SURGICAL OUTCOME OF THIRD NERVE PALSY –A PROSPECTIVE STUDY

DISSERTATION SUBMITTED FOR

MS(BRANCH III)OPHTHALMOLOGY

THE TAMILNADU DR.M.G.R MEDICAL UNIVERSITY

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CERTIFICATE

Certified that this dissertation entitled **"SURGICAL OUTCOME OF THIRD NERVE PALSY A PROSPECTIVE ANALYSIS**" submitted for MS (Branch III) Ophthalmology, The Tamil Nadu Dr.M.G.R.Medical University, April 2015 is the bonafide work done by **Dr. P. SHALINI**, under our supervision and guidance in the Paediatric Ophthalmology and Strabismus services of Aravind Eye Hospital and Post Graduate Institute of Ophthalmology, Madurai during her residency period from May 2012 to April 2015.

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DECLARATION

I **Dr. P. SHALINI** solemnly declare that the dissertation titled **"SURGICAL OUTCOME OF THIRD NERVE PALSY A PROSPECTIVE ANALYSIS"** has been prepared by me. I also declare that this bonafide work or a part of this work was not submitted by me or any other for any award, degree, diploma to any other university board either in India or abroad.

This dissertation is submitted to the **Tamil Nadu Dr.M.G.R Medical University**, Chennai in partial fulfillment of the rules and regulation for the award of **M.S. Ophthalmology (Branch III)** to be held in April 2015.

Place : Madurai

Date : **DR. P. SHALINI**

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CONTENTS

INTRODUCTION

Surgical planning for paralytic strabismus may be complex and difficult. With conventional strabismus surgery, the results are usually predictable because of balanced ocular muscle forces. In paralytic strabismus, these forces are not equal. Furthermore, there is a high degree of variability depending upon the number of muscles involved and the degree of paralysis of the individual muscles. [1]

The third nerve palsy is difficult to treat as results are poor with the therapeutic interventions. Third nerve affects four extaocular muscles and so if there is complete third nerve palsy, the eye is fixed in a characteristic down and out position due to unopposed actions of the superior oblique and lateral rectus muscles, respectively.

The treatment of third never palsy will also depend on the strength of the extraocular muscles. If the strength of the muscle is poor then even with maximal recession and resection the strabismus can recur

In cases with total third nerve palsy and minimal strength of the extraocular muscles the eye may be fixed in primary position for ocular alignment. These procedures are becoming popular nowadays and different techniques are tried.

Several studies are done retrospectively, considering outcome of different surgical procedures. Most of the studies are related to anatomical success. It is generally held that surgery for pattern strabismus yields a higher success, because anatomic factors unlike sensory factors can be easily identified and rectified. [2]

Given the variable success rates and limited literature on the outcome of large third nerve palsy, we devised a study to evaluate the postoperative anatomical and functional outcome of third nerve palsy; with surgical plan considering preoperative horizontal deviations in different gazes and strength of the extaocular muscles.

ANATOMY OF THIRD NERVE

The third cranial nerve is entirely motor in function .It supplies all extraocular muscles except lateral rectus and superior oblique.It also supplies intraocular muscle namely sphincter pupillae and ciliary muscle. [1]

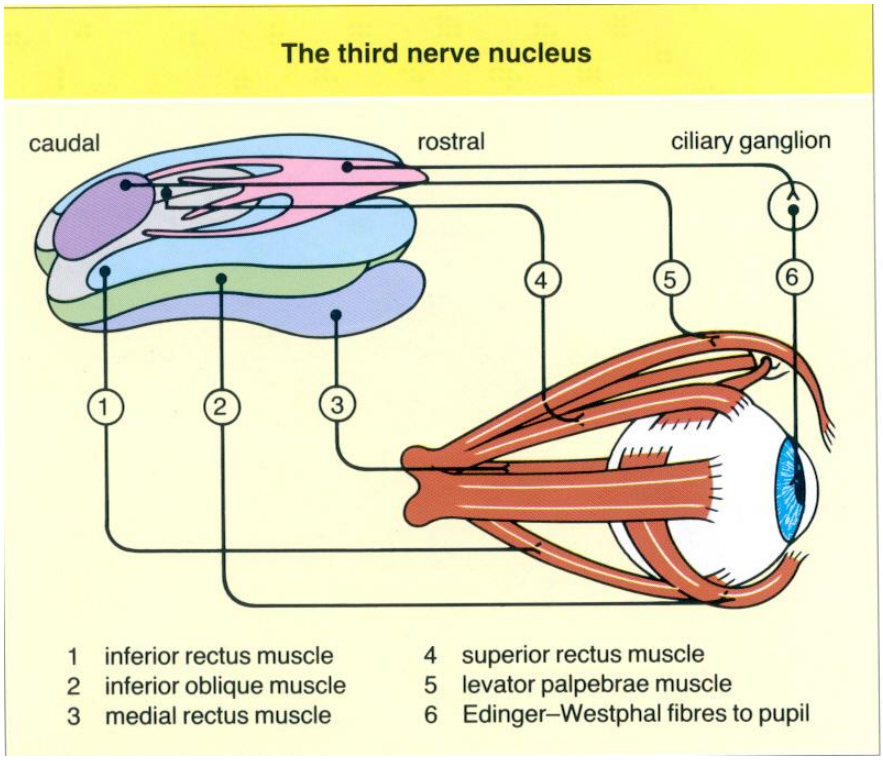
FUNCTIONAL COMPONENTS:

- Somatic efferent : motor supply to the levator palpebrae superioris, superior rectus, medial rectus, inferior rectus and inferior oblique.
- General somatic afferent : Proprioceptive impulses from these muscles
- General visceral efferent: Parasympathetic component - motor supply to sphincter pupillae and ciliaris .

NUCLEAR COMPLEX:

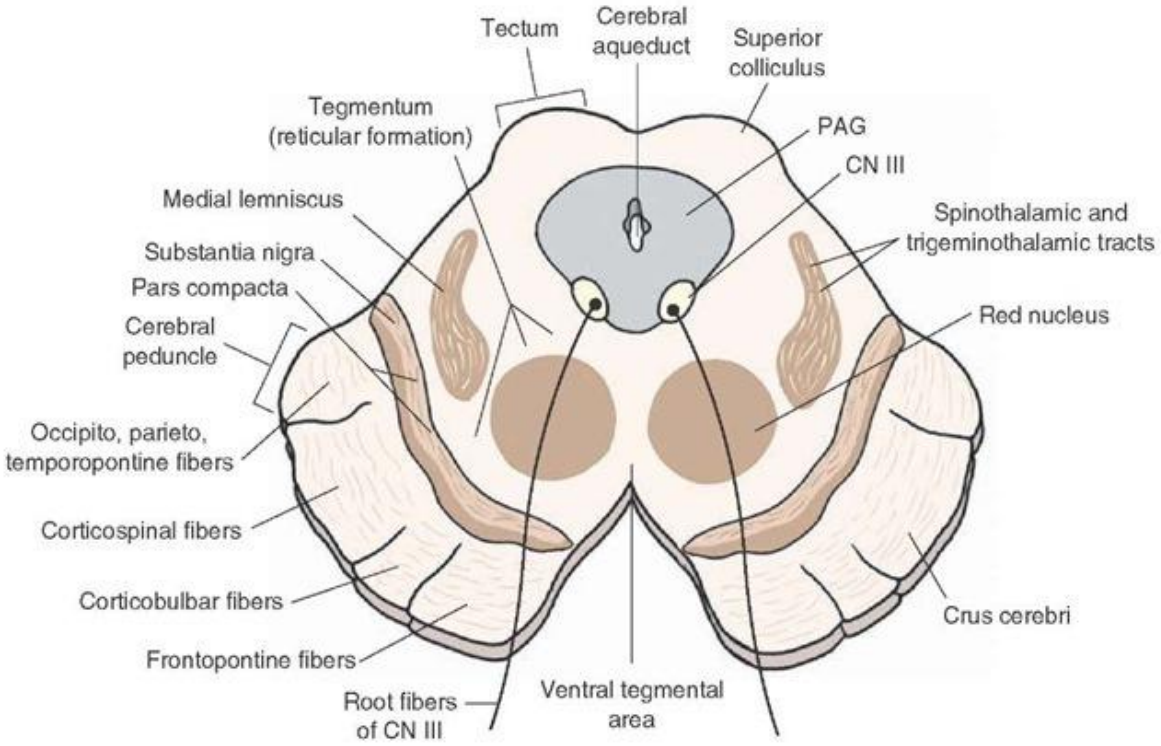
The oculomotor nerve nucleus lies midbrain, anterior to the cerebral aqueduct with multiple subnuclei that supply extraocular muscles. In general, the axons arising from these subnuclei travel in the ipsilateral nerve, except axons arising from the superior rectus subnucleus that travel through the contralateral third nerve complex to join the third nerve on that side.

In addition, a single central caudate nucleus issues fibers that join both third nerves to innervate the levator palpebrae bilaterally.



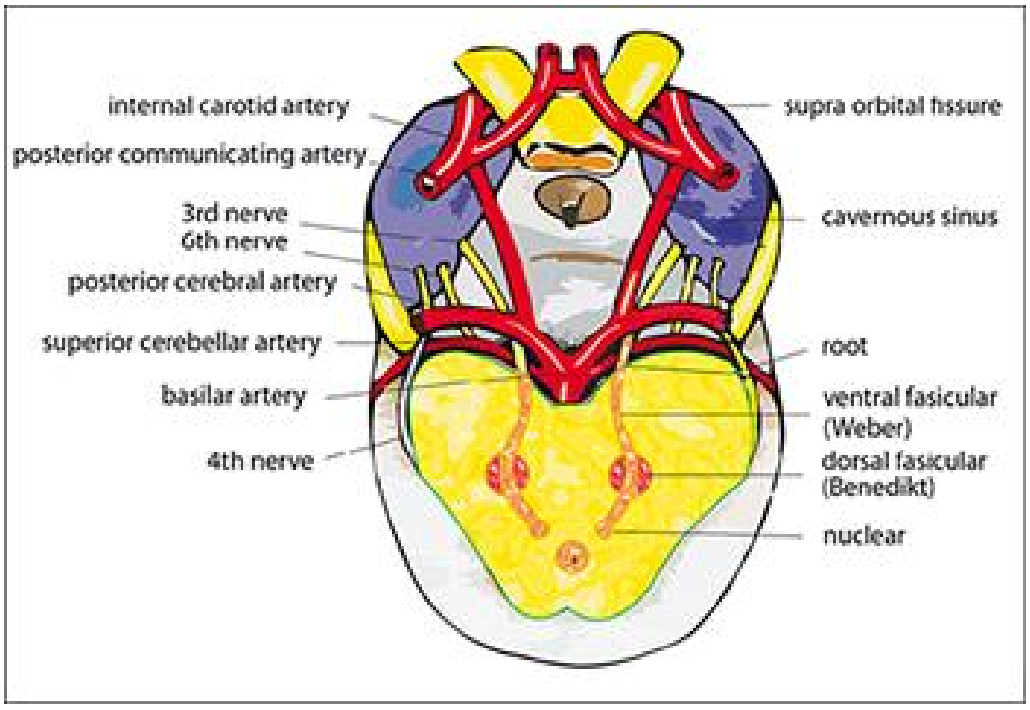
FASCICULAR PART: [1]

It cocnsists of efferent fibres that pass from from the third nerve nucleus through the red nucleus and the medial aspect of cerebral peduncle.they then emerge from the midbrain and pass into the interpeduncular space.



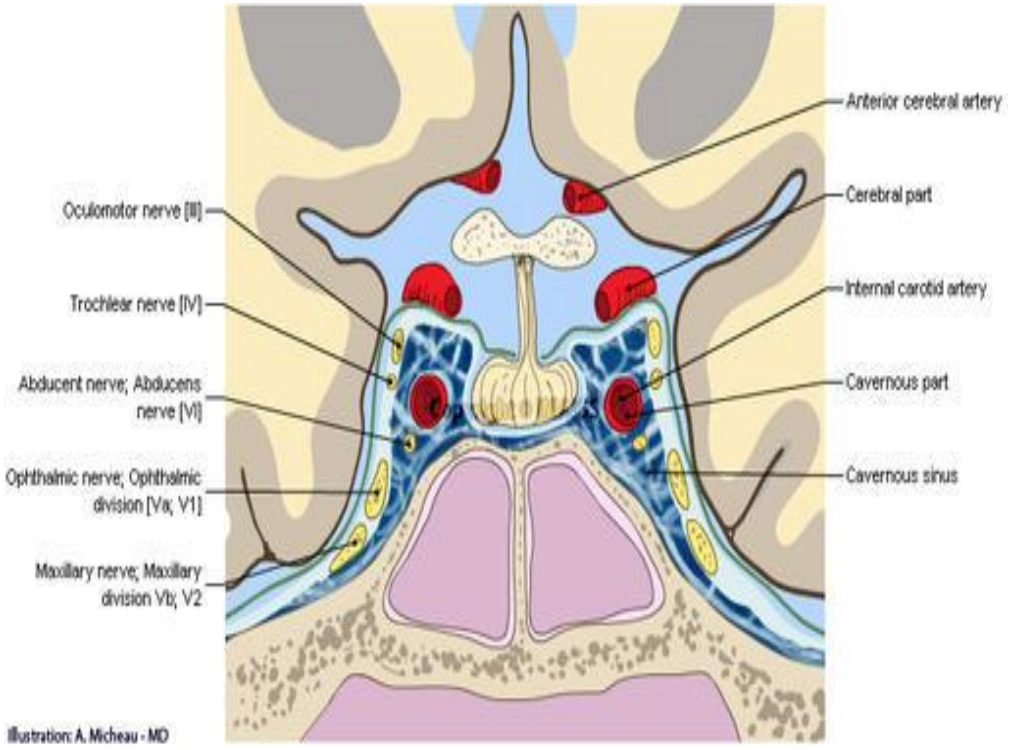
THE BASILAR PART:

It starts as a series of 15 to 20 rootlets in the interpeduncular fossa and coalesce to become a single rounded cord. The nerve then pass between the posterior cerebral artery and the superior cerebellar artery and they run in the interpeduncular cistern to reach the cavernous sinus.



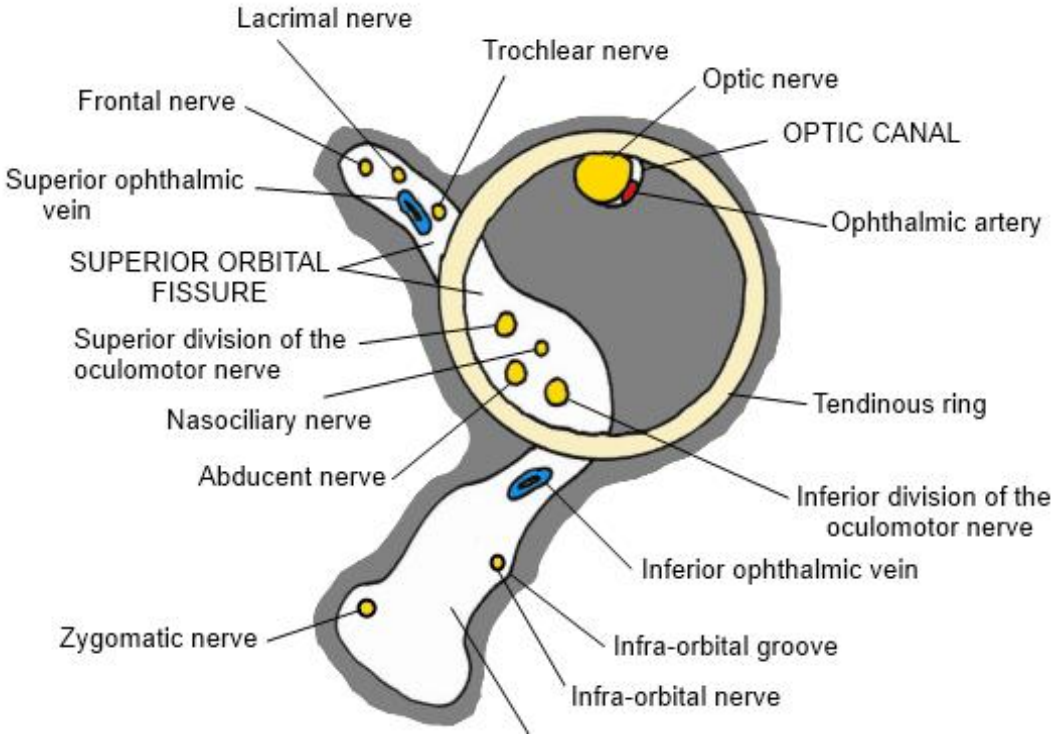
CAVERNOUS PART:

The nerve enters the cavernous sinus by piercing the posterior part of its roof on the lateral side of the clinoid process where it lies above the clinoid process. In the cavernous sinus it lies above the trochlear nerve.



