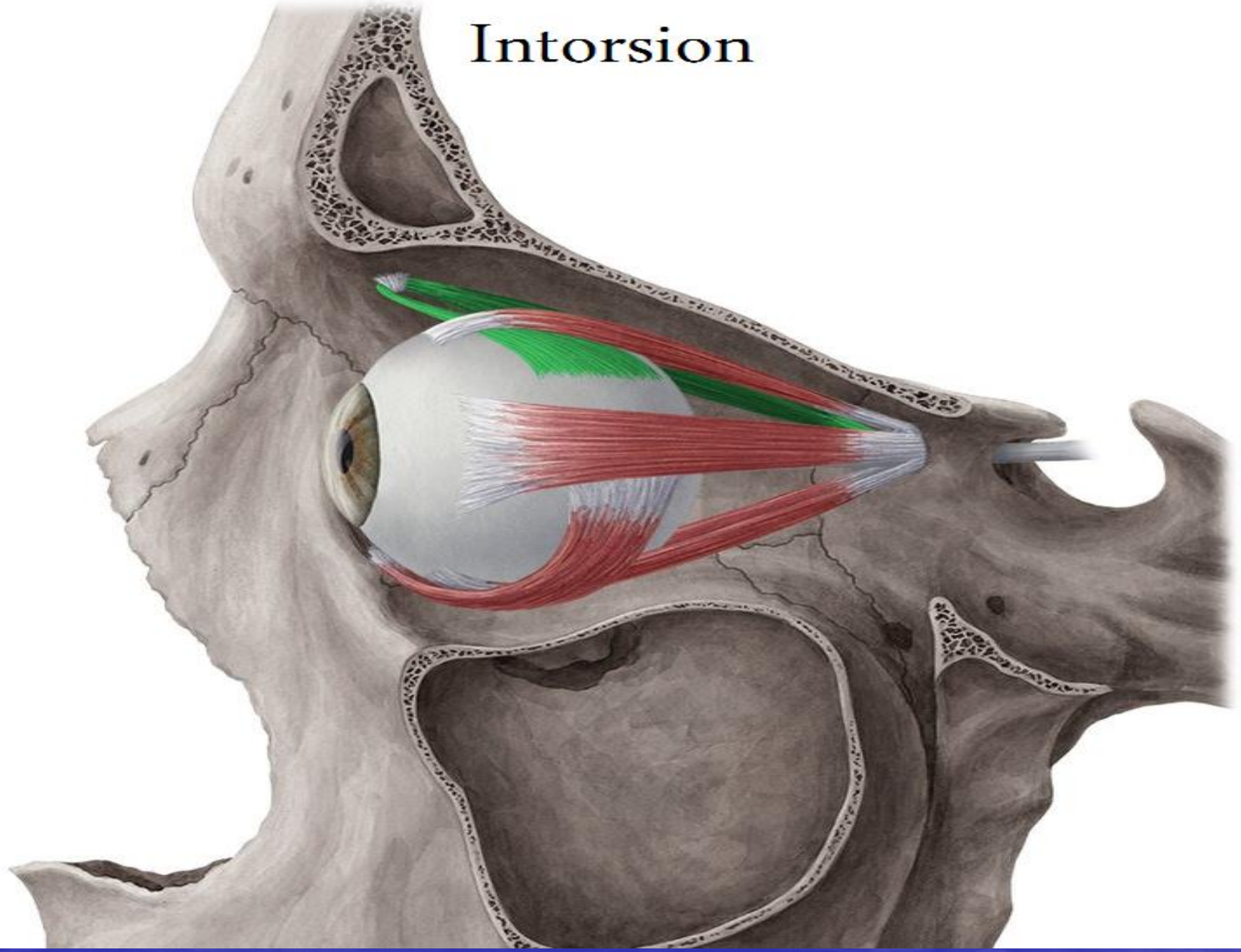



depression

Extorsion

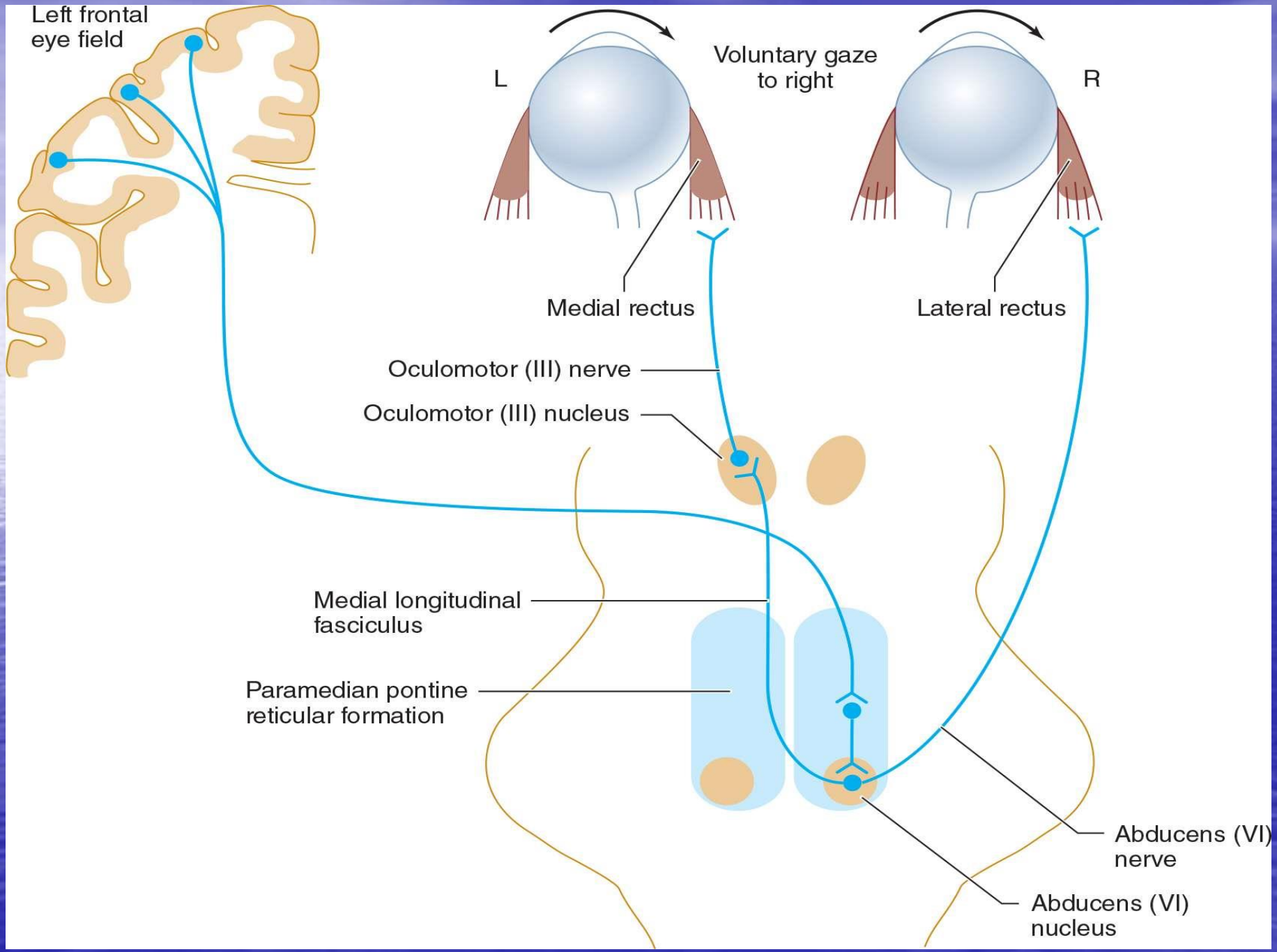


Intorsion



Physiology

- Functions of the EOM
- Higher cortical and brain stem control
- Nuclear connections
- Hering”s low of equal innervation
- Yolke muscles
- Pursuit and saccadic eye movement


Left frontal eye field
L
Voluntary gaze to right
R
Medial rectus
Lateral rectus
Oculomotor (III) nerve
Oculomotor (III) nucleus
Medial longitudinal fasciculus
Paramedian pontine reticular formation
Abducens (VI) nerve
Abducens (VI) nucleus