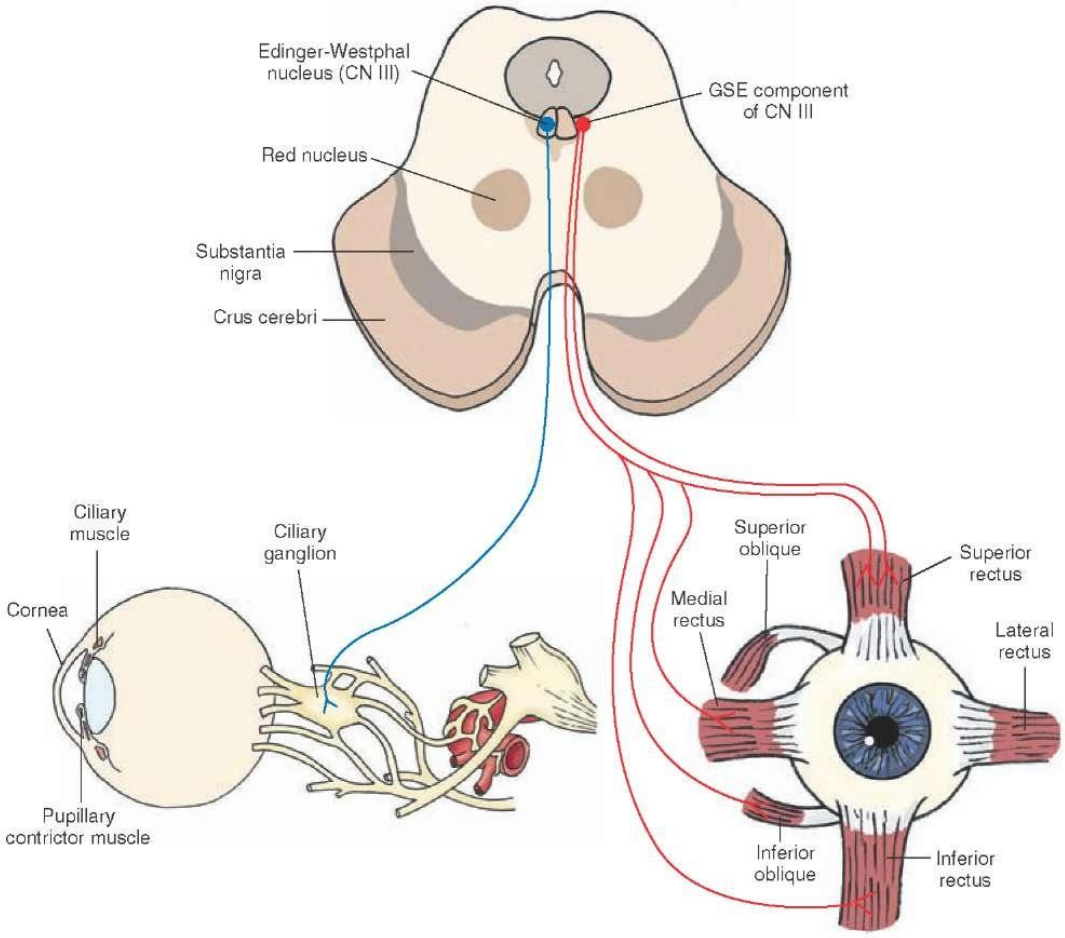
SUPERIOR ORBITAL FISSURE[2]

It divides into two division at the anterior border of cavernous sinus and enters the superior orbital fissure in the middle part



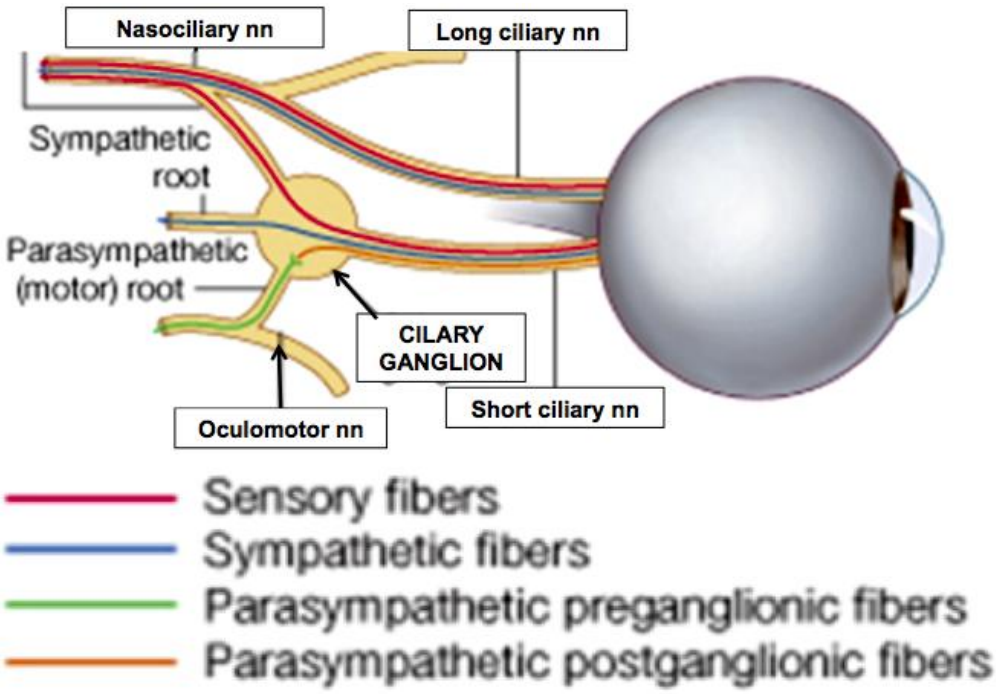
INTRAORBITAL PART: [2]

The small superior division ascends on the lateral side of optic nerve and supplies SR and LPS.The large inferior division supplies rest of the muscles except SO and LR.



CILIARY GANGLION:

It is a peripheral parasympathetic ganglion placed in tht course of oculomotor nerve, It lies near the apex of the orbit between the optic nerve and the tendon of lateral rectus muscle.The ciliary ganglion which divide into 15 to20 short ciliary nerves ,which pierce the sclera around the entrance of optic nerve.



BLOOD SUPPLY : [1]

Blood supply to third nerve has multiple sources that feed a vasa nervorum capillary network. In the subarachnoid space, the third nerve is supplied by small thalamo mesenchephalic branches from the basilar artery and the intracavernous carotid, and within the orbit its supply arises from recurrent branches of the ophthalmic artery.

ETIOLOGY

Paralysis of third cranial nerve can be congenital or acquired. It can be complete or partial.

CONGENITAL THIRD NERVE PALSY: [2]

It has been reported to occur due to following causes

1. Developmental aplasia or hypoplasia of the third nerve nuclei or the nerve.
2. Intrauterine trauma.
3. Birth trauma-probably compression of the third nerve occuring at some point between the brain stem and entry of nerve into cavernous sinus.
4. As a part of cerebral palsy.
5. Infantile intracranial infections like encephalitis and meningitis.

CONGENITAL SYNDROMES:

1. **Congenital adduction palsy with synergistic divergence:**

   Adduction will be restricted in one eye and there will be abduction restriction in both eyes.

2. **Vertical retraction syndrome**:

   - Limitation of elevation or depression associated with retraction of the globe and narrowing of palpebral fissure.
   - Associated with esotropia or exotropia more marked in the direction of action of involved muscle.
   - Can be unilateral / bilateral.
   - Anomalous oculomotor innervation .

3. **Cyclic oculomotor paresis:** [3]

   - Rare unilateral condition - usually present from birth.
   - Patient will have - ptosis, mydriasis, reduced accommodation and ophthalmoparesis .
   - Gets spasms every 2 minutes which lasts for 10-30 seconds.
   - Spasms are characterised by elevation of ptotic lid, adduction of globe, constriction of pupil.
   - Remains unchanged throughout life.

4.Congenital fibrosis of extraocular muscles: [4]

TYPE 1: Non progressive B/L restrictive ophthalmoplegia.

- AD Inherited – chromosome 12p
- Absence of superior division & subnuclei of third nerve,
- Superior rectus & LPS becomes fibrotic.
- Primary position, eyes are infraducted with inability to move above horizontal midline .Ptosis also present.
- Pupils –normal, FDT-restriction , Imaging-small muscles.

TYPE 2:

- AR Inherited-chromosome 11 q 13
- Maldevelopment of both third & fourth nerves ptosis present with B/L fixed exotropia

TYPE 3:

- AD Inherited Absence of vertical eye movement, with preservation of horizontal movements.
- Maldevelopment of third and fourth nuclei.

ACQUIRED THIRD NERVE PALSY:

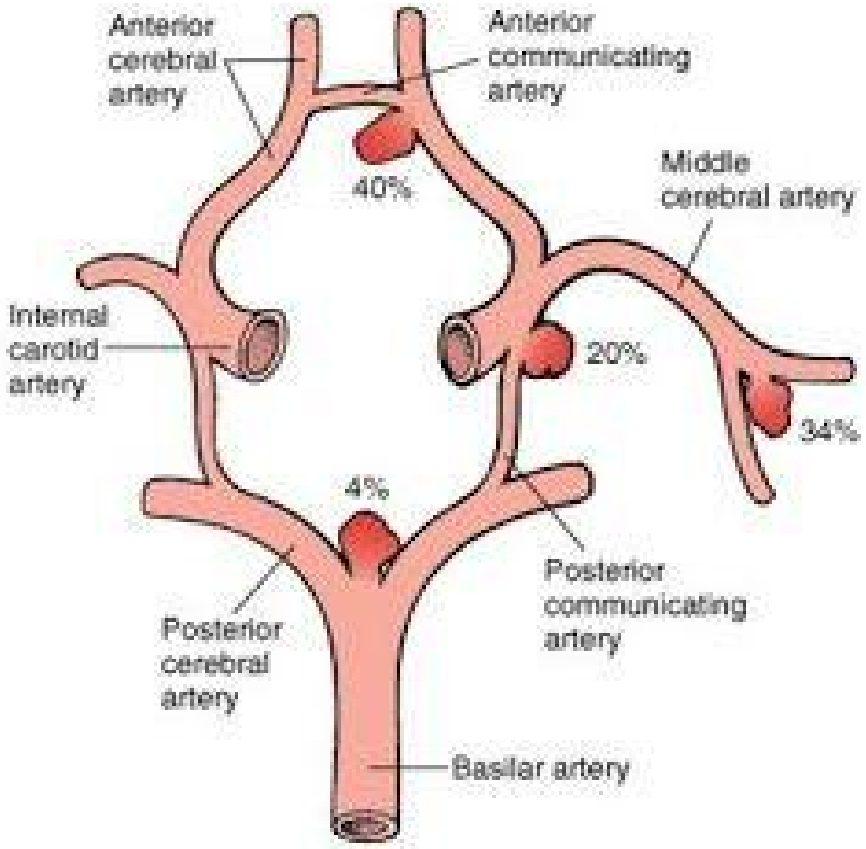
The causes which can involve the third nerve at various levels are as follows

1. **Nuclear**
    - Infarction or hemorrhage
    - Cavernous malformation
    - Tumor

2. **Fascicular** [3]
    - Infarction
    - Hemorrhage
    - Migraine - with MRI signal abnormalities during acute phase consisting of a thickening and enhancement of the nerve at its exit from the midbrain
    - Tumor
    - Multiple sclerosis
    - Stereotactic surgery

3. Basilar part:

- Aneurysms of the ICA,PCA cerebral artery arteriovenous fistula[12]
- Tumors, of the third nerve



- Glioblastoma multiforme
- Sarcoidosis
- Wegners granulomatosis
- Ophthalmoplegic migraine
- Pseudotumor cerebri
- Trauma,
- diabetes,
- atherosclerosis,

4. Intracavernous part

- Cavernous sinus thrombosis
- Tumors,
- Aneurysm of the internal carotid artery
- Dural carotid-cavernous sinus fistula
- Metastasis
- Pituitary infarction or hemorrhage (pituitary apoplexy)
- Wegener's granulomatosis
- Gammopathy
- Intraneural hemorrhage
- Mucocele of the sphenoid sinus or sphenoid sinusitis
- Tolosa-Hunt syndrome or other granulomatous diseases

4. **Intra Orbital part**

   - Orbital pseudotumor
   - Sphenoid sinus mucocele
   - Tumor
   - Trauma

5. **Unknown localization**[11]

   - Migraine
   - Trauma
   - Viral infections
   - Lyme disease
   - Subdural hematomas

6. **Toxic effects of drugs**[14]

   - Cocaine
   - Sildenafil citrate (Viagra)
   - Infliximab
   - cisplatin
   - Dental anesthesia
   - Scorpion bite
   - Radiation therapy

CAUSES OF THIRD NERVE PALSY IN CHILDREN[2]

- Congenital
- Traumatic
- Inflammatory
- Post viral syndromes
- Migraine
- Neoplasms

CAUSES OF THIRD NERVE PALSY IN ADULTS:

- Aneurysm
- Diabetes
- Neuritis
- Trauma
- Infection
- Tumour

CAUSES OF PUPIL SPARING THIRD NERVE PALSY: [12]

- Diabetes
- Hypertension

EVALUATION OF THIRD NERVE PALSY

- **CLINICAL FEATURES:**

1) **DIPLOPIA:**

It is the main symptom of paralytic squint.It is marked towards the action of paralysed squint. It occurs due to the formation of image on the dissimilar points on the two retinae.

2) **CONFUSION:**

It occurs due to the formation of image of two different objects on the corresponding points of two retinae following misalignment of the ocular axis.

3) **OCULAR DEVIATION;** [16]

In paralytic squint ,the primary ocular deviation is incomitant and it differs from the secondary deviation

- **PRIMARY DEVIATION:** It is the deviation of the affected eye when the unaffected eye is used for fixation
- **SECONDARY DEVIATION:** It refers to the deviation of the unaffected eye seen under cover when the patient is made to fix with the paralytic eye.
- **SPREAD OF COMITANCE:**A paralytic squint undergoes various stages.The first stage is the weakness of the paralysed muscle .Almost immediately the direct antagonist begins to

overact. The contracture of the antagonist muscle will begin to develop within days. At this point the deviation may become greater in the field of action of the antagonist muscle.During the next stage the deviation will spread into all gazes and becomes increasingly comitant.

4) **OCULAR MOVEMENTS:**

Restriction of movements occurs towards the action of the paralysed muscle.

5) **PAST POINTING:**

It ia also called as false orientation and it occurs due to the increase innervational impulse applied to the paralytic muscle during movement in the direction of action of paralysed muscle

6) **NAUSEA**

7) **VERTIGO**

8) **DIZZINESS**

9) **ABNORMAL HEAD POSTURE**

It includes

- Chin elevation or depression
- Face turn
- Head tilt

10) SENSORY ADAPTATIONS:

These include

- Suppression
- Ambylopia
- Abnormal retinal correspondence

- **EXAMINATION OF MOTOR SYSTEM** : [3]
  - Head posture
  - Ocular deviation
    - Chin lift (vertical)
    - Face turn (horizontal)
    - Head tilt (torsional)
  - Head posture ensures that the eye is out of the field of action of the paralytic muscle
  - Head posture is chosen such that ocular deviation is least or rarely such that the deviation is maximum enabling the suppression of the peripheral image easier

❖ **Ocular deviation** :

➢ **Pseudo strabismus** :

a) Appearance of squint inspite of the alignment of the two visual axis

b) Can be due to abnormal adnexal structures or abnormal relationship between the visual and optical axis of the eyes

c) Abnormal adnexal structures;

- Telecanthus , epicanthus, - pseudo esotropia
- Hypertelorism, Euryblepharon – pseudoexotropia
- Ptosis or lid retraction – may masquerade as vertical squint

d) Angle Kappa :

- The angle between the optical and the visual axis
- Normally about 5^{o} with eyes looking out
- Hypermetropia – large angle kappa – pseudoexotropia
- Myopia – small or negative angel kappa – pseudoesotropia

- To establish the existence of squint
- Quantifying the squint

- **Detection of squint :**
  - **Cover uncover test**
    - Prerequisites:
      - Ability of both eyes to fixate target
      - Ability of both eyes to have central fixation
      - No gross EOM deficit
    - Proper fixation target necessary
    - Distance at 6m and near at 33 cm
    - Occluder should be used – in children palm may be used
    - Done in all positions of gaze

  b) Observations made during cover test :

    - Cover the apparently fixing eye and observe the apparently deviating eye
    - If the apparently deviating eye moves to take up fixation →manifest or true squint
      - Using a translucent (Spielmann s) the apparently fixing eye may be seen to deviate behind the translucent cover
    - Ptosis that recovers when the hypotropic eye fixates – pseudoptosis

c) Observations during uncover test :

- Helpful in unmasking the latent squint
- When both eyes appear to be fixing →one eye covered – the absence of movement of the other eye shows that it was not deviating → the eye uncovered and the behaviour of the uncovered eye noted
  - If it remains deviated →poor fusion
  - If it recovers back →speed of recovery noted (strength of fusion)
  - When the uncovered eye resumes fixation as the other deviates (→dominance of the uncovered eye , unequal visual acuity in both eyes
  - Free alternation of fixation →equal vision in two eyes

d) Indirect occlusion or distant cover test :

- In infants who don't allow to occlude or palm close to their face
- The light or fixation target is obstructed for each eye by an occlude used at a distance away from the child.

e) Alternate cover test :

- Interrupts fusion mechanisms and total deviation can be measured
- Done after cover – uncover tests
- Each eye alternately covered and uncovered for 2 seconds
- The speed and smoothness of the recovery when uncovered as the eye returns to its pre dissociated state found

f) Cover uncover tests help us to determine

- Eso and exo deviations (tropias and phorias)
- Shows visual dominance and Presence of amblyopia

➢ **Measurement of deviation** :

➢ Objective

➢ Subjective

OBJECTIVE:

➢ **Prism Bar Cover test** :

- Cover uncover test with addition of neutralisation of the deviation by prisms
- Fixation distance, fixation target and proper dissociation of the two eyes should be ensured