Looking Patient Left

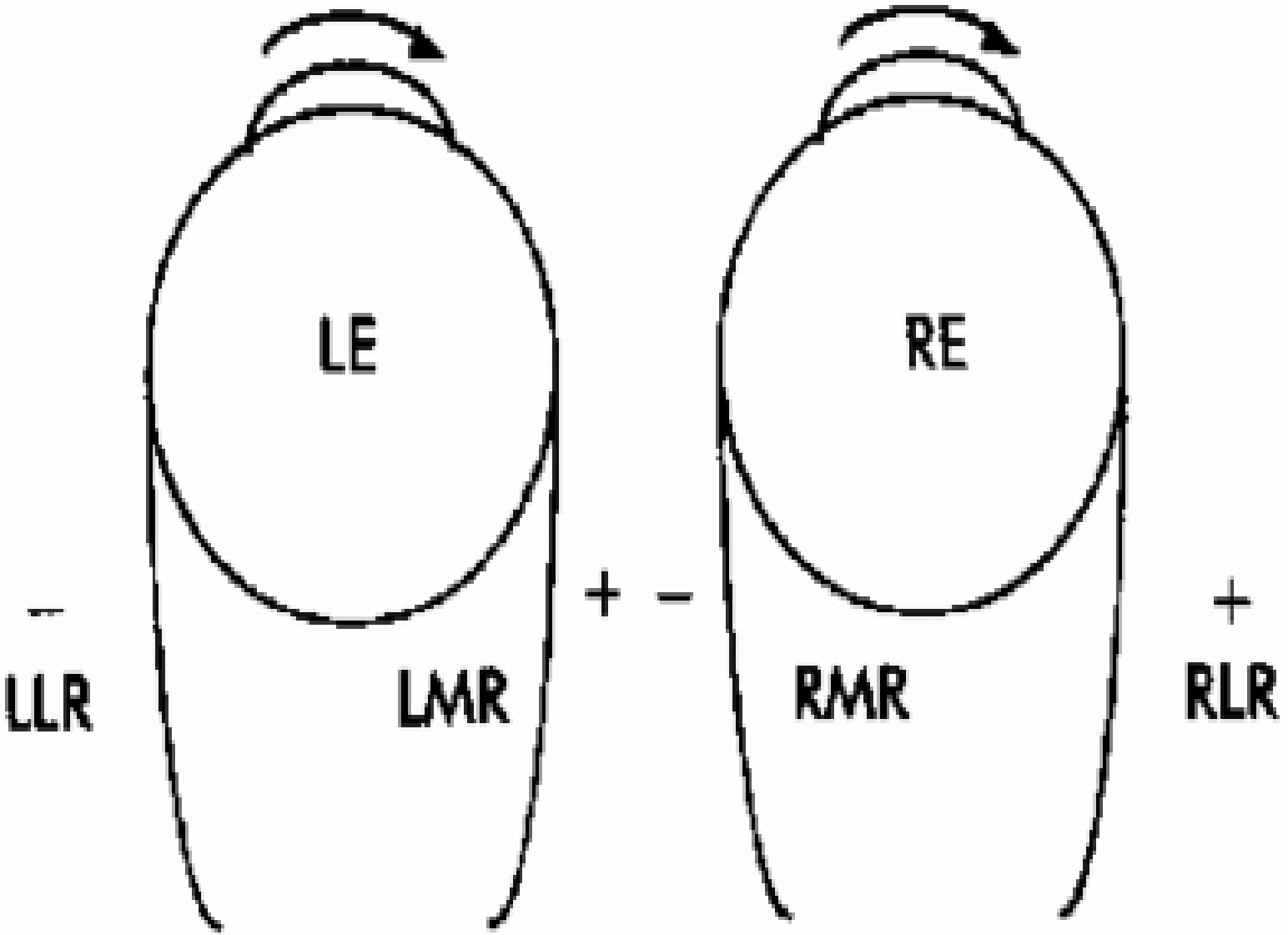
Agonists

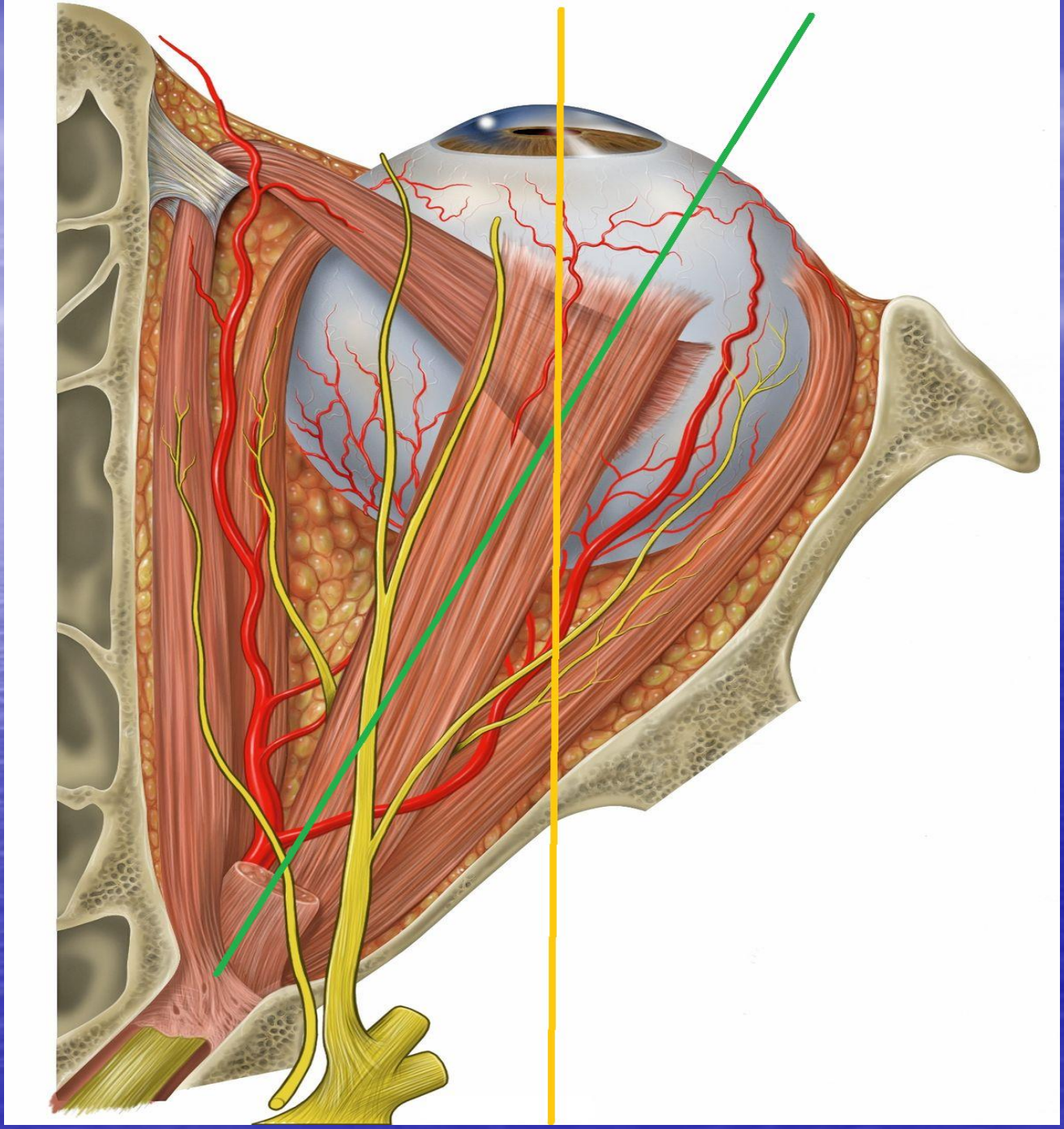
Antagonists

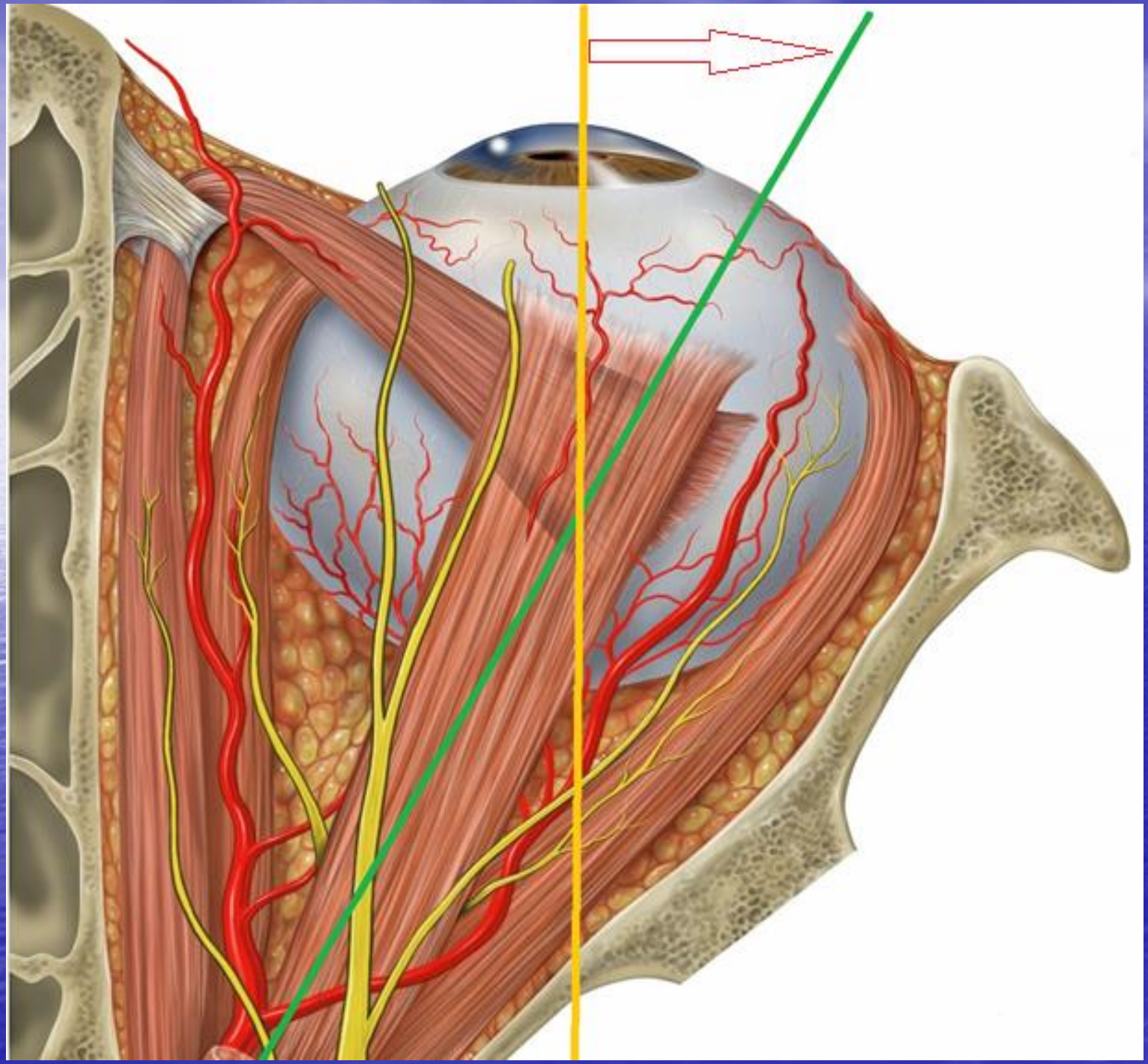
Looking Patient Right

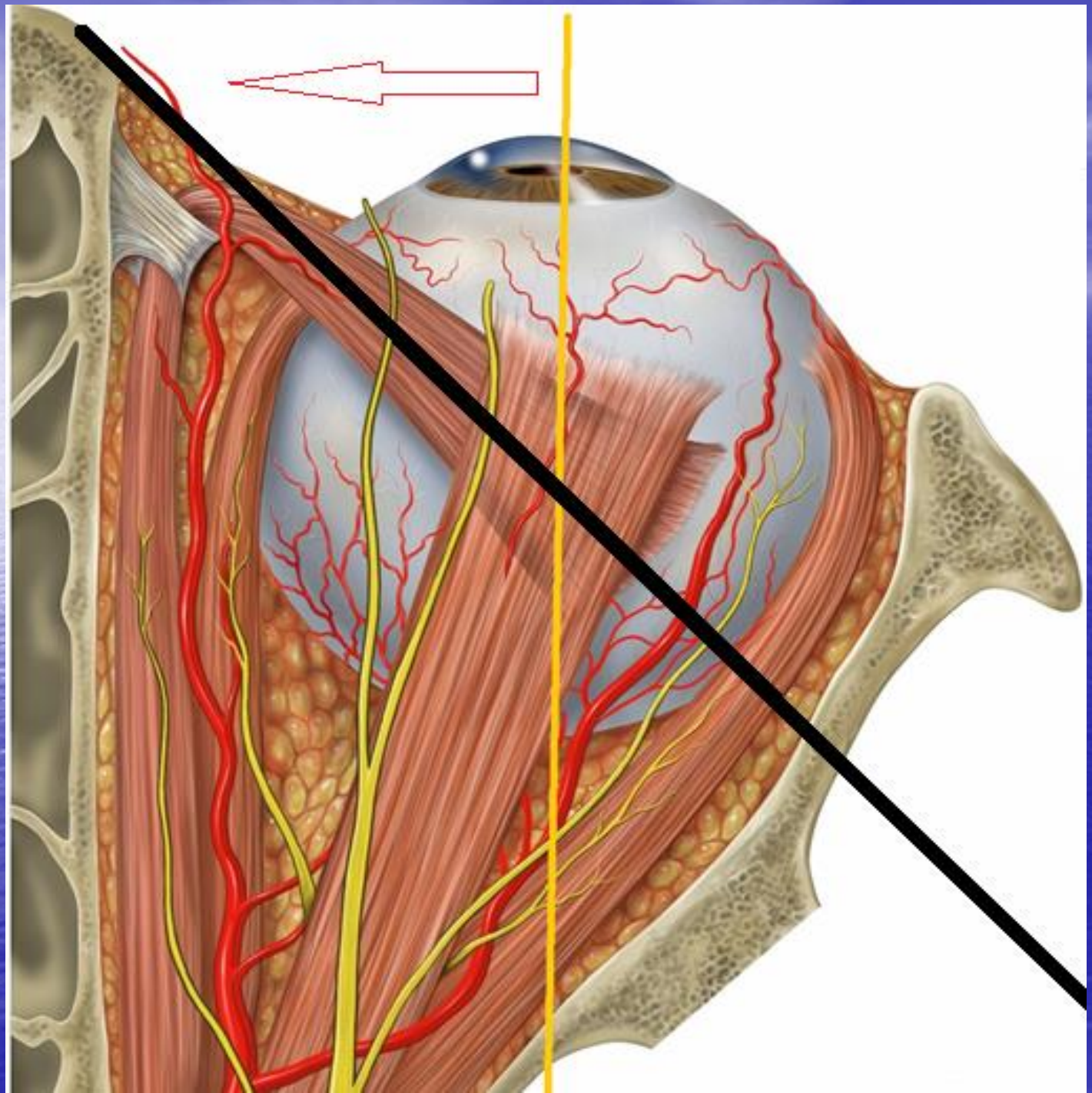
Agonists

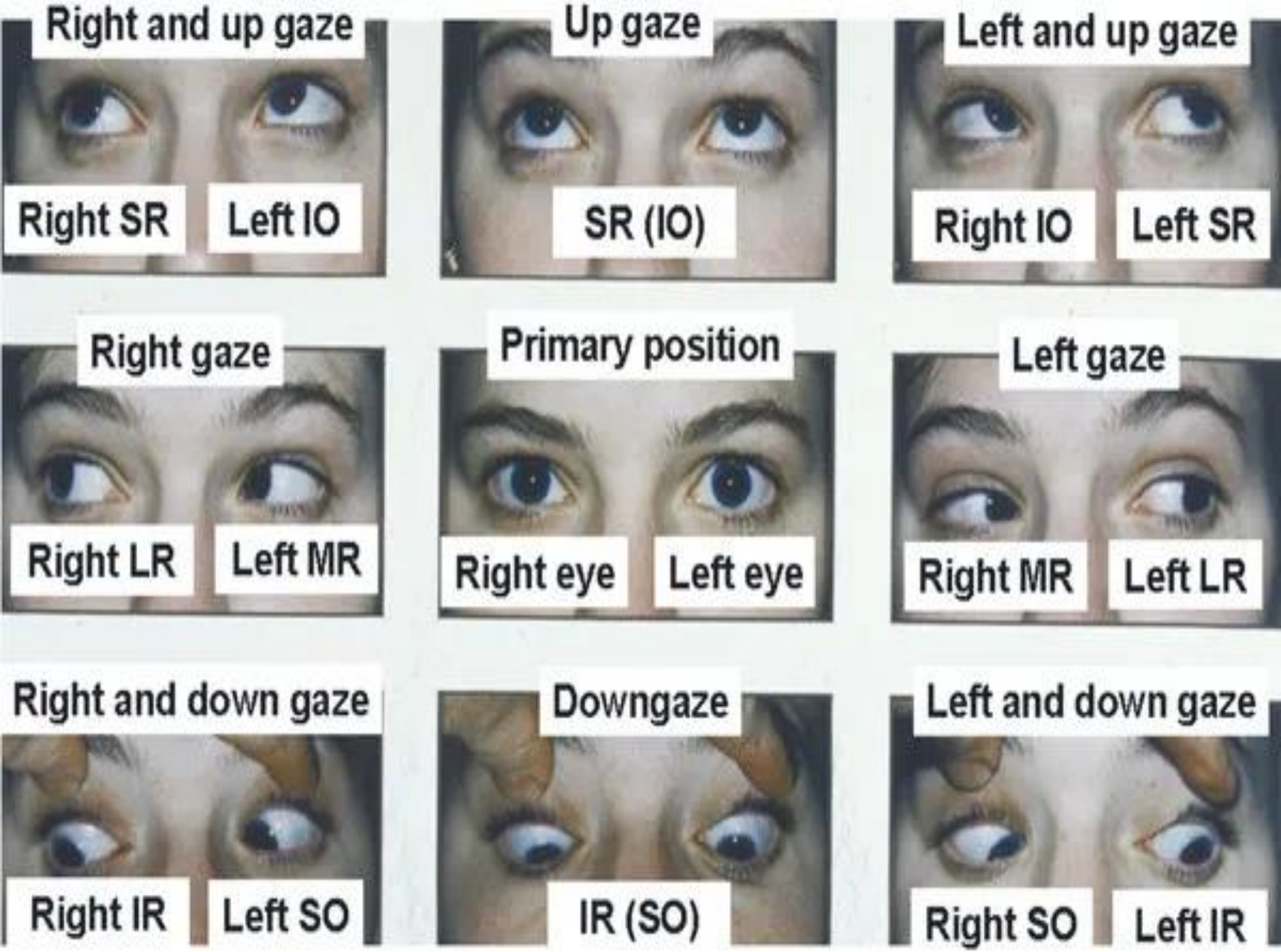
Antagonists


LE
RE
–
LLR
LMR
+
–
RMR
+
RLR

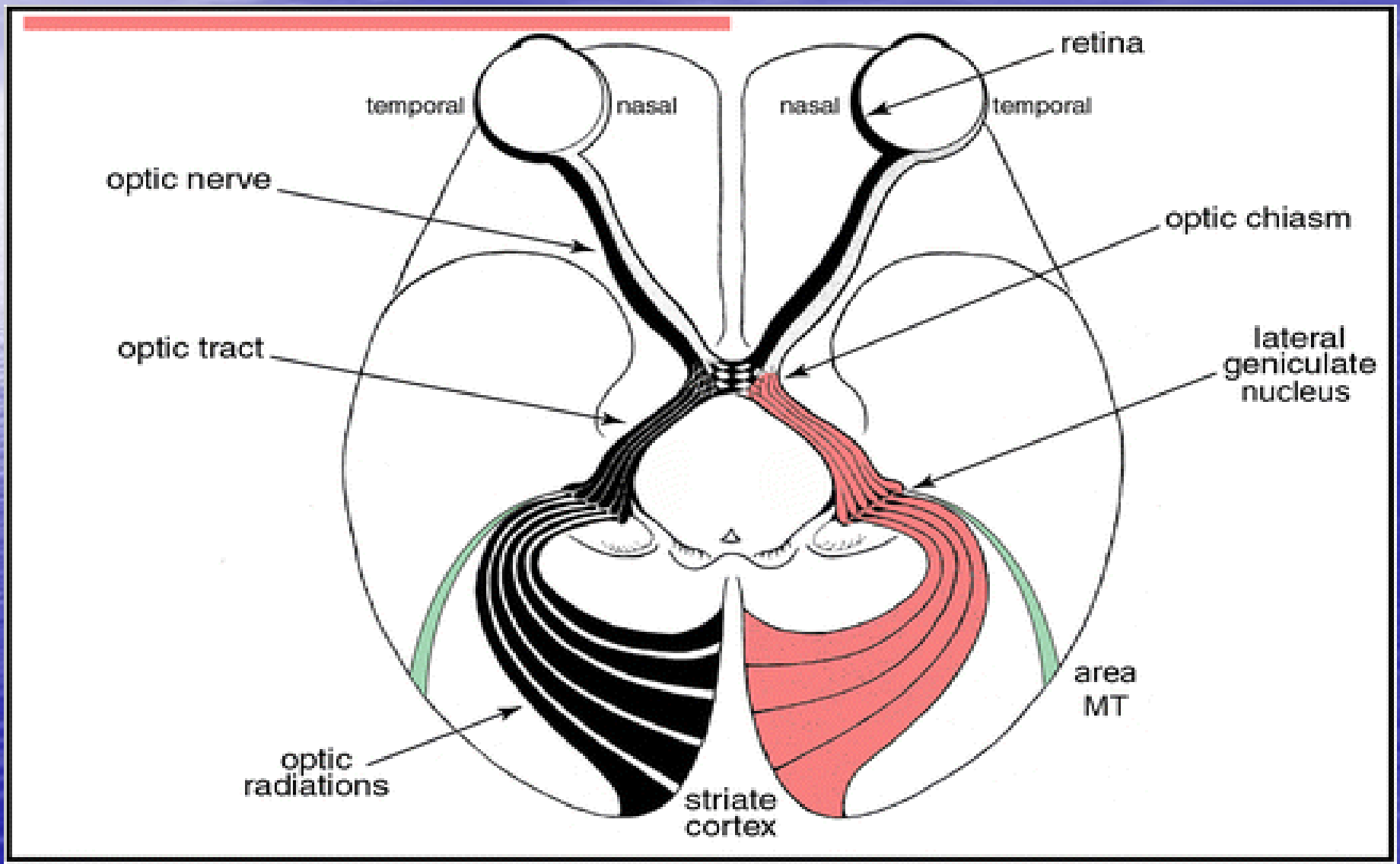







Right and up gaze
Right SR
Left IO
Up gaze
SR (IO)
Left and up gaze
Right IO
Left SR
Right gaze
Right LR
Left MR
Primary position
Right eye
Left eye
Left gaze
Right MR
Left LR
Right and down gaze
Right IR
Left SO
Downgaze
IR (SO)
Left and down gaze
Right SO
Left IR

Visual Maturation



Eye movement disorders

- Non-paralytic squint
- Paralytic squint
- Gaze palsies
- Disorders of brain stem and vestibular nuclei (Nystagmus)

Non-paralytic squint

- Both eye movements are full
- No paresis
- Only one eye is directed towards the fixation target
- The angle of deviation is constant and not related to the gaze direction .

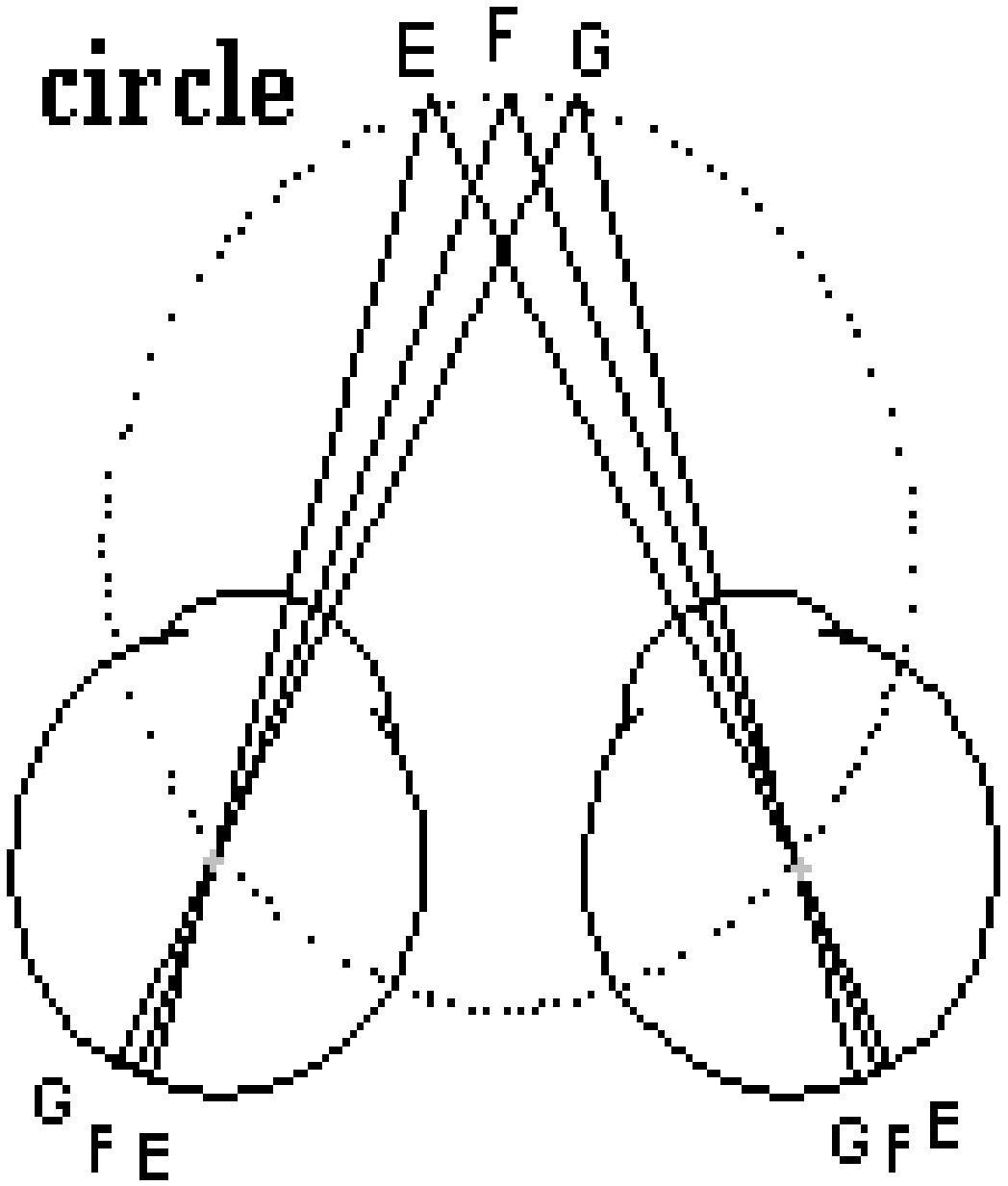
Binocular single vision
BSV

- Normally both eyes are directed towards the same object .
- Eye movement is coordinated so the retinal image falls always on a corresponding points of each retina .
- These corresponding points are fused centrally as one
- The eyes views the object from different angles so they do not fuse precisely .

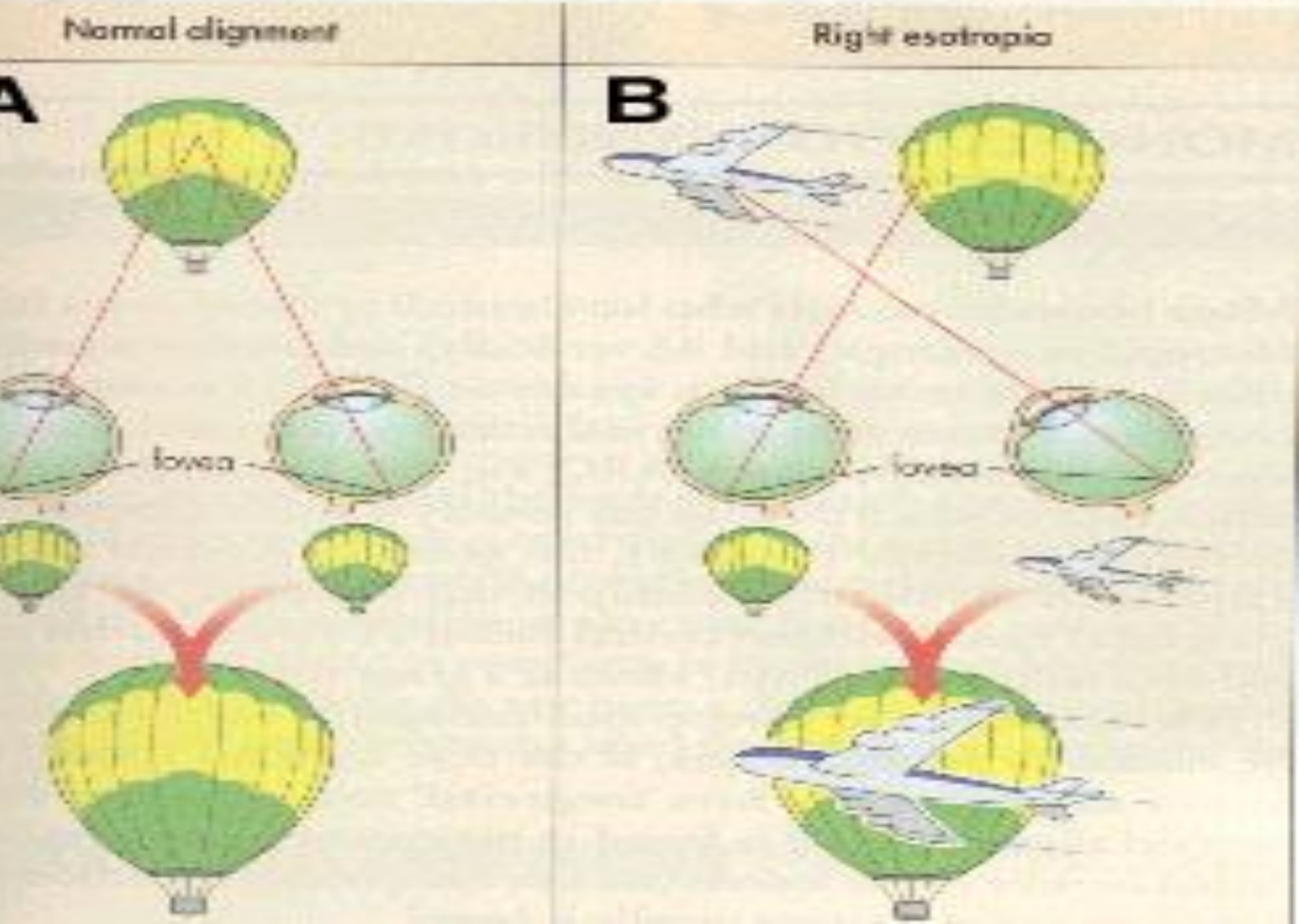
Central fusion requirement

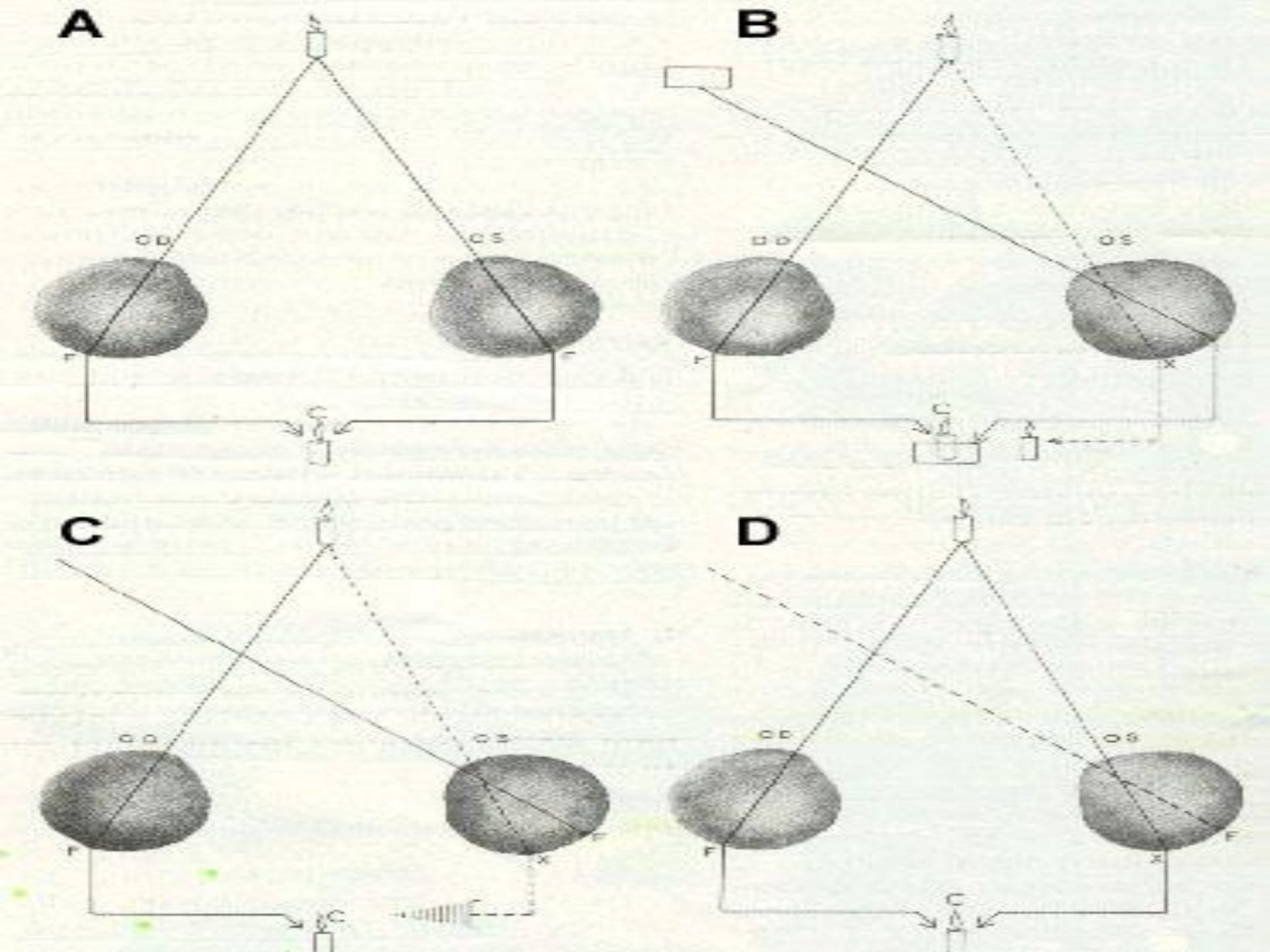
- Alignment
- Image magnification
- Image clarity
- Image orientation