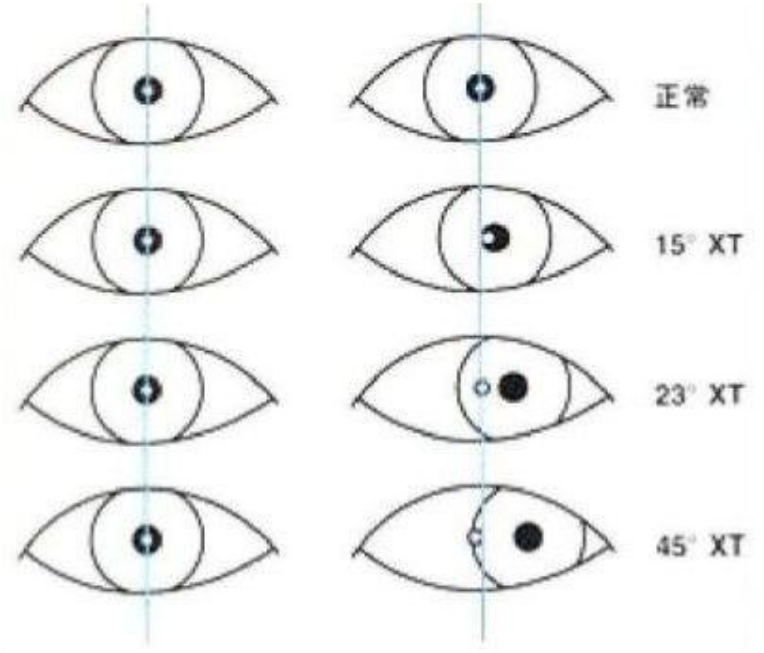
- Static deviation devoid of - Accommodative and fusional vergence relaxed by proper refractive correction and occlusion if needed respectively
- Apex of the prism should point towards the deviation
- In combination of horizontal and vertical deviation → prisms are placed horizontally in front of one eye and vertically in front of another
- Plastic prisms → frontal position parallel to the infraorbital margin
- Glass prisms → Prentice position – the posterior face of prism perpendicular to the line of sight
- $\Delta MD/ \Delta AD = 1- 0.025 \times D$; used to measure the actual deviation (AD) eliminating the effect of high plus and minus lenses
- Deviation with near and distance to be measured
- Deviation with and without glasses should be measured
- Deviation in nine different cardinal positions should be checked for incomitance
- Both subjective and objective methods – to determine the type of retinal correspondence

- **Deviometers**
- **Listers perimeter** – for near measurements
- **Cephalodeviometer** – a single fixed target and the head turned to bring the eye into desired positions – deviation of the head read using a protractor along with a scale
- **Synoptophore** :
    - Not very reliable for measuring horizontal deviations since proximal convergence comes into play distorting the deviations
    - Useful to measure torsion
    - To study accommodation convergence relationship
- **Synoptoscope of Curpax** – – uses translucent mirrors instead of opaque mirrors
- **Synoptometer -** measurement of deviation in peripheral positions possible with the help of mirrors
- **Corneal reflection tests** :
    - **Hirschberg s test** :
        a) First catoptrics image of purkinje can be used to estimate the ocular deviation in a gross or semiquantiitative manner
        b) Measures the angle of manifest squint especially in uncooperative patients and when fixation is poor
        c) Not exactly centre due to angle kappa but symmetrical

d) 1 mm shift = 5^{o} (15 Δ)

e) Pupillary border : 15 deg

f) Limbus : 45 deg



- **Krimsky s test:**

  a) The prism bar placed on the fixating eye and the amount of deviation neutralised by observing the corneal reflex in the deviating eye (or over the deviated eye until the corneal reflexes are neutralised)

  b) Only manifest deviation measured – may underestimate the true size of deviation

SUBJECTIVE – utilise the subject s perception of deviation

1. **Maddox wing test :**
    a) Dissociates the eye for near fixation and measures the heterophoria
    b) RE sees a white vertical arrow and a red horizontal arrow
    c) LE sees only horizontal and vertical row of numbers
    d) Horizontal deviation measured by asking the number the w0hite arrow points to
    e) Vertical deviation is measured by asking which number the red arrow intersects
    f) Cyclophoria is determined by asking the patient to move the red arrow so that it is parallel with the horizontal row of numbers
2. **Maddox rod test** :
    a) Consists of a series of fused red cylindrical glass rods converting a white point source of light into a red line perpendicular to the axis of the cylinder
    b) Rod in front of right eye – dissociation since the red line and the white light cannot be fused
    c) The amount of deviation is measured by the superimposition of the two images using prisms

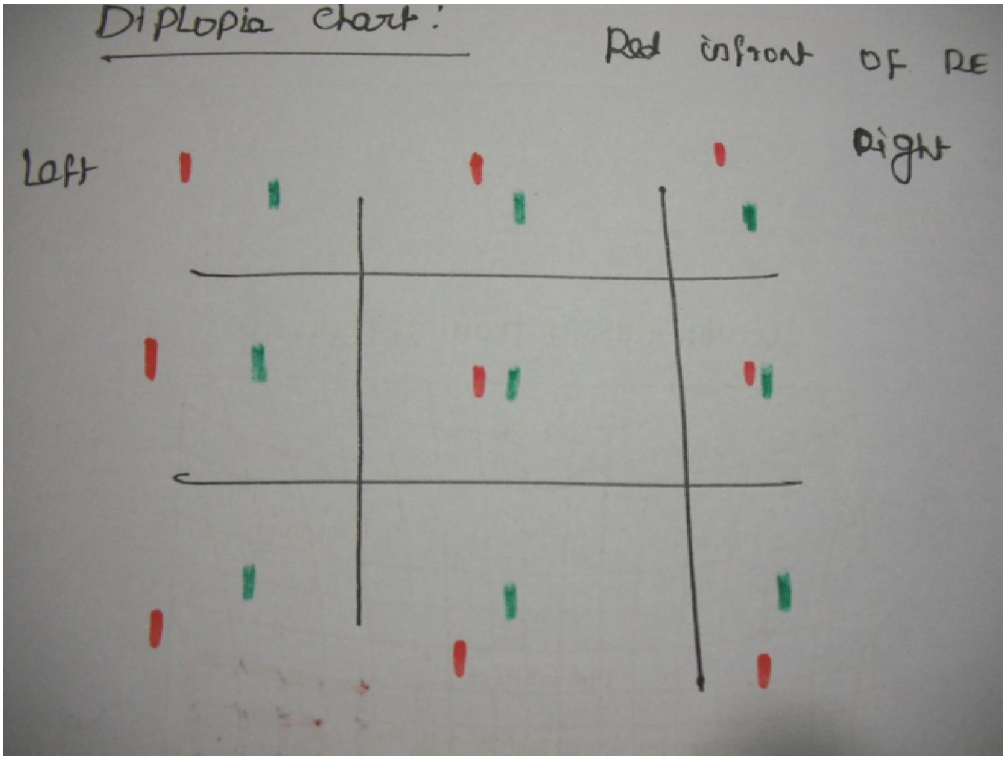
d) Both vertical and horizontal deviations can be measured but phorias cannot be differentiated from tropia.

3. Diplopia testing :

a) Diplopia principle : the single physical location is perceived by the subject as two perceptual localisations

b) Red and green goggles over right and left eye

c) Iluminated slit target used horizontally for vertical deviations and vertical for horizontal



d) Maddox tangent scale can be used for distance and the deviation quantified using neutralisation with prisms

e) Very useful for the diagnosis and follow up of incomitant squints

4. Hess / lees screen ;

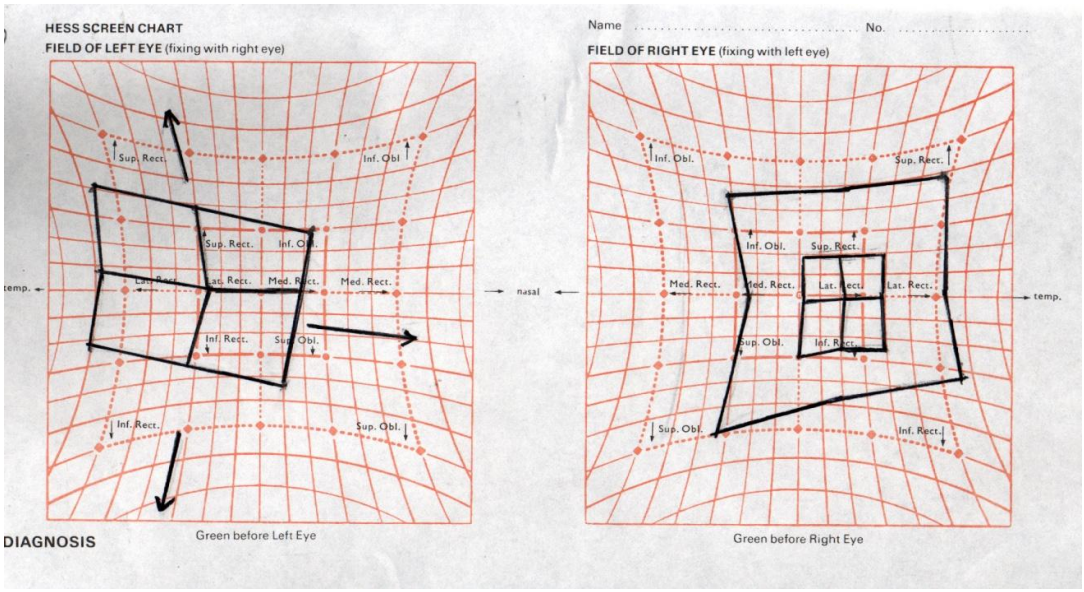
a) Haploscopic principle :two physical locations are used to have one perceptual localisation

b) Dissociation done by

- Hess screen test – red green glasses
- Lees screen – mirror septum
- Lancaster red green test – filters in the foster torches and the red green glasses
- Polaroid dissociation – more physiological

Hess screen – each square – 5° excursion of the fixing eye

- Inner square- 15° of eye movements from the primary position
- Outer square – 30° excursion for the fixing eye



HESS CHART OF RIGHT THIRD NERVE PALSY

- Contraction of right chart and expansion of left
- Right chart - underactions of all muscles except lateral rectus and superior oblique
- Left chart - overactions of all muscles except medial rectus and inferior oblique

➢ **Measurement of cyclodeviation** : [3]

- Subjective tests better than objective tests
- Diplopia charting with slit target allowing the patient to appreciate the tilt

  Horizontal slit tilted in the direction opposite to the cyclodeviation

1. DOUBLE MADDOX ROD TEST:

a) Preferably one white and other red

b) Tilt by rotating the rod in the requisite direction

c) The change of axis shows the actual cyclo deviation

2 .SYNOPTOPHORE:

Slides tilted to make the patient appreciate the straightening of the torsion in the slides

3. INDIRECT OPHTHALMOLOGY

a. Fundus photography and indirect ophthalmoscopy : normally the fovea is located 0.3 disc diameters below a horizontal line passing through the centre of the disc
b. A difference of 0.25 disc diameter difference between the two eyes considered abnormal

❖ **Limitation of movements :**

➢ Ductions :

- Adduction : the nasal one third of the cornea crosses the lower punctum
- Abduction : the temporal limbus should touch the lateral canthus
- Vertical movements are difficult to assess
- Oblique actions:

- Indirect assessment : (for inferior oblique)
    - Vertical deviation only in sursumadduction – mild overaction
    - Vertical deviation on adduction – moderate
    - Vertical deviation in primary gaze – severe

➢ Measurement of vergences :

- Measures the ability of the motor system to cope with an induced misalignment of visual axes
- To measure the vergences the visual axes are misaligned artificially with prisms or on the synoptophore
- Convergence :
    a) A line drawn on a paper brought closer to the eyes until it becomes double – break point convergence – near point of convergence (subjective NPC)
    b) The line is withdrawn gradually – the point at which it becomes double is called recovery point convergence
    c) They differ from each other
    d) The point at which the line becomes blurred is called near point of accommodation
    e) The NPC is 8 – 10 cm. NPC of 10 cm or more is considered defective

f) The point at which one eye loses fixation and drifts out (objective NPC)

g) Nearpoint ruler, Royal air force binocular gauge, Living stone gauge

- Convergence sustenance:

a) The ability of the eyes to hold the convergence at near point

b) Normally 45 seconds to one min - < 30 sec is definitely poor

❖ **Examination of sensory status** :

➢ Binocularity and diplopia :

- confirm if it is true diplopia and if it is binocular ;
- dissociative tests help to find out if binocularity is present in the absence of squint, squint without diplopia
- presence of binocular perception can result in unexpected post operative diplopia after cosmetic correction

➢ Type of correspondence

❖ Suppression :

- facultative / obligatory
- unilateral or alternating
- extent (area of suppression) and depth (intensity or severity) should be noted

- Tests for suppression:

  1. Bagolini striated glasses :

     - Most physiological test
     - A pair of striated glasses seen in front of each eye - a source of light is seen as a line at right angles to the striations
     - The axis of the striations is kept at right angles to each other
     - Responses :
       - Symmetrical cross response:
       - In the absence of manifest squint → normal retinal correspondence
       - In the presence of manifest squint →anomalous retinal correspondence of harmonious type
       - Asymmetrical cross response:
         - Two lines touching each other at some other point other than the midline
         - Incomitant squint with normal retinal correspondence (diplopia response)
       - Single line (suppression response)
         - Indicates suppression of the other eye

- Cross response with a central gap :
  - Central suppression scotoma

2. Worth four dot test :

- Utilises red green colour dissociation
- Less physiological
- Four dots – red top, two green horizontal and white bottom viewed thro red green goggles (red before right eye)
- Normally done at 6 meters , subtends an angle of 1.2 deg
- Four dots :
  - Normal binocular response with no manifest deviation
  - Harmonious anomalous retinal correspondence with manifest squint
- Five dots :
  - Two vertical red dots and three green dots (inverted triangle)
  - Esodeviation : uncrossed
  - Exodeviation : crossed
  - Vertical squint : vertically displaced
- Three dots : right suppression
- Two dots : left suppression

3. Synoptophore :
    - ♦ Presence of stereopsis indicates good BSV
    - ♦ With abnormal retinal correspondence in microtropia low grade stereopsis may be present
4. After image testing :
    - ♦ Highly dissociating orthoptic test
    - ♦ The two eyes (fixation points – foveal or eccentric) flashed with horizontal linear after image in the right eye and vertical in the left eye
    - ♦ Symmetrical cross response : presence of normal retinal correspondence (squint may or may not be present)
    - ♦ Asymmetrical crossing :the horizontal and vertical lines have their centres separated – the amount of separation depending on the angle of anomaly
    - ♦ Single images in contralateral suppression

- Testing extent of suppression :
    1. Suppression scotoma is charted under binocular conditions (one eye fixed while the field of other eye is charted)
        - ♦ Prisms – to displace the central object peripherally until it is visualised in diff directions
        - ♦ Synoptophore

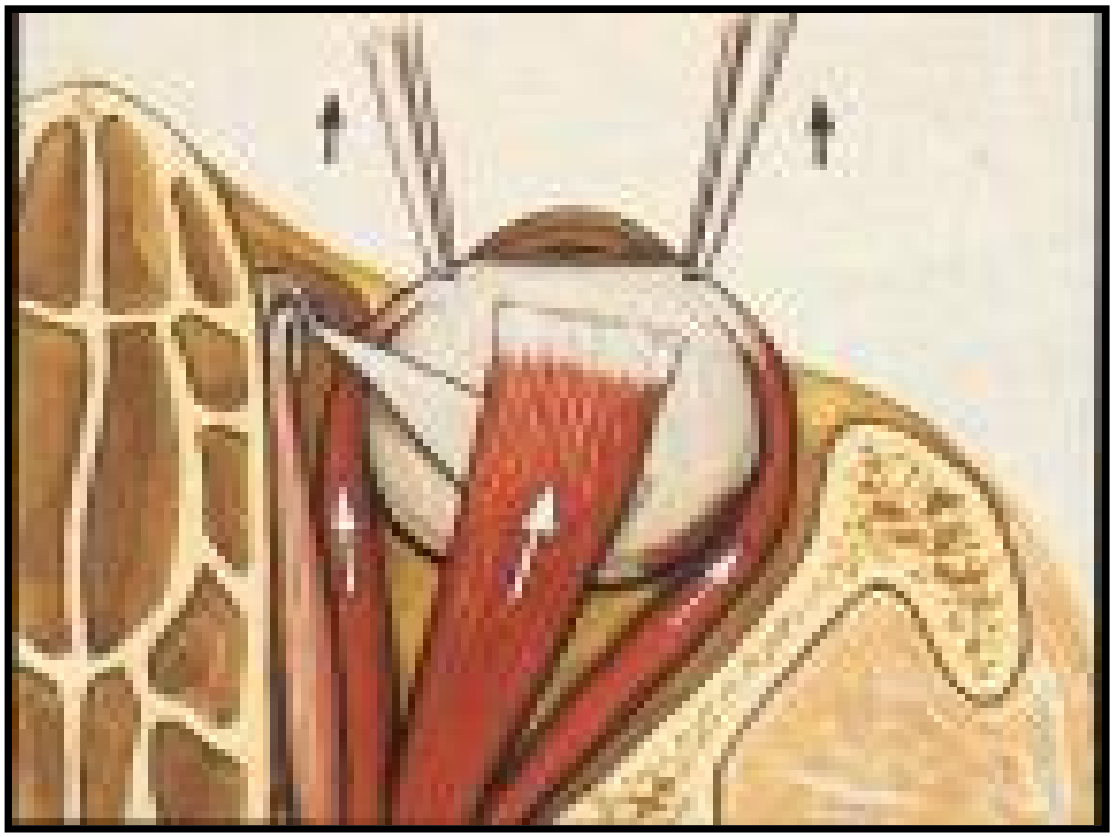
- Lee s screen or Hess screen
- Polaroid scotometer

2. More dissociating tests (prisms, Lees screen) – single coarse large scotomas that extend from fovea to the diplopia point (Jampolsky s hemiretinal scotoma s in exodeviations and discrete scotomas in esodeviations)
3. Lee dissociating tests (Aulhorn phase difference haploscope) and Polaroid scotometer) – two discrete scotomas –
   - Foveal scotomas – 2- 3 deg
   - Diplopia point scotoma
   - Seen in both eso and exodeviations but exo has vertical step like Jampolsky' s hemiretinal scotoma .