Vieth-Müller circle



ALIGNMENT OF FOVEAL IMAGES



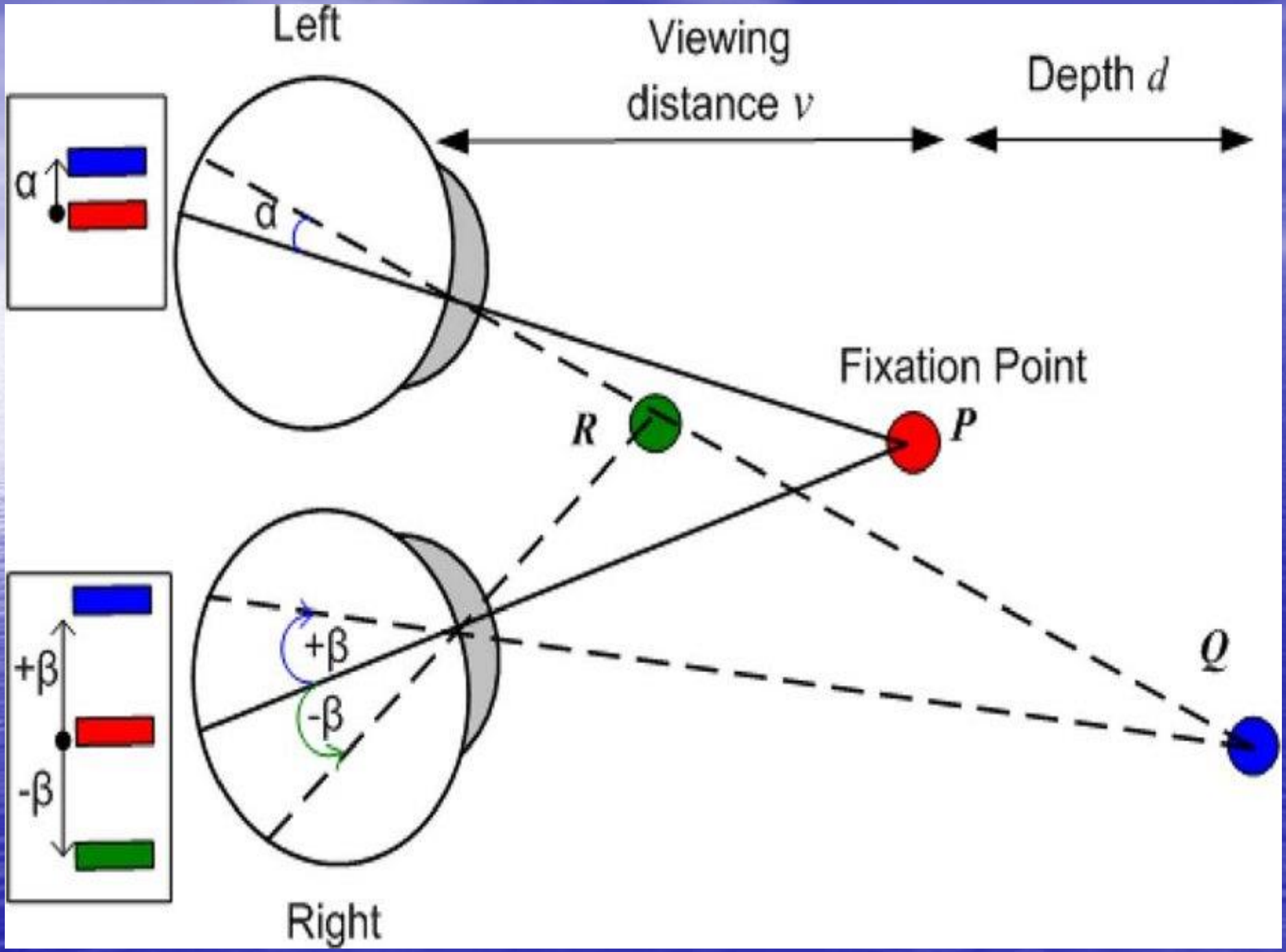

A
B
C
D

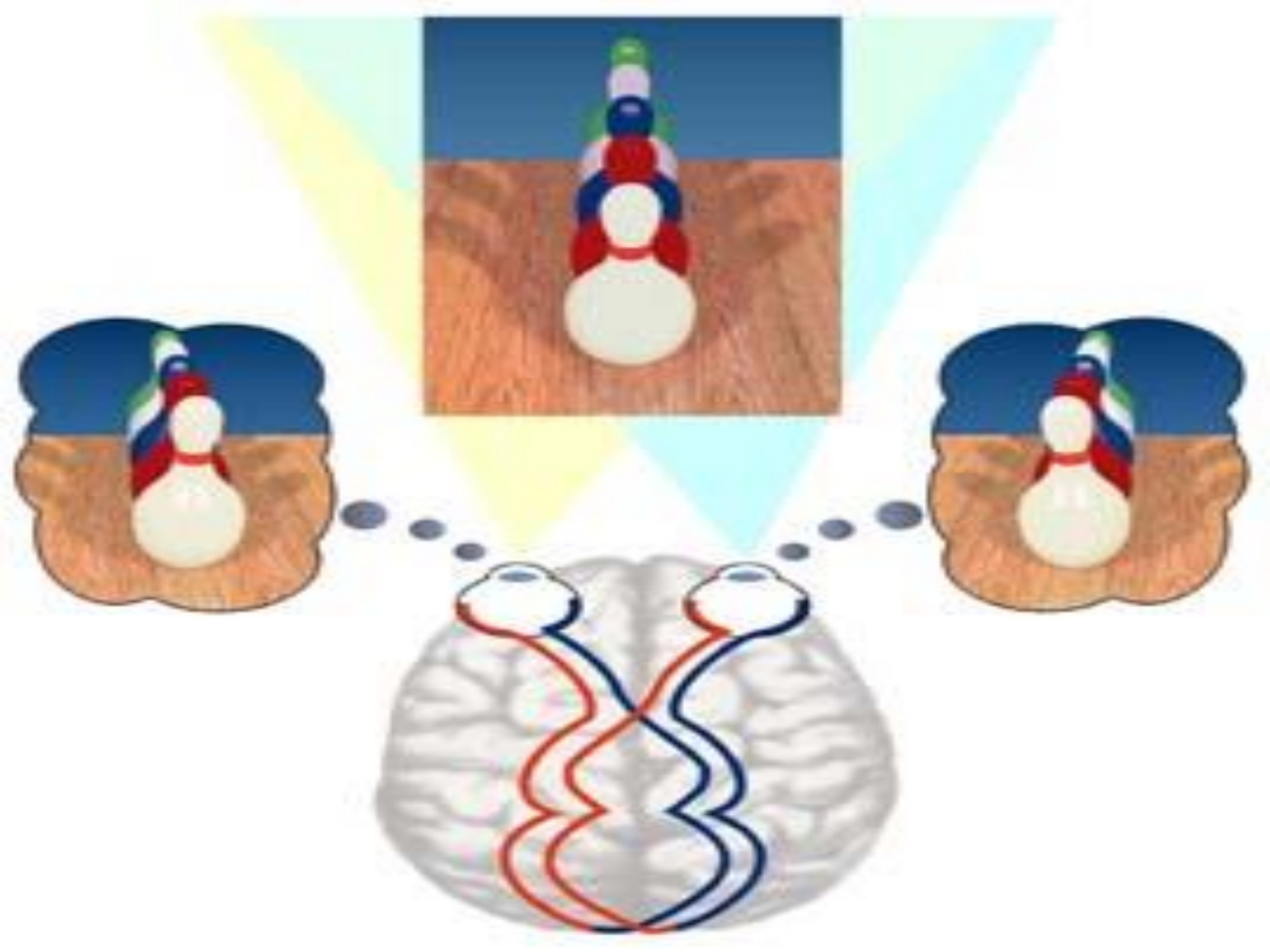
BSV

- The closer the object the greater the disparity between the two retinal images .
- This allow a three dimensional vision.
- Stereopsis
- Stereopsis development requires that the eyes movement and visual alignment are coordinated in approximately the first five years of life .

Advantages of BSV & stereopsis

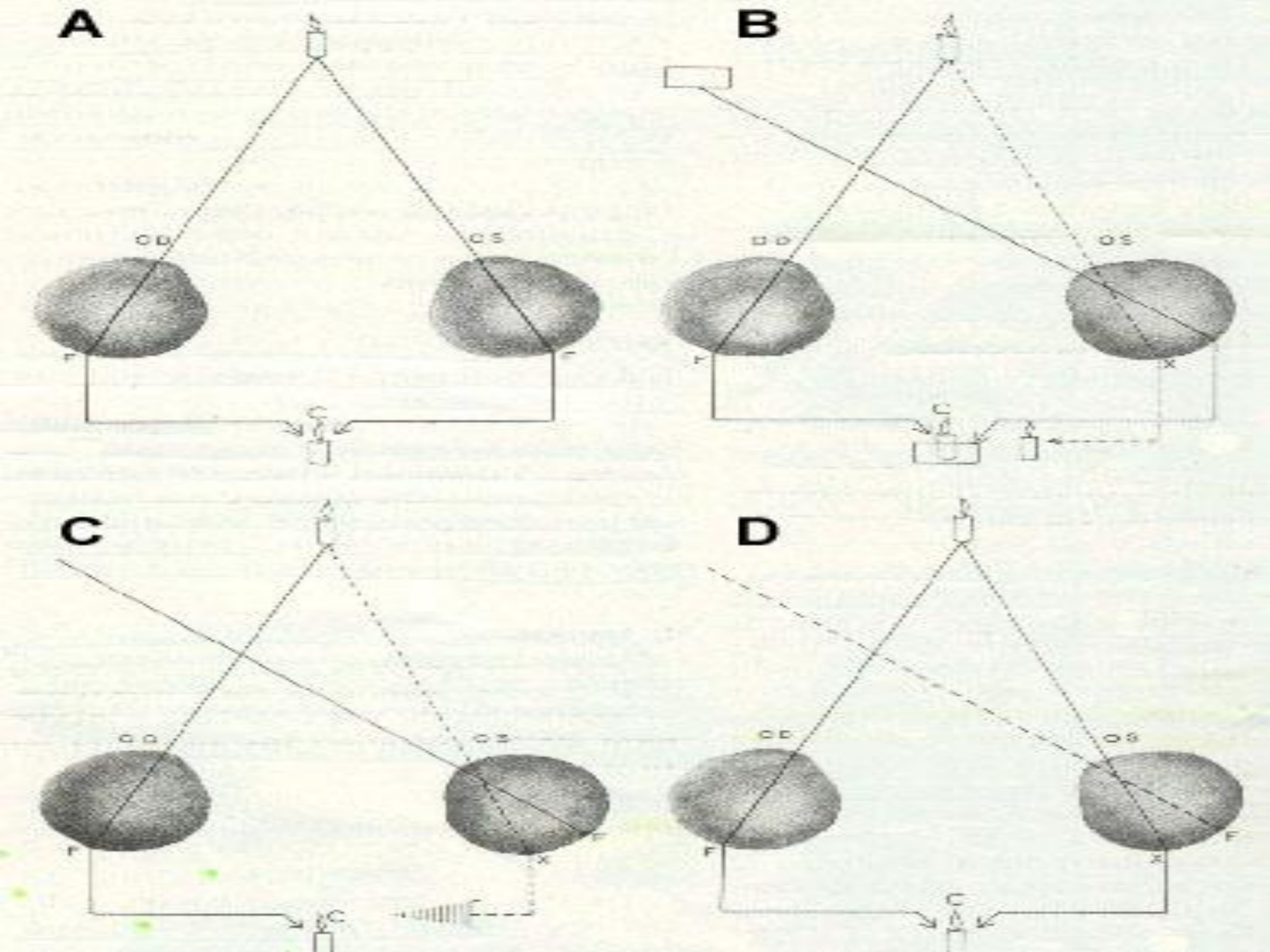
- Increase the field of vision
- Eliminate blind spot of each eye .
- Provide binocular visual acuity which is better than single eye vision
- Stereopsis and depth perception


Left
Viewing
distance v
Depth d
α
α
Fixation Point
R
P
+β
-β
+β
-β
Q
Right



BSV

- If both eyes are not aligned BSV is not possible this will result in :
- Diplopia : single object is seen in two different places ,
- Confusion : two separate and different objects appear to be at the same point.