FORCED DUCTION TEST: [2]

It is done to differentiate between paralytic and nonparalytic squint

FDT ON RECTI MUSCLE

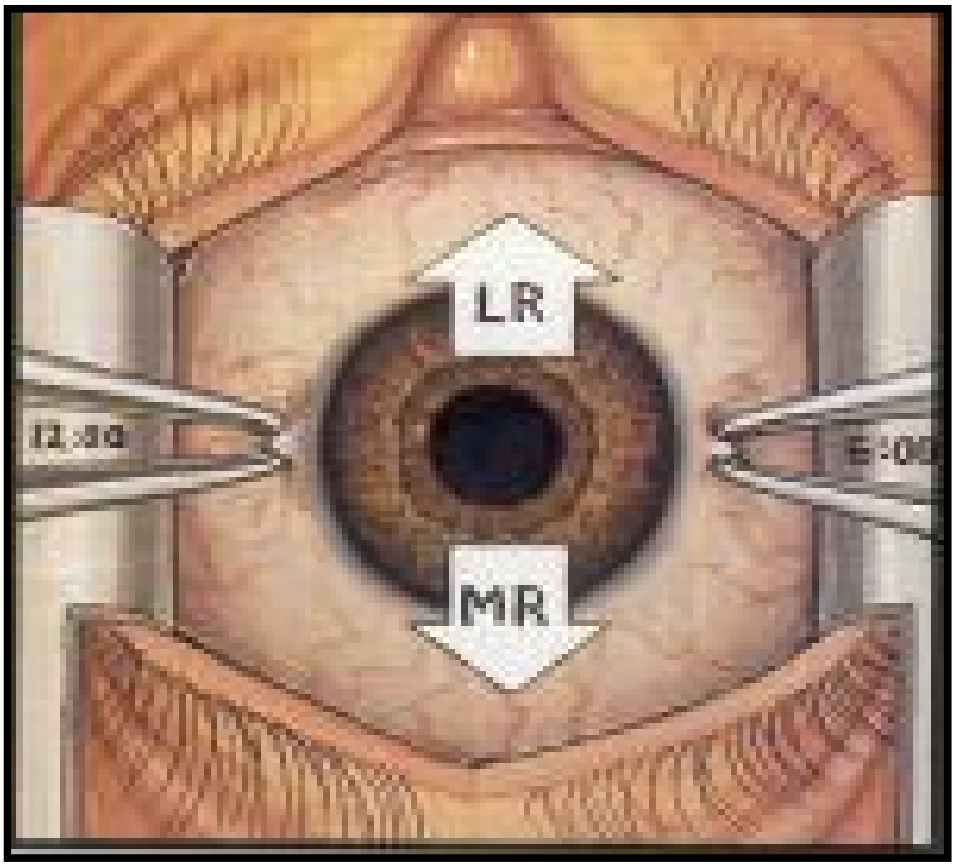


INDICATIONS:

- Trauma
- Endocrine ophthalmopathy
- Congenital restriction
- Preop restriction of motility
- Long standing deviation with secondary muscle contracture
- Transposition procedure
- Orbital diseases

CONTRAINDICATION

Open globe injury

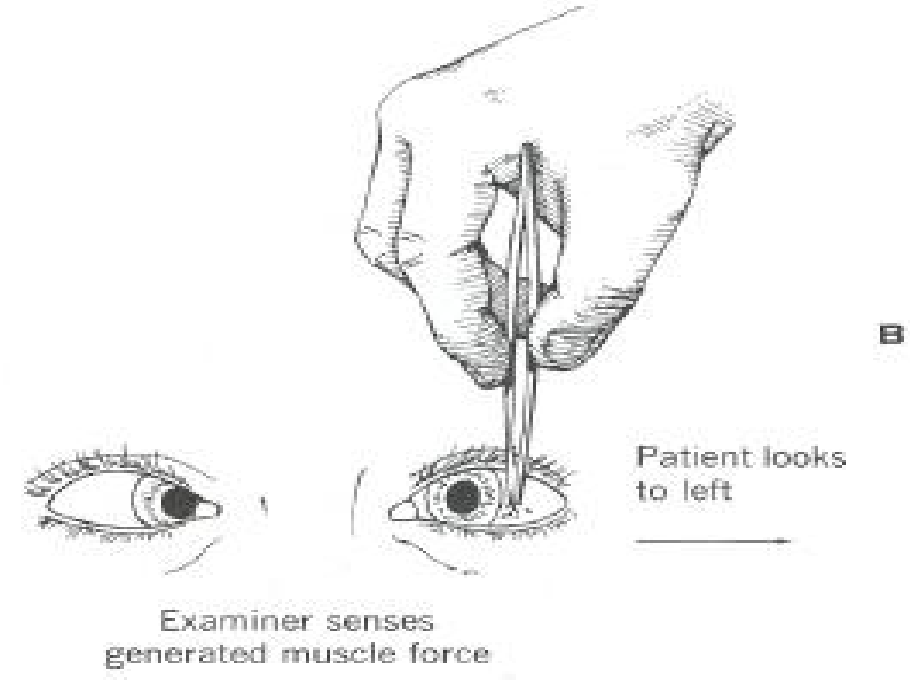


FORCED GENERATION TEST: [3]

It is done to assess the strength of muscle before surgery to differentiate between paralytic and restrictive squint.

INDICATIONS:

- Trauma
- Endocrine ophthalmopathy
- Congenital restriction
- Preop restriction of motility
- Long standing deviation with secondary muscle contracture
- Transposition procedure
- Orbital diseases



CONTRAINDICATION

- Open globe injury
- Syncope
- Vasovagal attack

PREPROCEDURE HISTORY:

- H/O bleeding diathesis
- H/O Anticoagulants intake
- H/O Syncope
- H/O Vasovagal attack

COMPLICATIONS

- Subconjunctival haemorrhage
- Corneal abrasion
- Conjunctival laceration

FUNDAMENTAL LAWS GOVENING THE OCULAR MOTILITY

HERINGS LAW OF EQUAL INNERVATION: [2]

It states that equal and simultaneous innervations flows from the brain to the pair of yoke muscles in both the eyes which contract simultaneously in different binocular movements

CLINICAL APPILCATION:

1. Secondary deviation
2. Inhibitional palsy of the contralateral antagonist muscle

SHERRINGTON'S LAW OF RECIPROCAL INNERVATION[2]

This law states that during ocular motility an increased flow of innervations to the contracting agonist muscle is accompanied by a decreased flow of innervations to the relaxing antagonist muscle.

CLINICAL APPLICATION:

1. Occurrence of strabismus following paralysis of EOM occurs due to this law
2. Reciprocal innervations

The Localization of Oculomotor Nerve Lesions

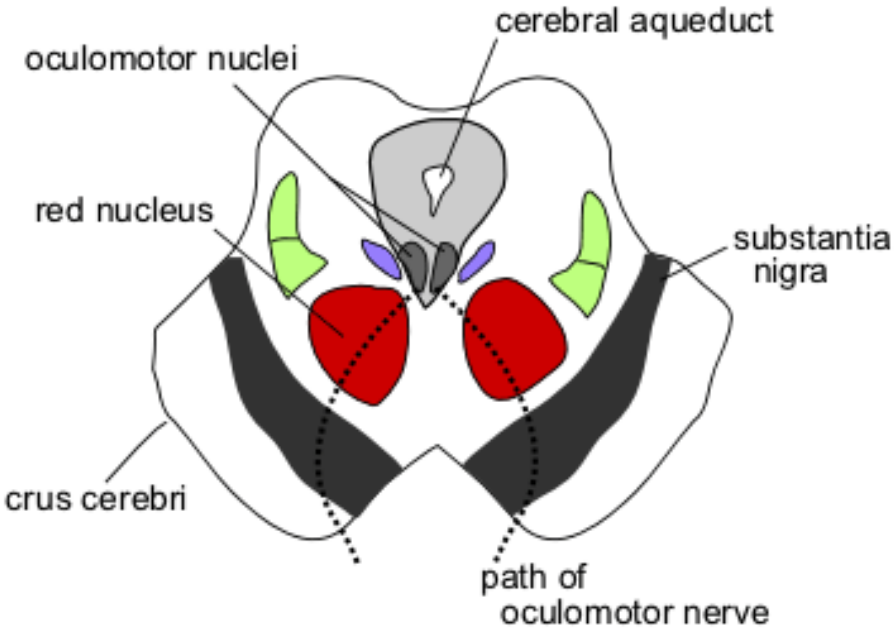
1. **NUCLEAR LESION**[16]

- **Third nerve nucleus**
  - Patient presents with total third nerve palsy on the same side, other eye ptosis and SR palsy.
- **Third nerve subnuclei**:
  - Patient presents with single muscle paralysis depending on the nuclei affected.
- **Levator subnucleus**:
  - Patient with ptosis in both eyes.

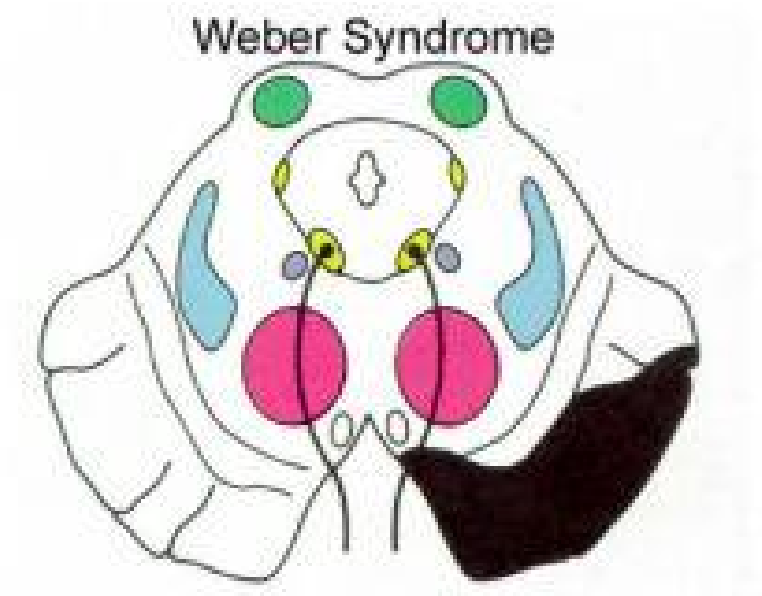
2. **FASCICULAR LESION:**

- **Isolated fascicular lesion:**
  - Patient will present with partial or complete third nerve palsy and pupil may be involved or spared.
- **Claude syndrome:**
  - Patient will have same side third nerve palsy and opposite ataxia and tremors.
  - It is due the involvement of superior cerebellar along with red nucleus and fascicle.

- **Benedicts syndrome:**
    - There will be same side oculomotor nerve palsy with other side choreathetoid movements
    - It is due the involvement of fascicle along with red nucleus.

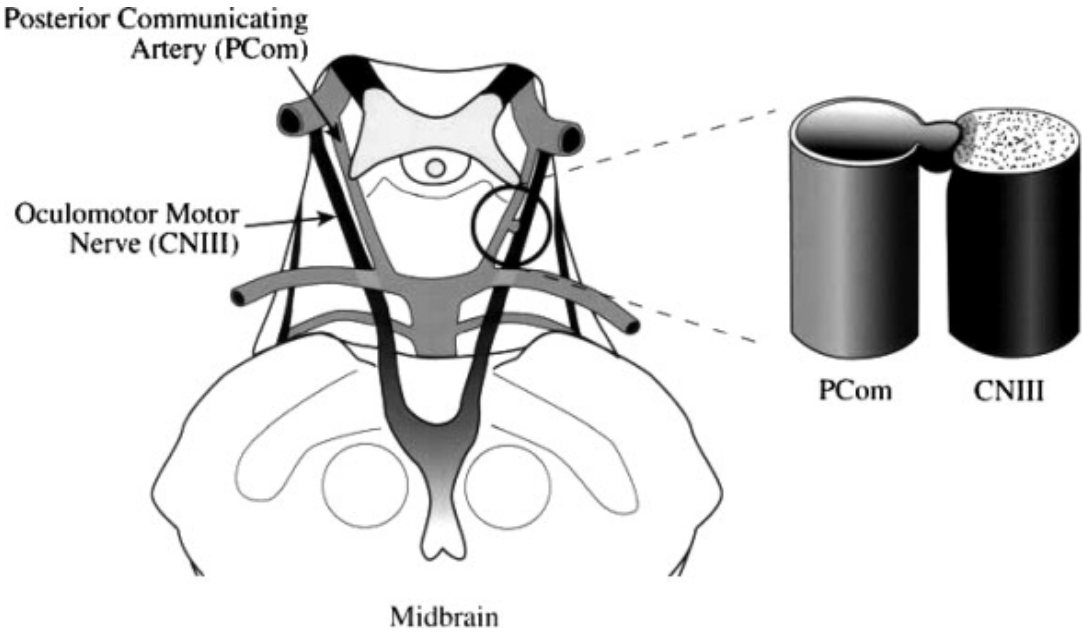


- **Webers syndrome:**
    - Here the lesion is at the level of fascicle and cerebral peduncle
    - Patient will have same side oculomotor nerve palsy and opposite side hemeparesis



3. BASILAR LESIONS: [11]

- Patient will have complete third nerve palsy with pupil involvement or sparing.
- Other cranial nerves may or may not be affected.
- They may also present with divisional palsy.



4. INTRACAVERNOUS LESION:

- Patient will have third nerve palsy that may be painful or painless and other ocular cranial nerve may be involved.
- Horners syndrome occurs with third nerve lesion and patient will have small miotic pupil.

5. LESION IN SUPERIOR ORBITAL FISSURE:

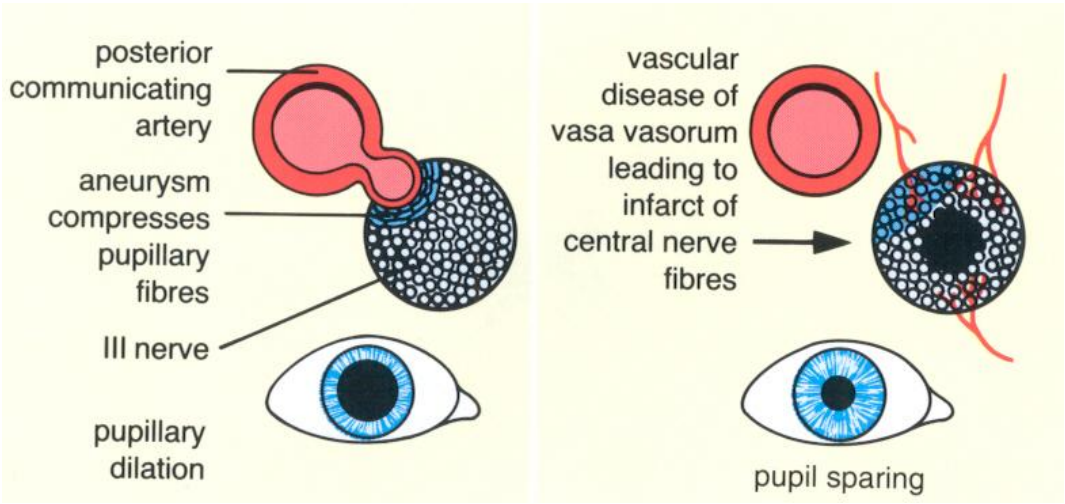
- There will be third nerve palsy with or without involvement of trochlear and abducent nerve.
- Associated findings will be proptosis.

6. LESIONS IN THE ORBIT:

- Patient will have lesion either in the superior or inferior division along with vision loss, proptosis.chemosis and lid edema.

7. LESIONS OF PUPILLOMOTOR FIBRES:

- Between the brainstem and the cavernous sinus the pupillomotor fibres are located superficially in the superomedian quadrant of the nerve.
- They derive their blood supply from the pial plexus of blood vessels



DAROFF'S RULE FOR THIRD NERVE NUCLEUS PALSY

Conditions that exclude nuclear lesion:

- Unilateral ptosis
- Unilateral internal ophthaloplegia
- Unilateral external ophthalmoplegia associated with normal contralateral Superior rectus function.

Conditions that obligate nucleus involvement :

- Bilateral third nerve palsy without ptosis.
- Unilateral third nerve palsy with contralateral Superior rectus abnormality and B/L partial ptosis .

Conditions that neither exclude nor obligate nucleus lesion :

- Bilateral total third nerve palsy .
- Bilateral ptosis .
- Bilateral internal ophthalmoplegia.
- Isolated U/L Single muscle involvement .

ABERRANT REGENERATION: [23]

Following injury to the oculomotor nerve at any point along its pathway from the brain stem to the orbit, a syndrome of oculomotor nerve synkinesis may occur. In adults, synkinesis first appears about 9 weeks after injury , whereas in infants with birth trauma, it first appears 1 to 6 weeks following birth. Oculomotor nerve synkinesis is thought to occur from misdirection of regenerated axons in the nerve or brain stem, ephaptic transmission, and/or nuclear reorganization. Those are

- Elevation of the lid on attemped downward gaze (pseudo-von Graefe phenomenon) or on adduction. The lid-gaze synkinesis is best seen with attempted adduction in downgaze. This horizontal gaze-lid synkinesis is similar to but of opposite direction from the lid synkinesis observed in Duane's retraction syndrome .
- Elevation and depression restriction of the eye with retraction of the eyeball on attempted vertical gaze may be seen,
- There may be light near dissociation. [25]
- Aberrant regeneration to the iris sphincter may be too weak to constrict the pupil on exposure to light, but at the slit lamp, clear segmental contraction of the sphincter may be seen when the eye tries to move in any third nerve direction (Czarnecki's sign) . This gaze-evoked segmental constriction of the pupil may occur in

portions of the sphincter that are unreactive to light, while other segments of the pupil have normal light reaction without Czarnecki's sign.

- Lagophthalmos may be present during Bell's phenomenon .

Other causes include, trauma, aneurysm, migraine, and syphilis but is almost never caused by ischemic neuropathy. Long-standing lesions within the cavernous sinus, such as meningiomas, trigeminal neuromas, pituitary tumors, or large aneurysms, may also present with it.

Posterior communicating artery aneurysm ,abetalipoproteinemia may have primary aberrant regeneration. Severe head trauma can cause synkinesis between third and fourth nerve, resulting in misdirection of nerve fibers to the right MR and right lateral rectus .

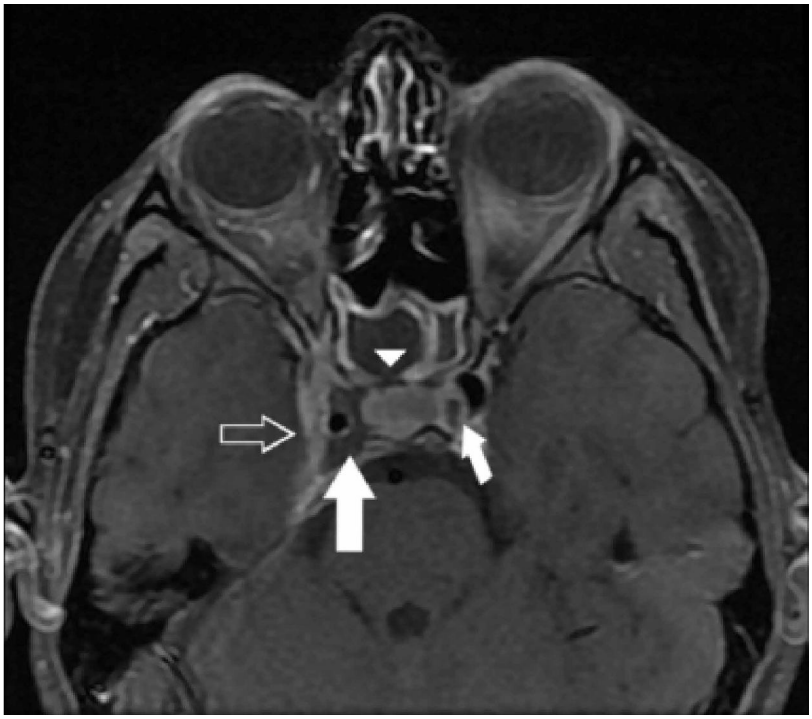
INVESTIGATION:

Third nerve palsy of acute onset especially if non pupil sparing should be subjected to thorough neuro ophthalmic investigation .

MRI/MRA[31]

- MRI is a more sensitive imaging technique in condition like infarction, small abscess,infiltration ,inflammation or tumor.
- MRI is also the procedure of choice for demonstrating meningeal and dural inflammation and infiltration.
- Berry aneurysm causing third cranial nerve palsy can be easily identified with MRA 3 Teslsa.
- In child less than 10 years of age regardless of the state of pupil,if MRI is normal ,carotid angiography is not essential In patients above the age of 10 years with pupil involvement ,if MRI shows a mass compatible with an aneurysm then carotid angiography should be done to rule out aneurysm.

MRI SHOWING LESION IN CAVERNOUS SINUS



- In patients above 10 years of age with pupil sparing,if MRI is normal a thorough medical evaluation should be done.All such patients should be followed frequently anf if pupil is involved or the patient shows any sign of subarachnoid haemorrhage angiography should be done to rule out aneurysm.

MRA –showing giant thrombosed aneurysm of the ICA

CT scan

- CT scan is superior to MRI in detecting subarachnoid hemorrhage,lesion with calcification in some tumours and aneurysm.

Cerebral angiography

- It the investigative technique of choice for berry aneurysm in intracranial locations.
- It is commonly done for patient less than 60 years of age with pupil involving third nerve palsy who is a known diabeteic and hypertensive.

Tensilon test:

It is done to exclude myasthenia gravis

ESR:

If ESR is high then temporal artery biopsy should be done to rule our temporal arteritis in patients more than 55 years of age.

MANAGEMENT

If on investigation a definitive cause of third nerve palsy is found then the patient should be referred to a neurophysician or a neurosurgeon depending on the etiology. However if no surgical cause is found then patients should be managed conservatively followed by extaocular muscle surgery if required.

MEDICAL MANAGEMENT: [14]

- Systemic conditions like Dibetes, hypertension, anaemia, obesity and hyperlipidemia should be controlled .
- Systemic steroids are recommended in patients with temporal arteritis, rheumatalogical disorders.
- Systemic steroids may hasten the recovery in non specific inflammation.
- In patients with pseudo tumour cerebri they can be treated with oral carbonic anhydrase inhibitor
- Vitamin b complex can be used as a neurotonic
- Pilocarpine is used in patients who are worried about the anisocoria .

OBSERVATION:

Like any other paralytic squint we have to wait and watch for self recovery for atleast 6-8 months. During this period the patient should be followed up once in 6 weeks and following examination should be done

- Measurement of exotropia and hypotropia with prism cover test
- Diplopia charting
- Hess charting

AMBYLOPIA

- It is more common in paediatric third nerve palsy and it must be identified as early as possible and should be treated aggressively. Ptosis correction should be done to avoid ambylopia.
- Alternate patching has to be done to avoid its recurrence.

DIPLOPIA

It can be treated by occluding one eye either with a adhesive tape or patches .It is difficult to treat with prisms because of its variable naturend very large deviationsIn mature patients with complete ptosis ,surgical correction of ptosis has to be deferred until the eye has been straightened.

SURGICAL MANAGEMENT:

PRINCIPLES OF SURGERY: [7]

1. Like any other paralytic squint at least 3-6 months should elapse before performing any surgical treatment to straighten the eye.
2. Surgery should be undertaken continuously in patients with complete palsy and good binocular vision.
3. The patient should be explained clearly about principle aim of surgery to avoid disappointment. It is done in multiple sittings to avoid ischemia of anterior segment.

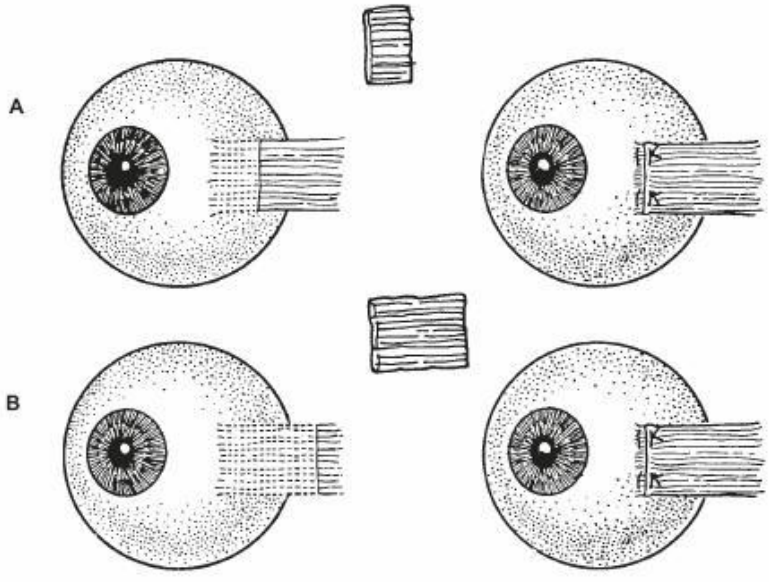
SURGICAL GOALS:

1. To improve alignment in primary gaze.
2. To produce or enlarge some degree of binocular vision.

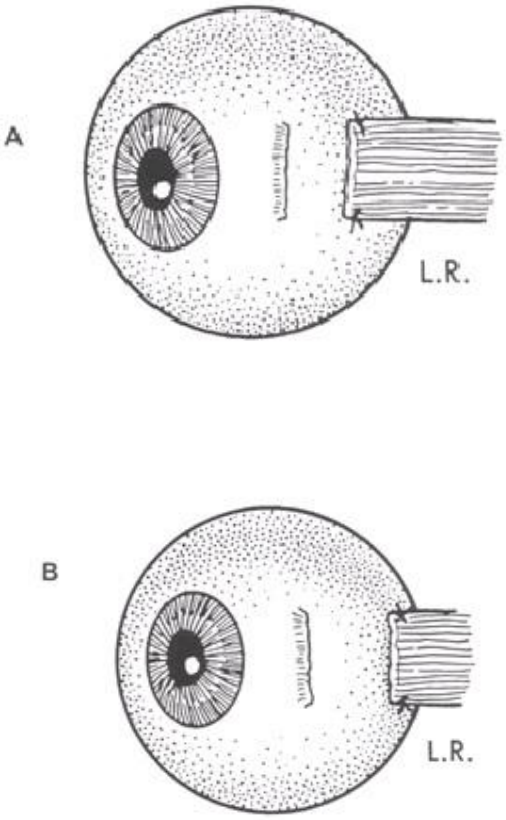
SURGICAL PROCEDURES: [8]

Surgery should be contemplated only if the strabismus measurement and diplopia remains stable for 3 months.It usually occurs after 6-8 months of paralysis.

1. **SURGERY FOR EXOTROPIA:**
    - It involves recession of LR and resection of MR
    - In an incomplete palsy,recess-resect procedure should be done as for comitant exotropia.
    - In complete palsy, a lateral rectus recession(12-14mm) and large medial rectus resction (12-14mm) should be performed when there is a demonstrable residual MR function.



Resection of MR



LR RECESSION

2. SURGERY FOR HYPOTROPIA:

- Supraplacement of horizontal recti during recess-resect procedure is preferred by some surgeons
- Superior oblique tenotomy is preferred by some surgeons.
- Inferior rectus recession with resection of superior rectus is preferred by some surgeons.

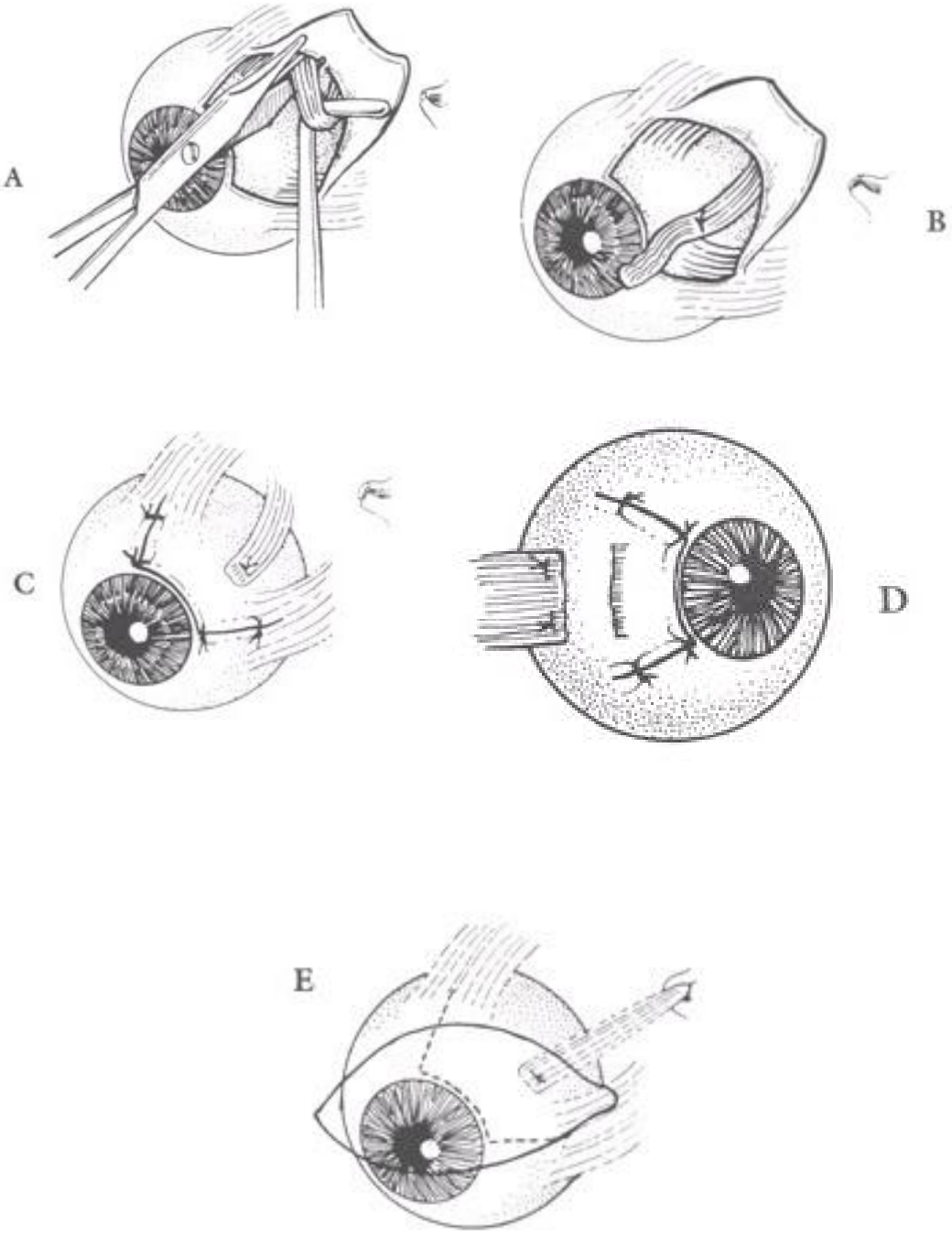
3. SUPERIOR OBLIQUE TENDON TRANSFER:

If eye remains still exotropic after 3 months of above procedures, transposition of superior oblique tendon may be considered in a patient with acquired third nerve palsy ,only if the following conditions are met:

- Palsy is complete
- Involved eye is fixing
- Maximum recess-resect surgeries on the horizontal recti have failed to restore the globe to primary position.

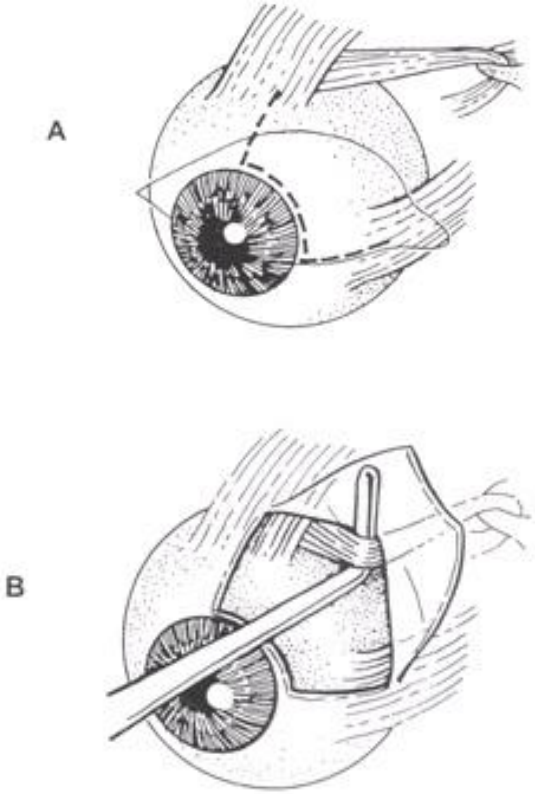
JACKSON PROCEDURE: [9]

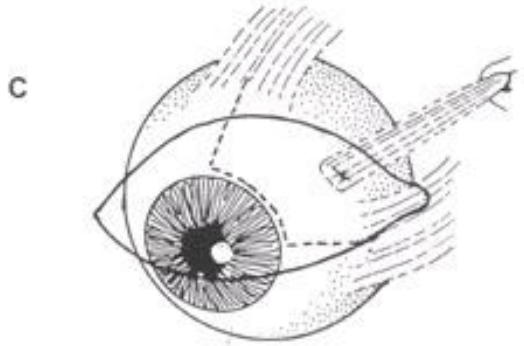
For management of total oculomotor nerve palsy a new technique was introduced by Jackson in 1907.After fracturing the trochlea through the incision made in the superior eyelid, the superior oblique tendon is removed and attached to the medial rectus along its superior border The secondary actions of superior oblique muscles are eliminated by this procedure and the muscle acts in adduction along with lateral rectus muscle.The disadvantage of this surgery is that it is more difficult ,chances of haemorrhage in the orbit while fracturing trochlea is high and the SO tendon may get damaged during fracture of trohlea if it is calcified.The surgical outcomes are better with this procedure.