A
B
C
D

Results of non-alignment

- Constant non-alignment will lead to a defense to avoid diplopia and confusion

- Suppression of the deviating eye will lead to AMBLYOPIA
- Intermittent deviation will not lead to amblyopia but stereopsis may not develop

Etiology of non-paralytic squint

- Central coordination of the eye motility abnormality , here the child and the eyes are normal
- May be associated with ocular disease :

  Anisometropia (different refractive error)

  Media opacity (corneal and lens)

  Retinal abnormality (retionblastoma)

  Hypermetropia (Accommodative)

Presentation

- Squint noted by parents or accompanying
- Intermittent VS constant .
- Family history of squint .
- History of refractive errors and glasses
- History of patching
- History of surgery and trauma
- Time of squint presentation
- Duration
- Past medical and birth history

Examination

- To look for features that simulate squint as
  - Wide nasal bridge
  - Epicanthus
  - Facial asymmetry

Examination

- Vision
- Pupils
- EOM
- Abnormal head position & face turn
- AS to look for causes of squint
- Dilated fundus examination

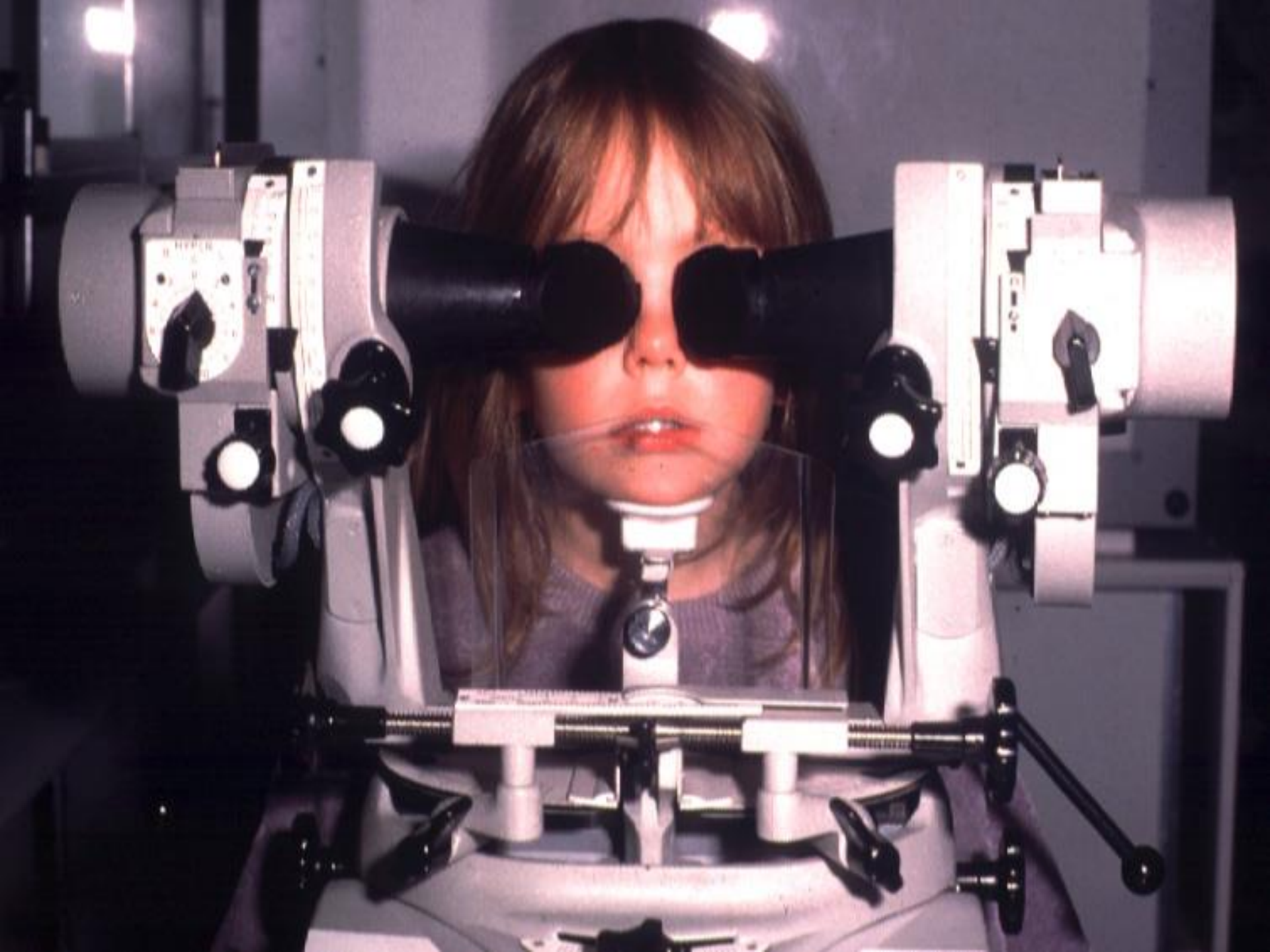
Examination
Alignment

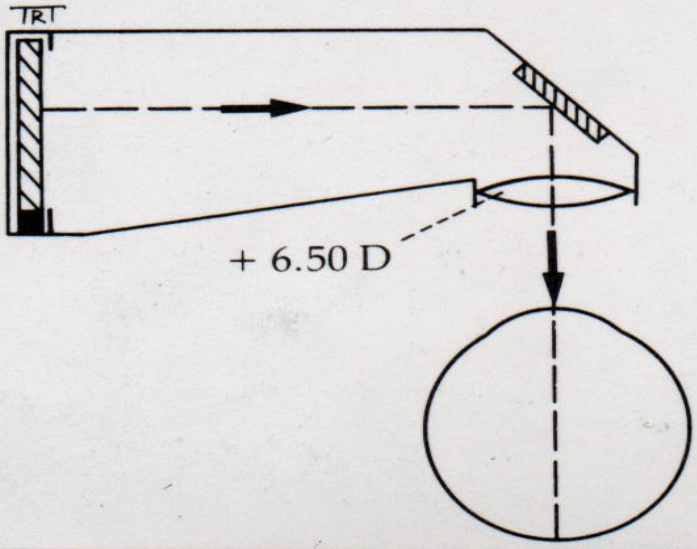
- Corneal light reflex
- Cover & uncover test
- Alternating cover test
- Prism associated tests