A
B
C
D
E

SCOTT PROCEDURE: [9]

This procedure was proposed by Scott in the year 1977.Here also the same correction is made but trochlea is not fractured and the SO tendon is attached to MR muscle superior border. In primary position the ocular alignment is good but postoperatively hyperdeviation are seen with poor horizontal alignment

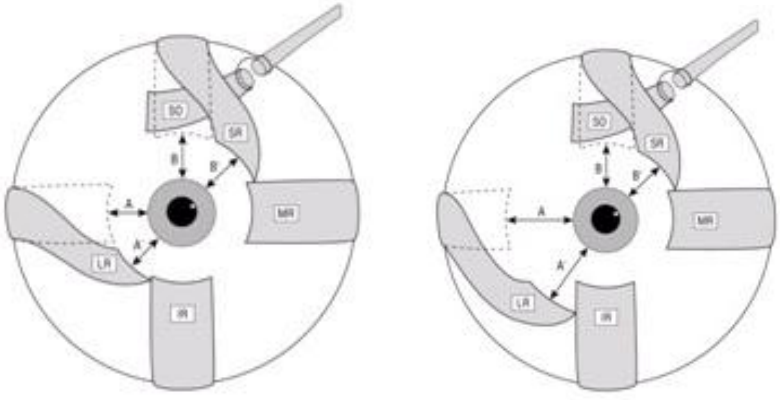




4. SURGERIES FOR PARTIAL THIRD NERVE PALSY:

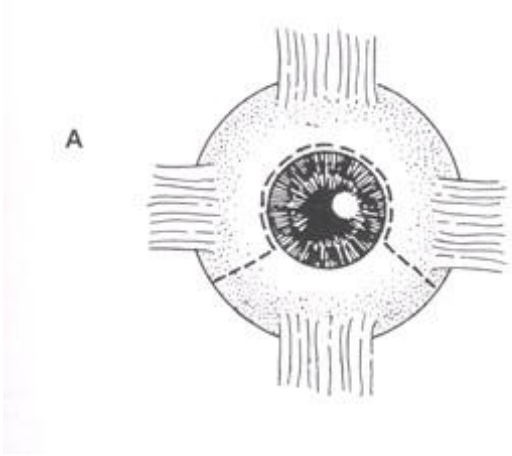
- **IN CASE OF INFERIOR BRANCH PARALYSIS:** [24,15]

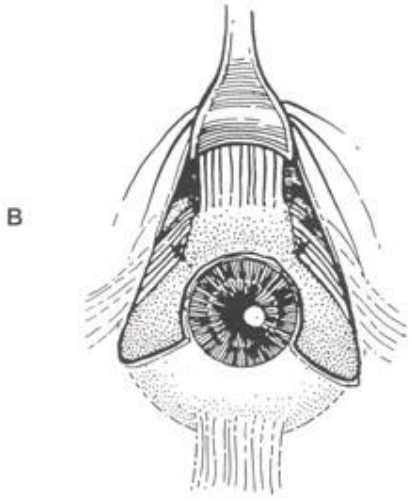
This procedure was reported by Kushner The SR muscle is transposed near to the MR muscle and the LR muscle is transposed adjacent to the IR insertion. It is combined with same side SO tenotomy. These patients do well with this surgery.

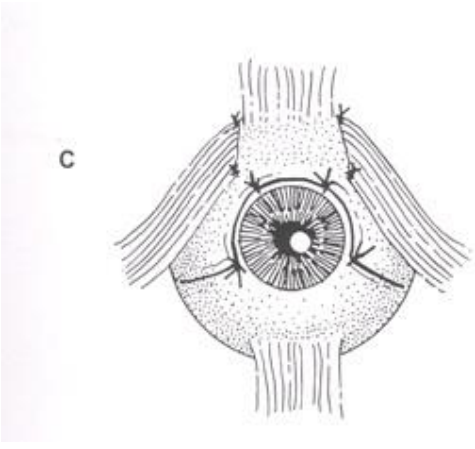


- **IN CASE OF PALSY OF SUPERIOR BRANCH:** [18]

Patient will have ptosis and elevation restriction due to the involvement of LPS and SR muscle respectively. In these patients both the MR and the LR can be transposed to the ends of SR muscle , This procedure is combined with recession of the SR muscle on the other side. This procedure is called as Knapps procedure.







- **PATIENTS WITH ISOLATED MUSCLE PALSY:**

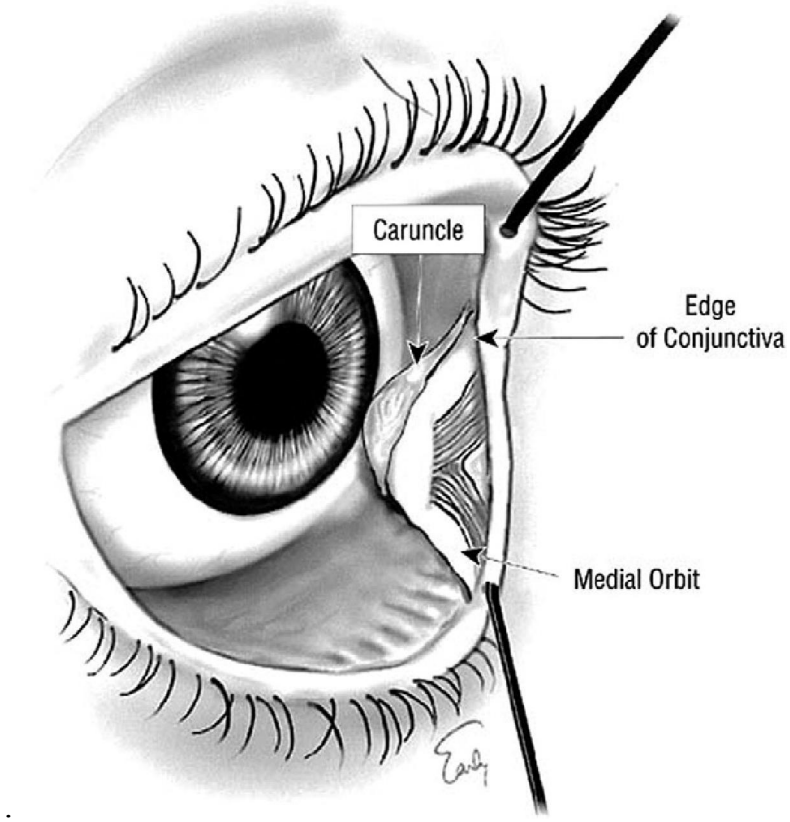
Patients with paralysis or MR can be treated by attaching the MR muscle to the periosteun .The LR muscle can be disinserted if required.

In patients with IO palsy, they can be treated by same side SO weakening procedures like tenotomy or tenectomy .It may or may not be combine with SR recession on the other eye

SURGERIES FOR COMPLETE THIRD NERVE PALSY:

- **DISINSERTION OF LATERAL RECTUS AND PERIOSTEAL FIXATION**[17]

  It is done in patients with poor muscle strength.It is a reversible procedure and the eye can be kept in primary position at the cost of compromising motility. They are usually combined with routine MR resection along with transfer of SO tendon and other globe fixing surgeries.



- **GLOBE ANCHORING PROCEDURES**[26,27]

  The globe can be fixed to the orbit by various methods. They include attaching the eyeball to the periosteum of the anterior lacrimal crest, to the medial wall of the orbit that can be either precanalicular or retrocanalicular. They can be anchored by using SO tendon, silicone bands, fascia lata and periosteal flaps. The disadvantage is that it causes medial canthus flattening, edema and discomfort.They are usually overcorrected by 10PD to prevent exotropia in later days.

5. SUGERIES FOR PALSIES WITH ABERRANT REGENERATION: [25]

It is difficult to operate eyes with aberrant regeneration.If it is minimal the standard resect-recess procedure is done on the horizontal group of muscles.

6. SURGERY FOR PTOSIS: [23]

Once the paralytic strabismus is treated maximally, Frontalis sling procedures can be done for ptosis.

REVIEW OF LITERATURE

Carmel P Noonan et al described a technique of surgery in patients with longstanding oculomotor nerve palsy.The affected eye was treated with recess –resect procedure and the other eye treated with LR recession . The fixation duress is proposed to decrease the elevation of the non-involved eye, thereby creating similar forces of duress in both eyes when fixation takes place . Two patients had residual esotropia of 8-10PD and 20PD of residual exotropia in one patient.Postoperatively no patients had ptosis and one patient had a resurgery. [10]

Kuldeep Kumar Srivastava described a method for surgically correcting the deviation in complete oculomotor nerve.They studied 5 patients with congenital total oculomotor nerve palsy. By using a nonabsorbable suture they anchored the eyeball to the anterior lacrimal crest with the medial palpebral ligament. 4 patients underwent LR recession. The postoperative results were good except for one patient who had exotropia. 6 to 9 months the patients were followed and there was not much change in alignment. [6]

Pradeep Sharma et al described a new technique of fixing the globe with a nonabsorbable suture to the nasal periosteum in acquired isolated

oculomotor nerve palsies. They studied on 4 patients with isolated oculomotor nerve palsy.LR recession was done in all 4 patients. MR muscle is anchored to the anterior lacrimal crest with 8-10PD in adduction.The patients were followed for a period of 1 year and the outcome was good. [29]

Terri L Young et al did a study to determine whether post operative hypertropia after superior oblique tendon anterior traspositon without trocheleotomy could be avoided with a simple surgical procedure. It was a retrospective study that included 8 patients with third nerve palsy. They had undergone the above procedure without vertical recti muscle surgery. The superior oblique tendon was cut at the medial end of superior rectus muscle and placed 1-3.5mm anterior to medial aspect of superior rectus insertion and lateral rectus was weakened. Preoperative deviation with the uninvolved eye fixing in the primary position ranged from 20-90PD of exotropia and from0-20 PD of hypotropia. Post operative horizontal deviation in primary gaze ranged from 12PD of exotropia to 20PD of esotropia, vertical deviation ranged from 2PD of hypertropia to 8PD of hypotropia.[22]

Irene Gottlob et al did a prospective study on seven patients with unilateral third nerve palsy. They did SO tendon transposition to a point medial and anterior to SR muscle insertion without trocheleotomy. Large LR recession was done in the affected eyeand the resect-recess was done in

the other eye on the horizontal muscles. They were followed up for a period of one to eight years. Orthophoria was achieved and maintained in four patients with one surgery. [19]

Anand V Mudgil et al described the third nerve palsy in children less than 8 years of age. 41 patients were included in this study . Congenital ,traumatic and neoplastic are the most frequent cause of third nerve palsy in children according to this study.Ambylopia causes decrease in visual acuity in 35% of patients and in 25% of the patients it was due to nonambylopic factors.8 children underwent strabismus surgery and 9 children had aberrant regeneration. Only 3 children had successfull complete third nerve palsy. They concluded that third nerve palsy is associated with poor visual outcome in children than 8 years of age. [30]

Linda A Schumacher-Feero did a retrospective study on 49 patients and reported partial third nerve palsy in 31 children and complete nerve palsy in 18 children.To maintain a good ocular alignment ,patient with oculomotor nerve palsy patient needed multiple squint surgery. [32]

Miho Sato et al did a new technique on one patient. They did LR myectomy and it was not attached to the globe combined with MR resection on the same eye and LR recession on the other eye. In primary position the patient was able to fuse and the abduction was normal. [5]

Merino P et al did a retrospective study on eleven patients with third nerve palsy who had undergone surgery. A good aesthetic result was defined by a final deviation of less than 10 prismatic diopters, a medium result by a deviation between 10-20 diopters and a bad result if the deviation was > or = 20 diopters. A good functional result was considered if there was no diplopia when the eyes were in their primary position. In all instances large recessions and/or resections of horizontal recti muscles were performed. Vertical deviation was treated in 4 cases. Multiple surgery was needed in 3 cases, 2 patients being operated on twice and 1 case was operated on four times. Botulinum toxin was used in 4 cases, before or after surgery. The aesthetic result was good in 7 cases, medium in 2, and bad in the other 2. Postoperative diplopia was present in 4 cases. They found that large recti muscle recessions and resections are required to treat problems of third cranial nerve palsy. Sometimes several surgeries are required to treat vertical deviation and previous hypocorrection.[33]

Mora J described a technique for congenital oculomotor nerve palsy in a 16 year old girl with large angle exotropia . Recession-resection surgery was done when she was a child but the results were not good In this technique the eyeball was anchored to the medial orbital wall permanently with a traction suture that was nonabsorbable. The surgical outcome was good with procedure. [37]

Khaier A did a retrospective study on 33 patients with oculomotor nerve palsy that was long standing.All patients had undergone MR resection and LR recession and traction sutures were put to the muscle and it was left in situ for 6 weeks. Pre-operative deviation was between 25 to 95prism dioptre exotropia, and 60prism dioptre exotropia was the mean deviation.. Post surgery the deviation was between16 to 40 prism dioptre exotropia, with mean deviation of 14.5prism dioptre exotropia. Post-operative motility was reduced maximally and they had very little abduction in the the final eye position. Disadvantages of this surgery were suture infection, conjunctival hypertrophy. [35]

Kose et al reported surgery on 6 patients with complete oculomotor nerve palsy. MR resection and hemi -hangback recession of the LR was done in all patients for exotropia.. The mean preoperative horizontal deviation was 66.6 PD and the post operative deviation was 11.6 prism

dioptre after 2 years. The SO muscle and the LR muscle function was normal in these patients. The main advantage of this surgery was even if there was residual exotropia ,second surgery can be done on SO muscle that was untouched in this procedure. This surgery gave cosmetically good results in all patients who were followed for a period of 2 years. [36]

Cabrejas et al did a retospective study to investigate the outcomes and predictive factors of surgical treatment of oculomotor nerve . Ocular alignment and motor function was the main outcome of the study. Diplopia, torticollis, and limitation of muscle function were considered for secondary outcome. 22 patients underwent surgery of which 14 patients had good ocular alignment and post operative dipolopia and torticollis was significantly reduced. They concluded that longer time interval between onset to surgery and large deviations were associated with poor surgical success. [38]

AIM

To evaluate the outcome of strabismus surgery in third nerve palsy.

OBJECTIVES:

1. To analyze the anatomical outcome of surgery i.e. correction of deviation
2. To analyze the functional outcome of surgery i.e. gain in binocular vision and stereopsis.
3. To analyze the factors affecting the final surgical outcome like:
    1) Age at the time of surgery.
    2) Duration of squint before surgery.
    3) Preoperative amount of deviation.
4. To analyse the Etiology

INCLUSION CRITERIA:

a) Patients with third nerve palsy for more than 6 to 12 months and underwent surgical treatment for the same.

b) Patients who can come for postoperative follow up .

EXCLUSION CRITERIA:

a) Associated fourth, sixth nerve palsies

b) Associated neurological morbidity that compromise measurement of deviation

c) Patients who cannot come for follow up in a specified time

MATERIALS AND METHODS

STUDY DESIGN:

Hospital based prospective study.

SOURCE OF DATA:

Pediatric Ophthalmology and Strabismus Services, Aravind Eye Hospital.

STUDY SUBJECTS :

Patients with third nerve palsy, who underwent surgical intervention from September 2012 to March 2014, were enrolled for the study.

STUDY PERIOD:

September 2012 to March 2014

DATA ANALYSIS

Statistical methods

Continuous and Categorical variables will be expressed as Mean (SD) and Frequency (Percentage) respectively. Chi-square test or Fisher's exact test were used to assess the association between the two variables. Mann-whitney U test was used to assess association between preoperative pattern

amount and Surgical outcome. Non-parametric Wilcoxon signed rank sum test was used to compare pre and post operative values. P-value less than 0.05 was considered as statistically significant. All statistical analysis was done by Statistical software STATA version 11.0.

METHODS:

This was a prospective study which included 16 patients who underwent strabismus surgery for third nerve palsy from September 2012 to March 2014.

All the patients had a thorough examination including the detailed history, ocular and motility evaluation followed by the systemic and more specifically for other neurological signs.

The detailed history included about the onset, H/o trauma, symptoms especially for double vision,head posture etc with specific duration, systemic illness like Diabetes/Hypertension any other associated problems pertaining to the condition .

A detailed ocular examination including the presence of compensatory head posture, position of the eyes, skull, facial asymmetry, position of the lids, status of the pupil , pupillary reflexes ,other routine

anterior segment examination was carried out with the help of slit lamp..Visual acuity estimation was done according to the age appropriate method, refraction when indicated and a detailed fundus evaluation (Indirect ophthalmology) when indicated were carried out followed by a detailed motility evaluation. This include :noting down the position of the involvedeye, detailed extraocular movements both duction and versions noting the extent of limitation of extraocular movements which was graded as -0 to -5,any overactions noted as +1 to +5 ,presence of intorsion in abduction confirmed to rule out the associated fourth nerve palsy. This is followed by the measurement of the deviation in primary position ,fixing either eye both for distance and near and in other required gazes. All the above said measurements done using prism cover test. Possibility of fusion was checked with corrective prisms and bagolini glasses. Hess charting and diplopia charting was done in all patients who could cooperative. Forced duction test, forced generation test were performed either preoperatively or on the table before surgery whichever is permitted .General systemic evaluation was done by the inhouse physician concentrating on Diabetes, Hypertension and Cardiac problems. General neurological examination was also done in our Neuroophthalmology clinic including neuroimaging, referral to the neurologist when opinion is needed.