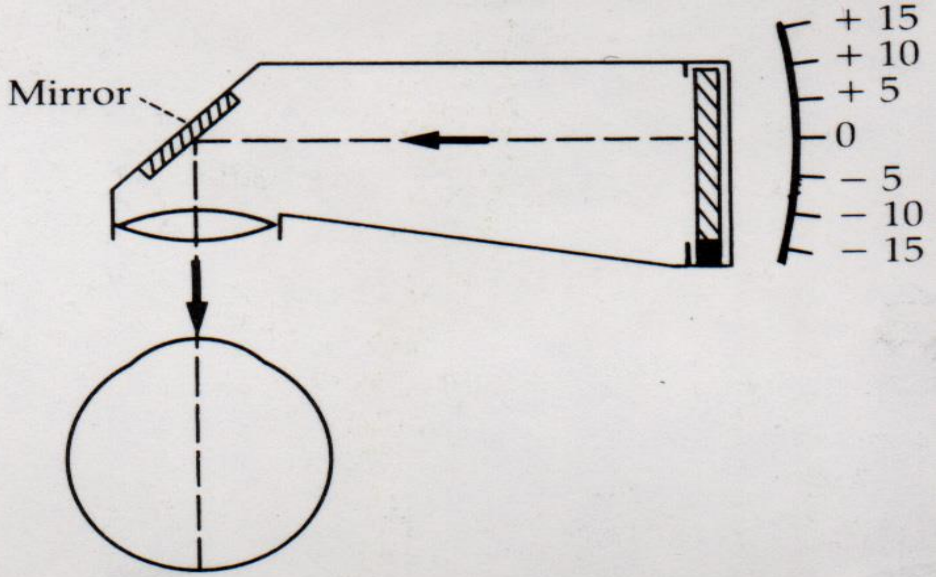

A

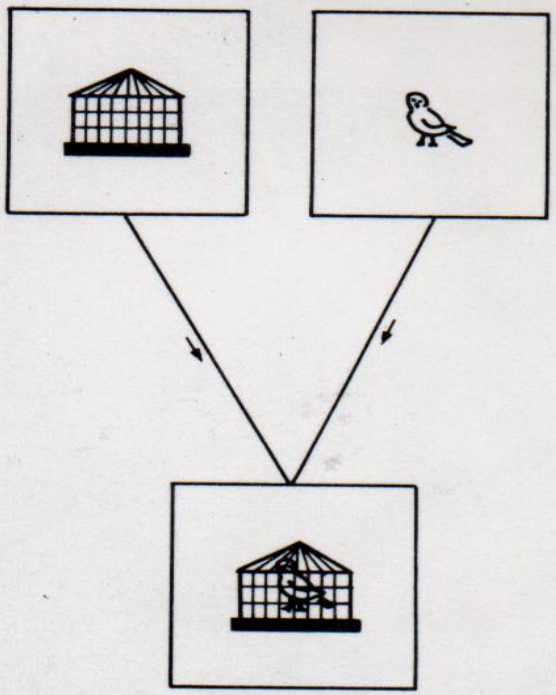
Examination

- Cyclorefraction
- Synoptophore
- Stereopsis examination

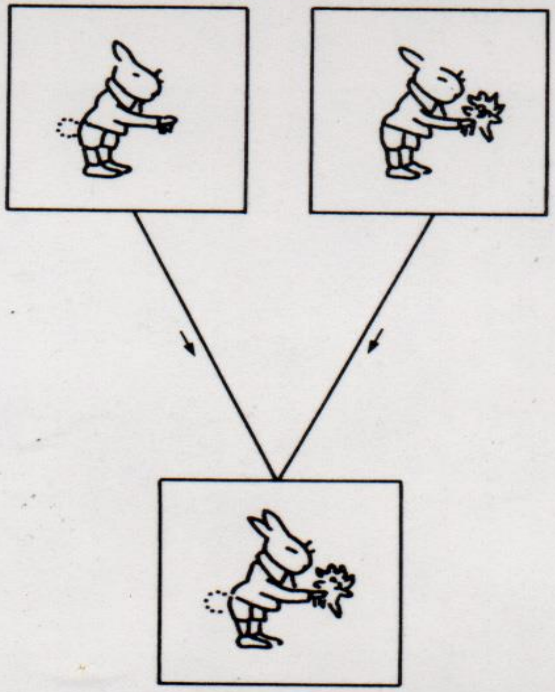




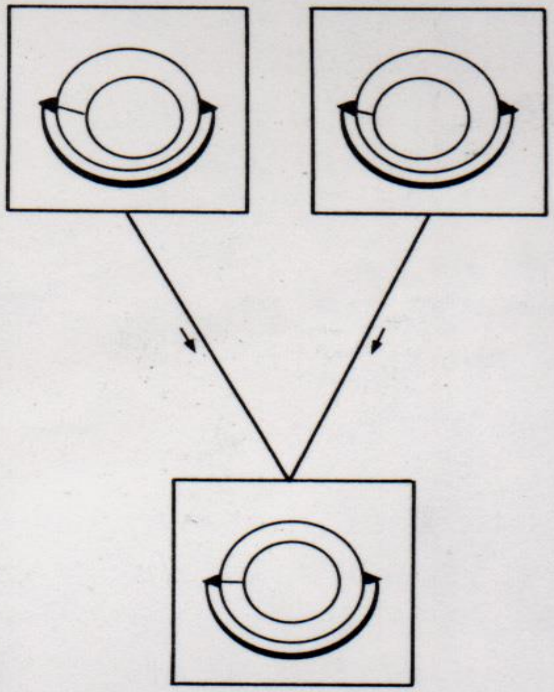




Simultaneous perception



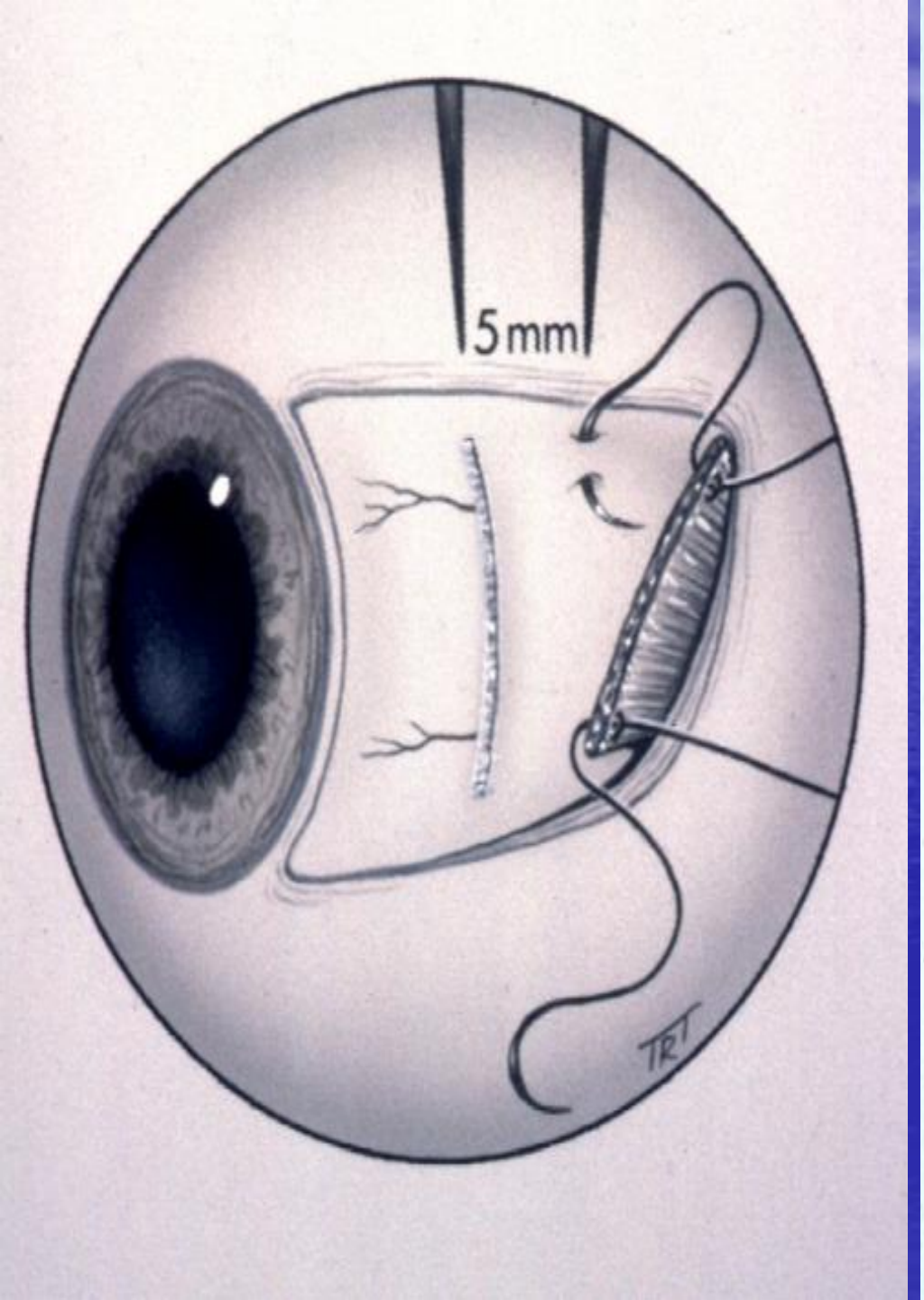
Fusion

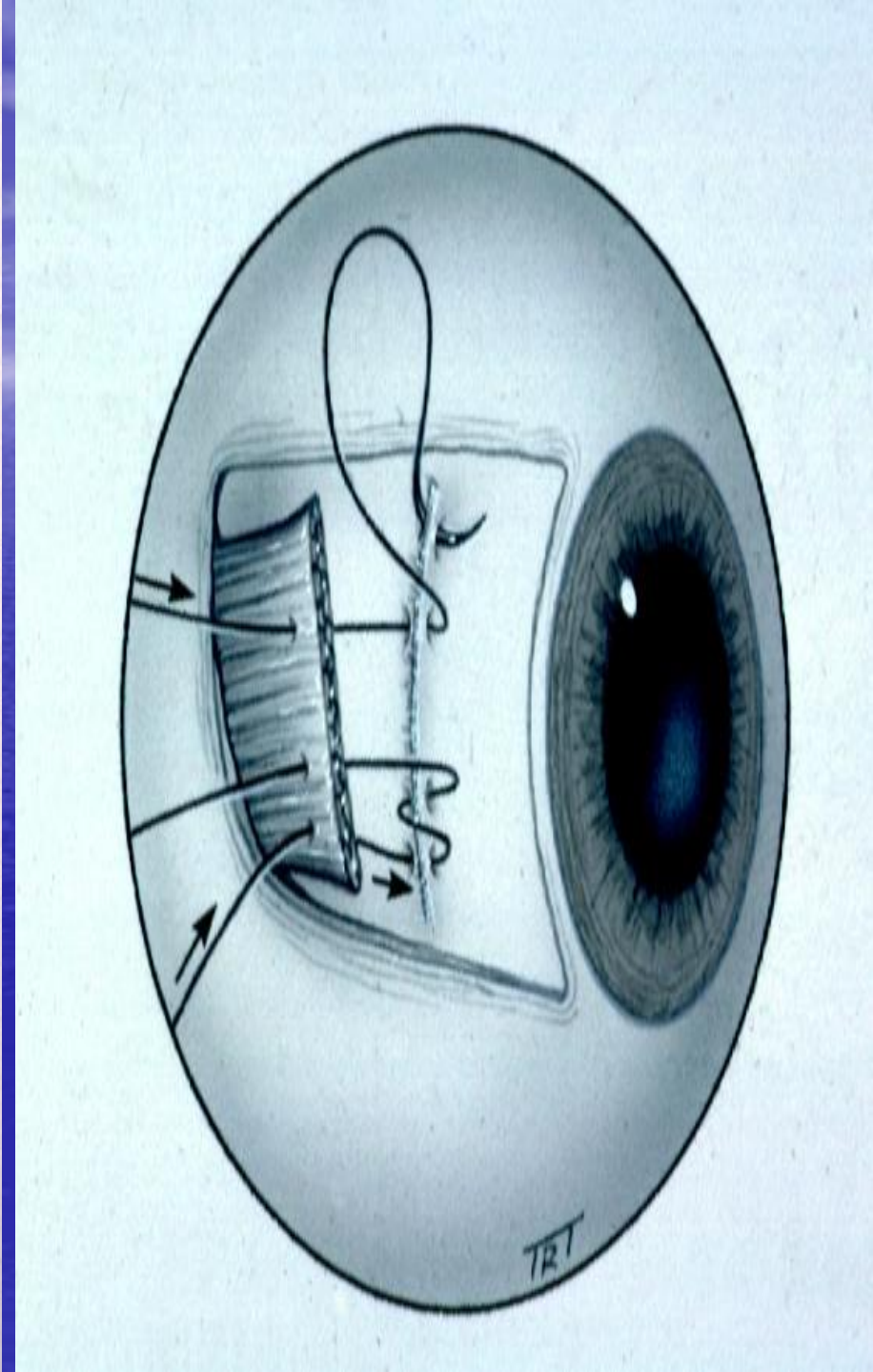


Stereopsis

Treatment

- Treat any significant refractive error
- Treat amblyopia with patching or penalization first
- Surgical treatment to change the muscle position on the globe by resection or recession to strengthen or weaken the muscle .
- For cosmoses and functional aims