SURGICAL PROTOCOL:

Surgical protocol which we used was individualized to every patient. The type of surgery was based on the amount of deviation and strength of extraocular muscles. The deviation in primary position was used to guide the type of surgery on horizontal muscles. In patients with good MR function (Adduction=-1.-2), recess/resect procedure was done. In patients with >50 PD exotropia and where MR function was poor (-4,-5),globe fixation was done. In patients with significant hypotropia >10PD ,additional procedures such as SO tenotomy and partial tendon Knapps was performed. Experienced surgeons performed the surgeries. The surgery was carried out either under general anaesthesia or local anaesthesia. Postoperatively treated with topical antibiotics, steroid combination for three to four weeks. Patient is reviewed on the first postoperative day, one month postoperative and after 3 months for measurement of ocular deviation.

POSTOPERATIVE ASSESSMENT:

The patients were evaluated step by step as it was done preoperatively concentrating on the possible reactions from the permanent sutures used, both on the conjunctiva and the skin at the lacrimal area , correction of the compensatory head posture ,amount of deviation got corrected(prism cover test), improvement in the limitation/ overaction of extraocular movements, improvement in their binocular status by checking on the position of diplopia and fusion.

All patients were followed up postoperatively at one and 3 month.

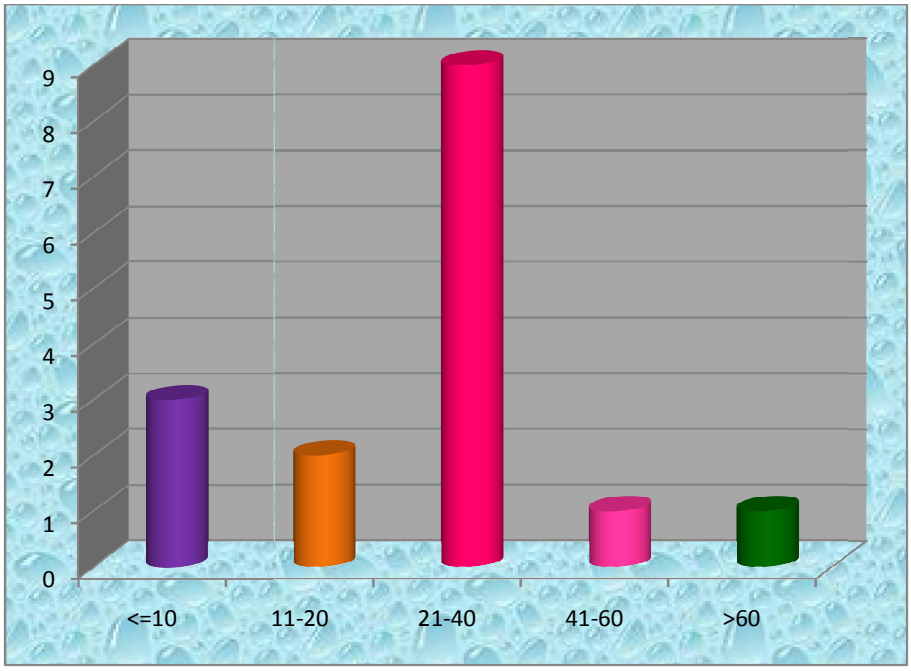
OBSERVATION AND RESULTS

Various parameters and data analyzed in our study have been described in these tables and figure

Age:

Age	N	%
<=10	3	18.75
11-20	2	12.5
21-40	9	56.25
41-60	1	6.25
>60	1	6.25
Total	**16**	**100%**

Mean (SD) of the age is 25.3(19.8) years & the range is 2 – 87 years



Sex:

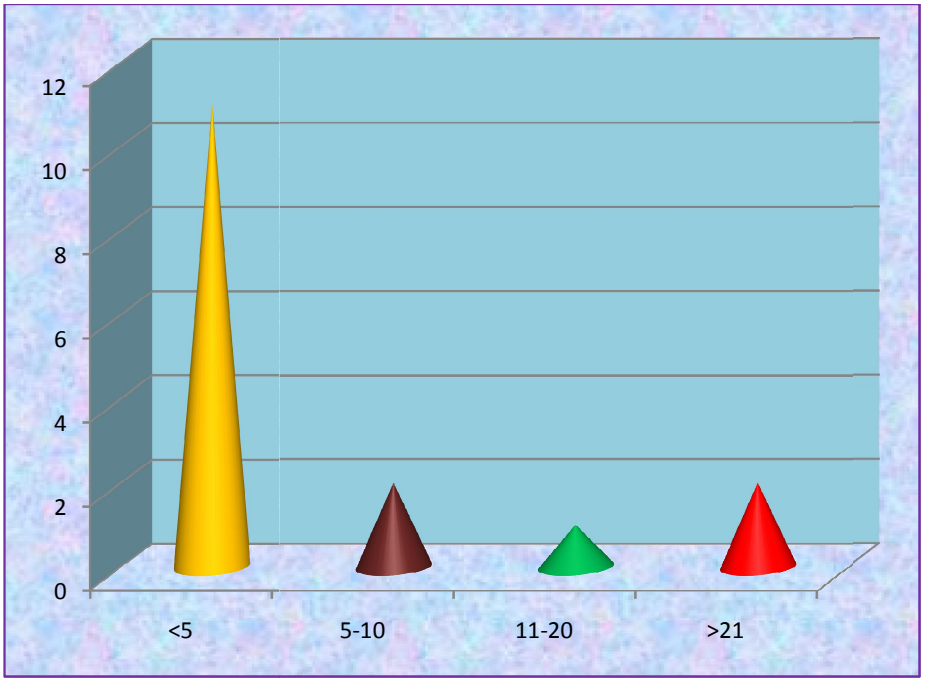
	N	%
Male	16	100.0
Total	**16**	**100.0**

In our study all the patients were male

Duration of Squint:

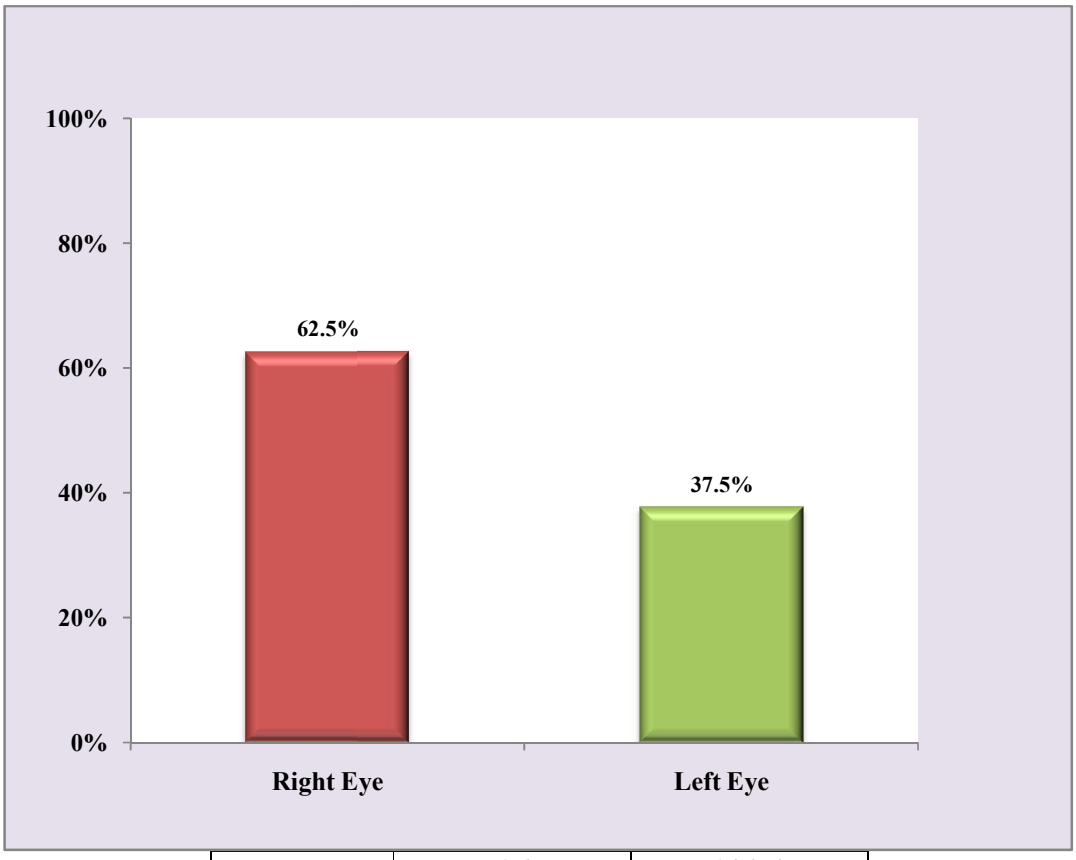
Median Duration is 3.5 years & the range is 5months to 23 years

Duration of squint	N	%
<5	11	68.25
5-10	2	12.5
11-20	1	6.25
>21	2	12.5
Total	16	100%



Affected Eye:

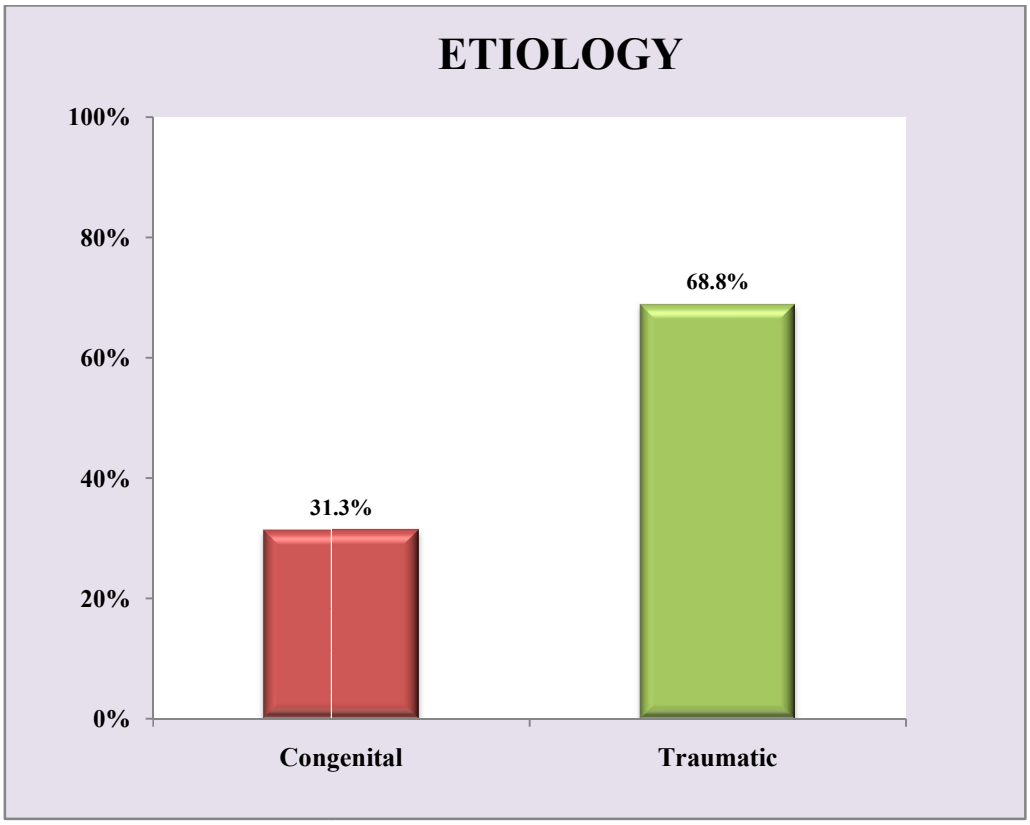
	N	%
Right Eye	10	62.5
Left Eye	6	37.5



Total	**16**	**100.0**

Etiology:

	N	%
Congenital	5	31.3
Traumatic	11	68.8
Total	**16**	**100.0**



Pre-op Visual Acuity Vs Post op Visual Acuity:

	N	Median(Senllen Equivalent)	Mean(SD)	Min-Max	P-value*
Pre Op Visual Acuity	16	0.18(6/9)	0.33(0.47)	0 – 1.48	0.084
Post Op Visual Acuity	16	0.18(6/9)	0.28(0.40)	0 – 1.3	

*Using Wilcoxon rank sum test

There was no change in preop and post op visual outcome.

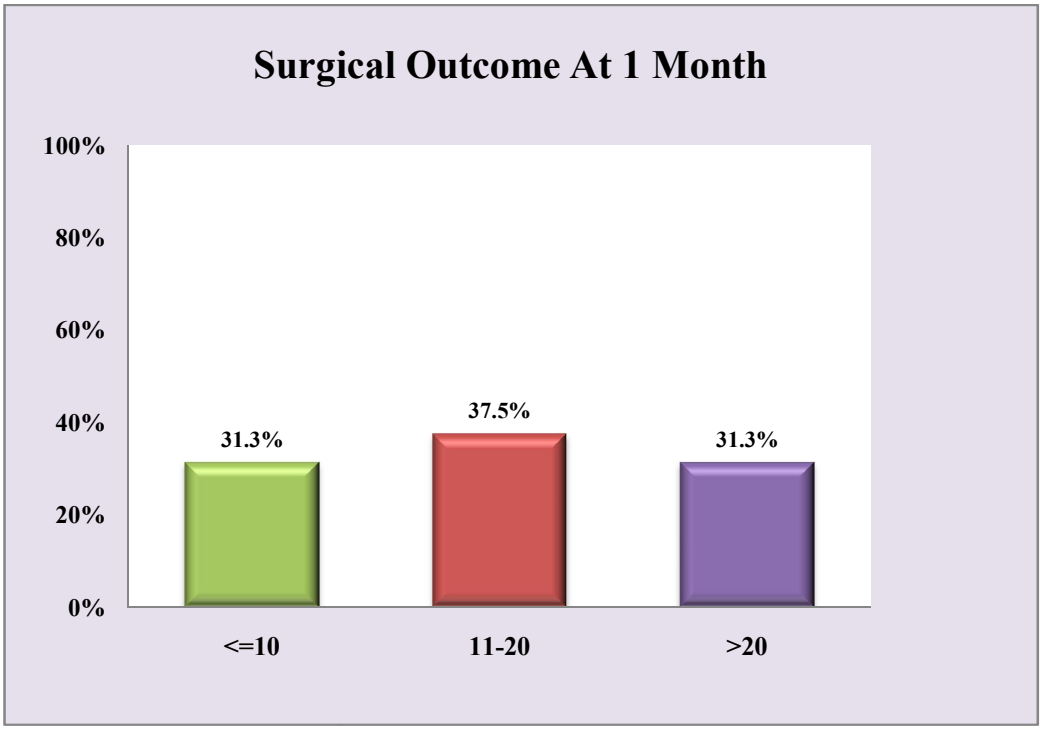
Diplopia pre and post operatively

Diplopia	PREOP	POSTOP
Yes	4	1
no	12	15
Total	**16**	**16**

ANATOMICAL OTCOME OF SURGERY AT 1 MONTH (PRIMARY DEVIATION<10 PD)

Surgical outcome at 1month

Primary distance deviation	N	%
<=10	5	31.3
11 – 20	6	37.5
>20	5	31.3
Total	**16**	**100.0**

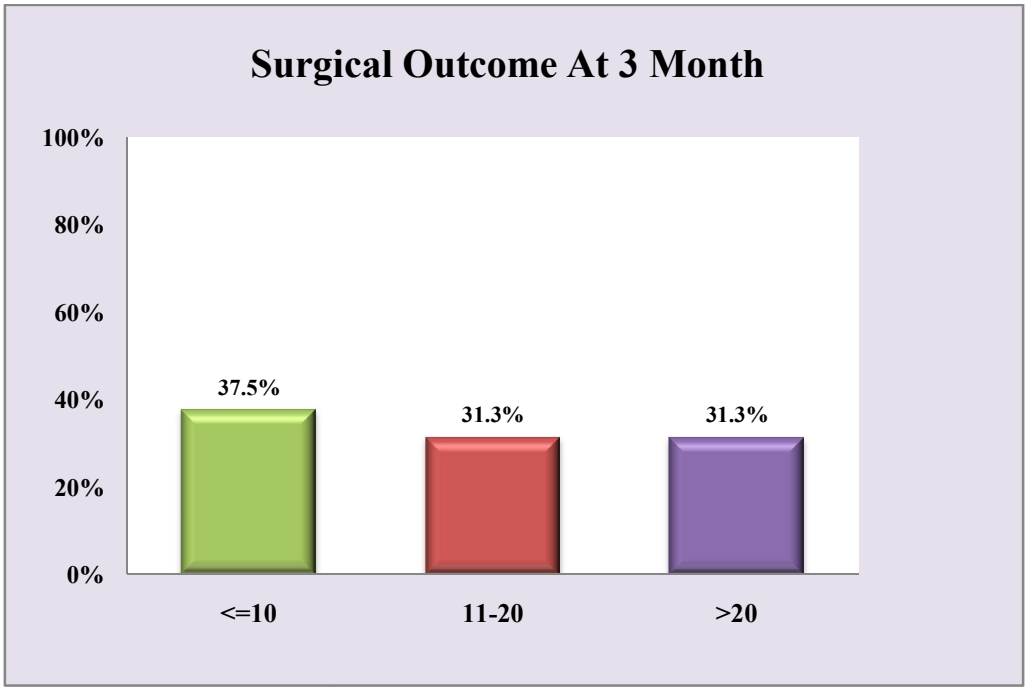


ANATOMICAL OTCOME OF SURGERY AT 3 MONTHS

(PRIMARY DEVIATION<10 PD):