5mm
TRT

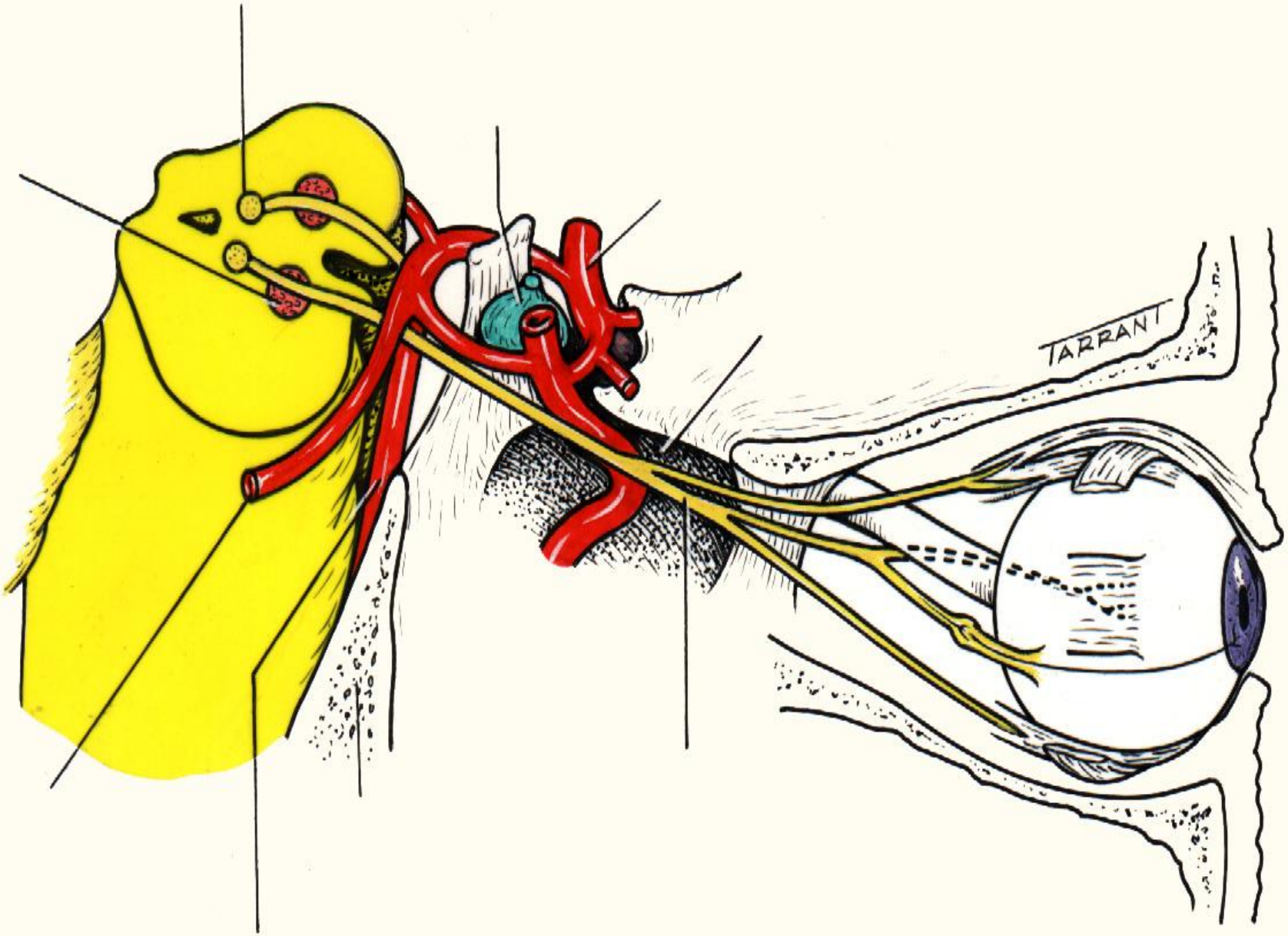

TRT

Prognosis

- Early amblyopia treatment can result in good vision gain
- Stereopisis is rarely gained
- Cosmetic treatment is important specially in pre-school age

Paralytic Squint

- Diseases of the third ,fourth & sixth cranial nerves and their central connections gives rise to paralytic squint
- Affection can happen at any point from the nucleus to the orbit


TARRANT

Paralytic squint

- The size of squint is dependent on the direction of gaze .
- Amount of deviation is grater when the eye moves to the direction of paralytic muscle
- In tethering amount of deviation is greater when the eyes looks to a gaze opposite to the direction of the affected muscle

Causes

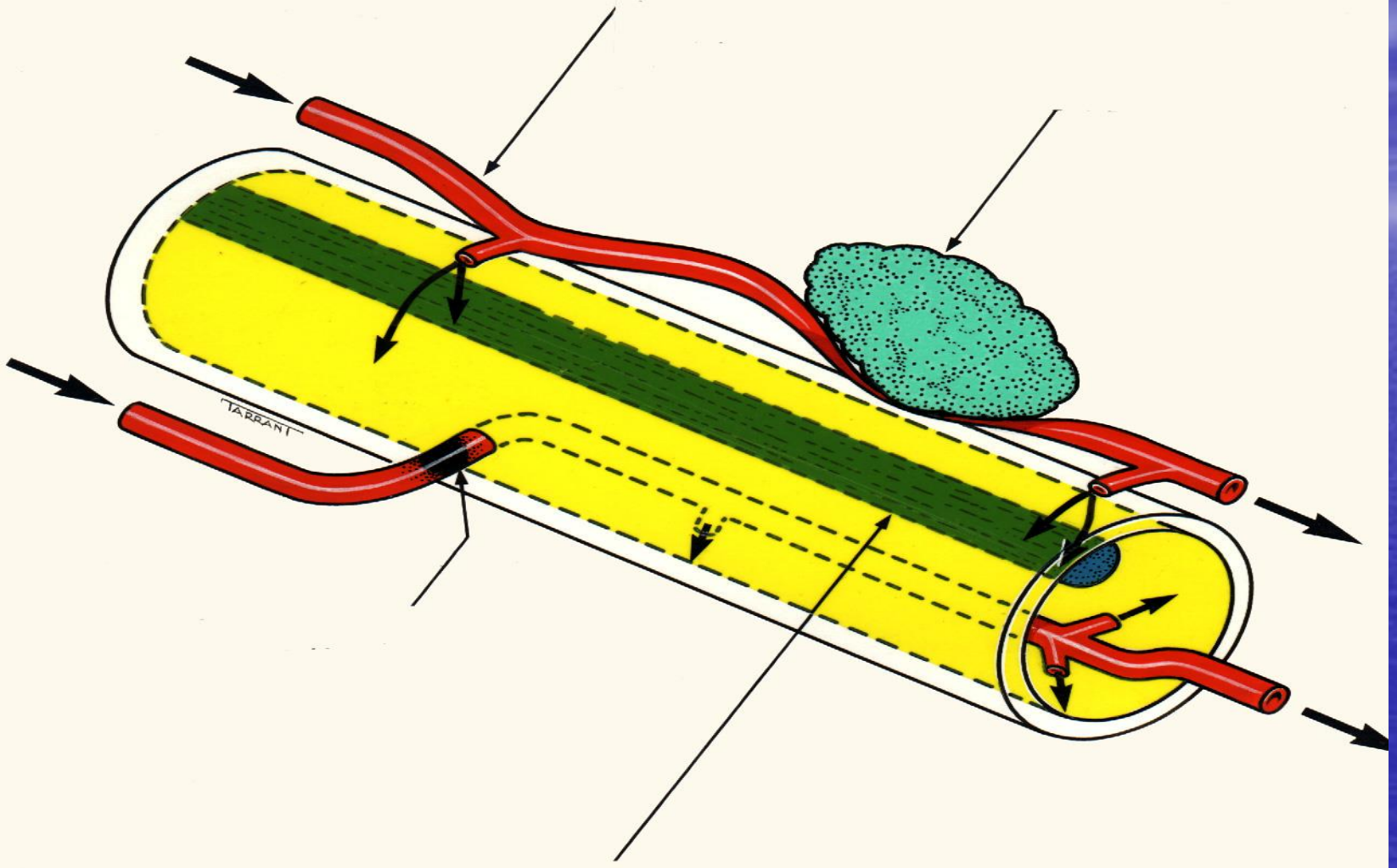
- Orbital disease as neoplasia
- Trauma
- CNS neoplasia : Meningioma
  Acoustic neuroma
  Glioma
- Raised ICP : can cause VI & III CN palsy

Causes

- Vascular diseases :DM
  HTN
  Aneurisms
  Carotid cavernou fistula
  Cavernous Sinus Thrombosis
- Inflammation :Sarcoidosis
  Vasculitis
  Infections (HZO)
  Gullain Barre syndrome

Presentation

- Diplopia
- Abnormal head position
- Third CN may result in failure of adduction , elevation and depression of the eye
- Ptosis
- Some time dilated pupil (surgical & medical third CN palsy) .


TARBANT



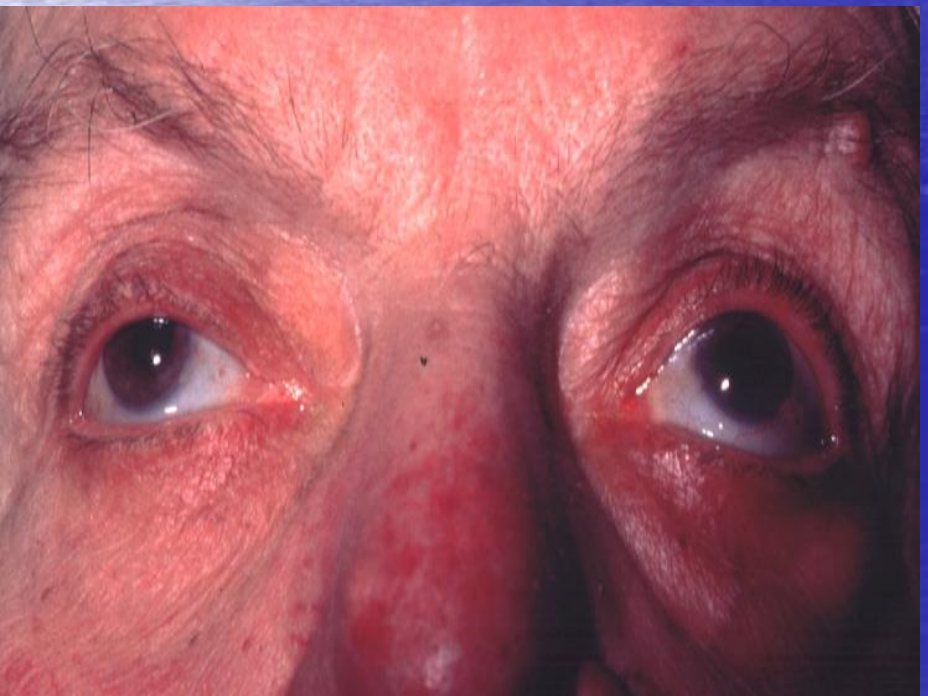



Figure 1: Left VI nerve (abducens) paresis or paralysis. Left esotropia with major limitation of abduction, increasing on left gaze


a
b

Presentation

- Fourth CN palsy will result in failure of depression in adducted position
- Will cause vertical diplopia
- Specially when reading or going downstairs .
- Sixth CN palsy result in failure of abduction

Treatment

- According to the underlying cause .
- Posterior communicating artery aneurism needs neurosurgical consult .
- DM & HTN will cause microvascular accident to vasanervosum which might improve within months

Treatment

- Orbital diseases & cavernous sinus abnormality may cause multiple CN palsies . CT & MRI may help in the diagnosis .
- Neurosurgical or ENT consult may be needed

Treatment

- In early stages prisms may help to decrease diplopia
- Covering one of the eyes
- Botulinum toxin injection
- EOM surgery may be needed for the permanent palsies