Surgical outcome at 3month

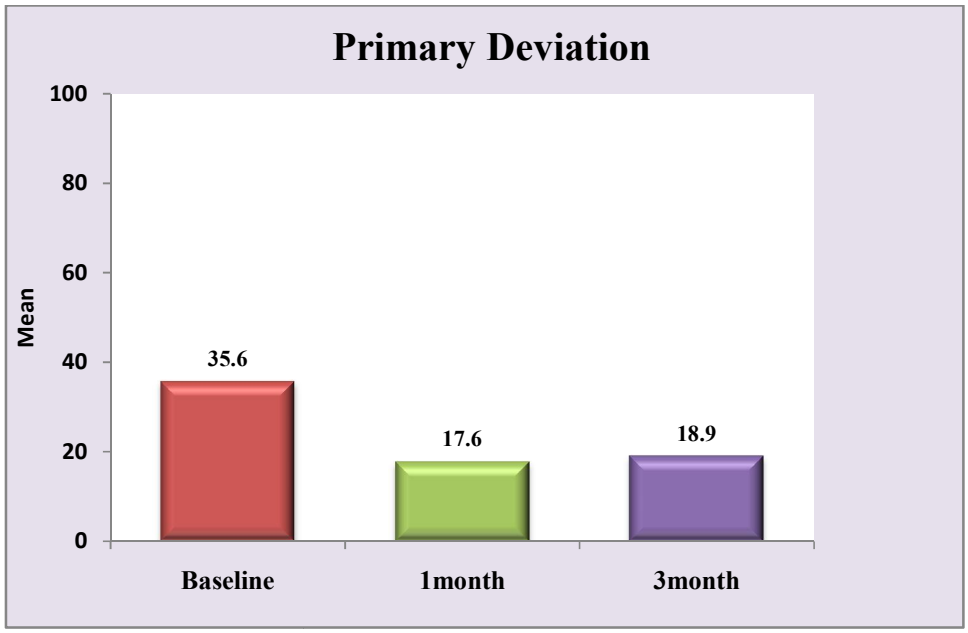
Primary distance deviation	**n**	**%**
<=10	6	37.5
11 – 20	5	31.3
>20	5	31.3
Total	16	100.0



Primary Deviation Baseline Vs 1month Vs 3month

	N	Mean(SD)	Min-Max	P-value*
Baseline	16	35.6(11.5)	20 - 60	-
1month	16	17.6(10.1)	4 - 35	0.001
3month	16	18.9(13.6)	2 - 50	0.002

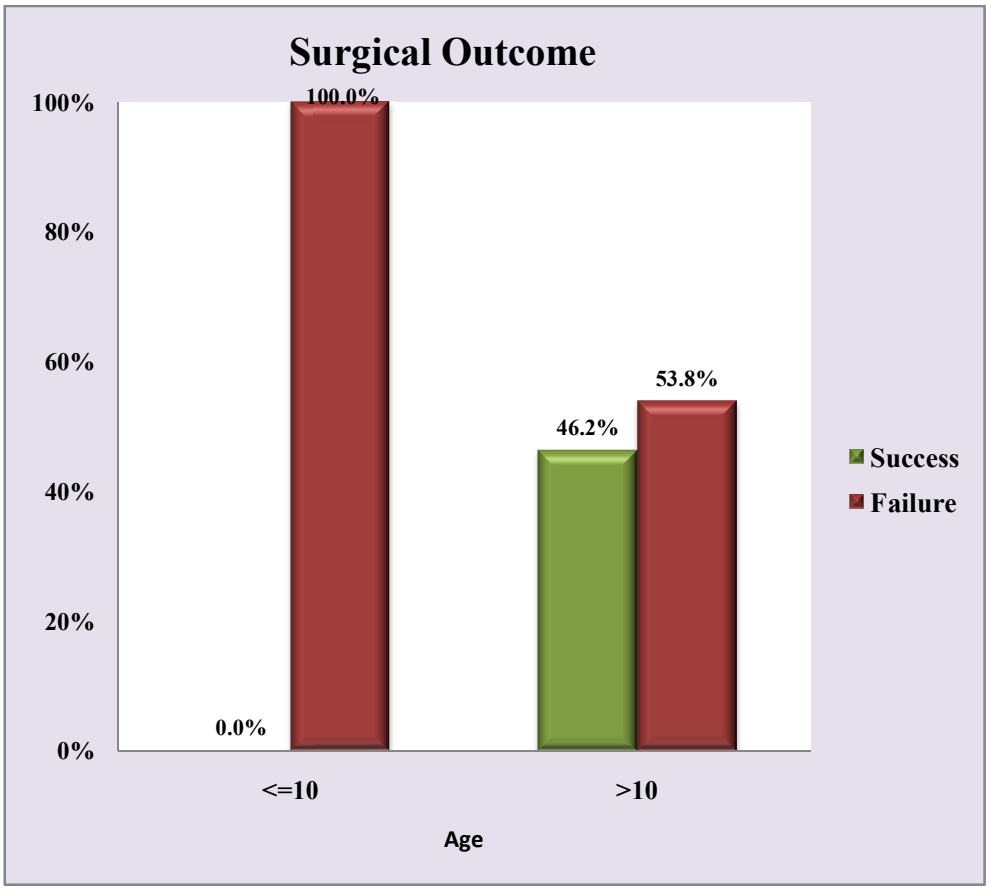
*Using Wilcoxon rank sum test



In our study there was significant reduction in the amount of deviation post surgery.

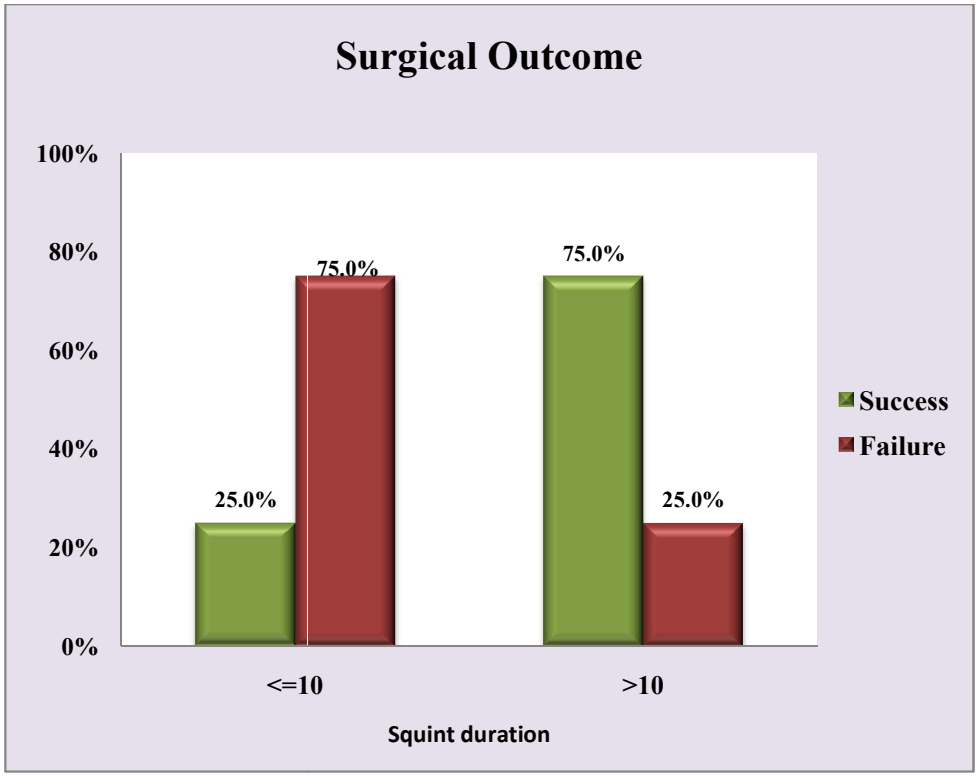
SURGICAL OUTCOME BASED ON THE AGE OF THE PATIENT

Age in years	Surgical outcome		Total	P-value
	Success	Failure		
<=10	-	3(100.0)	3	0.250
>10	6(46.2)	7(53.8)	13	
Total	6(37.5)	10(62.5)	16	



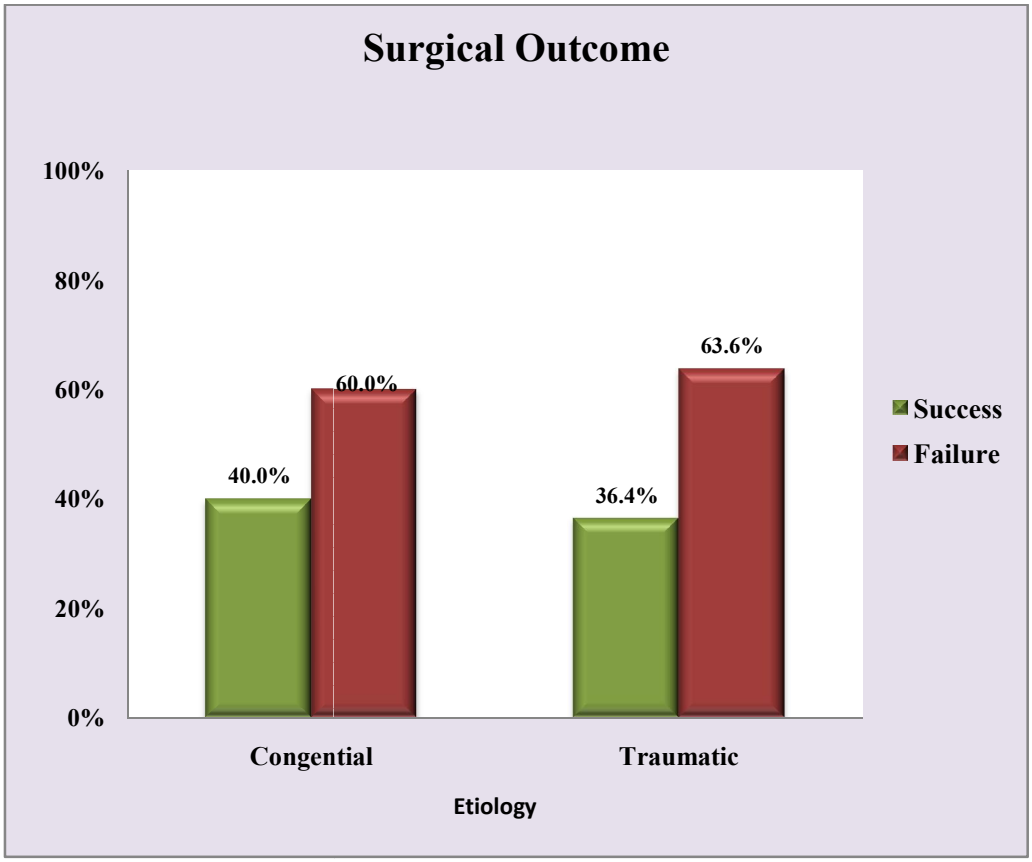
SURGICAL OUTCOME BASED ON THE DURATION OF SQUINT

Duration of squint in years	Surgical outcome		Total	P-value
	Success	Failure		
<=10	3(25.0)	9(75.0)	12	0.118
>10	3(75.0)	1(25.0)	4	
Total	6(37.5)	10(62.5)	16	



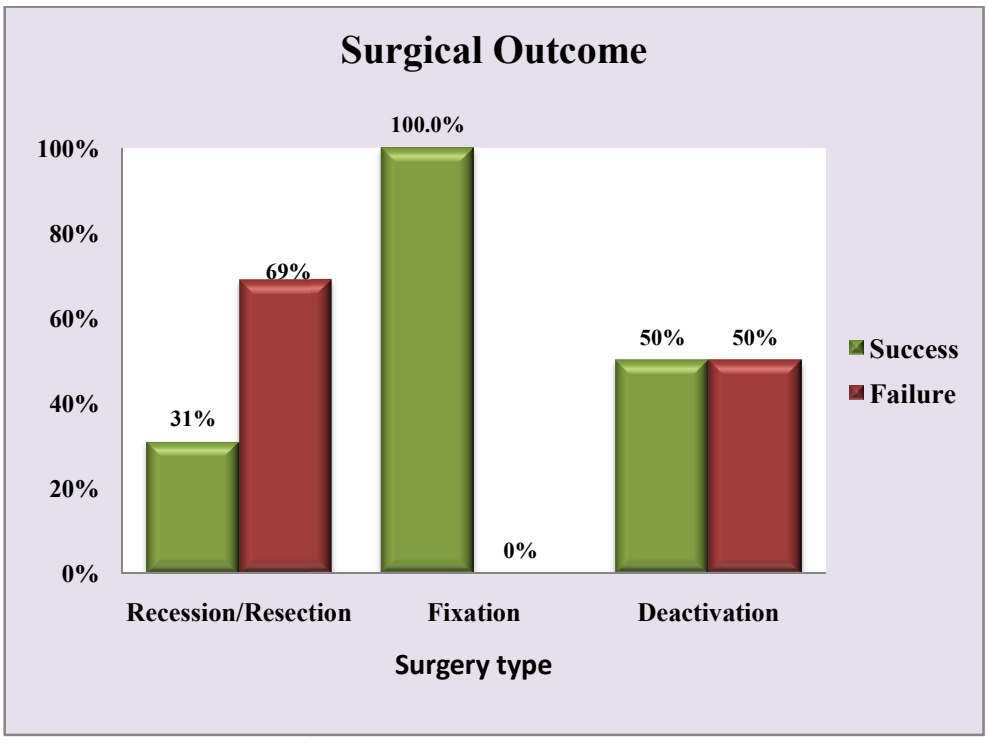
SURGICAL OUTCOME BASED ON THE ETIOLOGY

Etiology	Surgical outcome		Total	P-value
	Success	Failure		
Congenital	2(40.0)	3(60.0)	5	0.99
Traumatic	4(36.4)	7(63.6)	11	
Total	6(37.5)	10(62.5)	16	



SURGICAL OUTCOME BASED ON THE TYPE OF SURGERY

Surgery type	Surgical outcome		Total
	Success	Failure	
Recession/Resection	4	9	13
Fixation	1	-	1
Deactivation	1	1	2
Total	6	10	16



BSV AND STEREOPSIS AT 3 MONTHS POSTOP

BSV

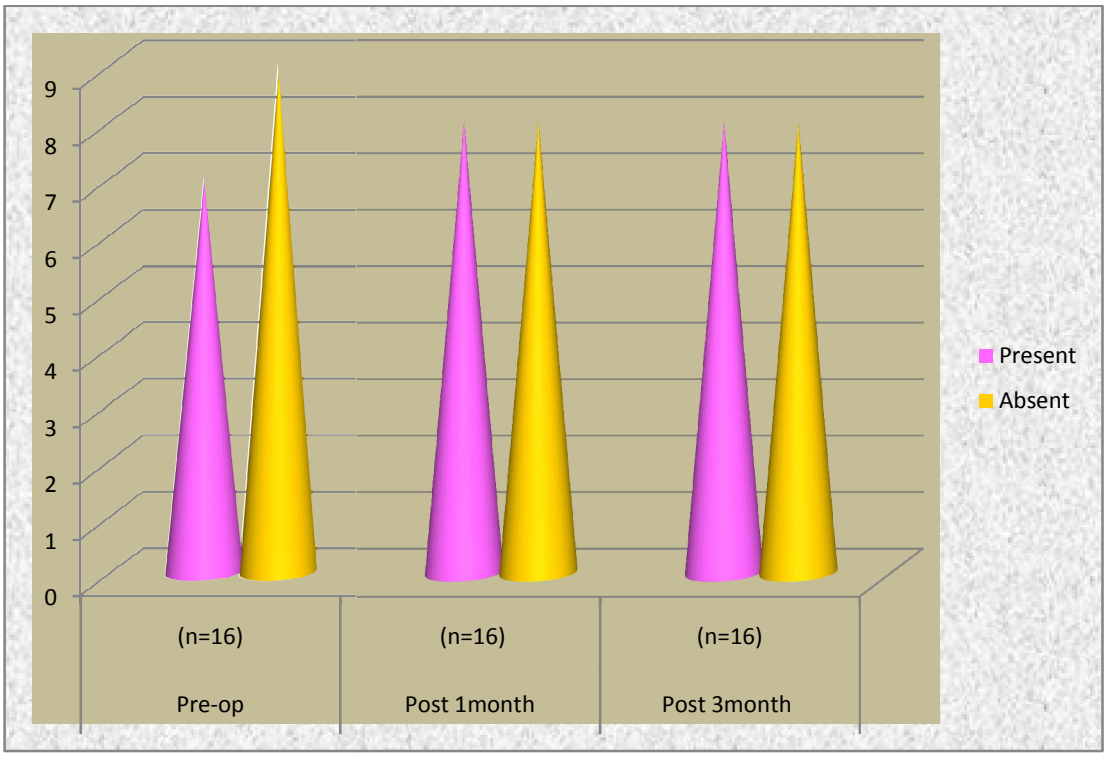
	Pre-op (n=16)	**Post 1month (n=16)**	**Post 3month (n=16)**
Present	12(75.0)	13(81.3)	13(81.3)
Absent	4(25.0)	3(18.8)	3(18.8)
Total	**16(100.0)**	**16(100.0)**	**16(100.0)**

One patient had improved BSV post surgery

STEREOPSIS:

	Pre-op (n=16)	Post 1month (n=16)	Post 3month (n=16)
Present	7(43.8)	8(50)	8(50)
Absent	9(56.3)	8(50)	8(50)
Total	**16(100.0)**	**16(100.0)**	**16(100.0)**

1 patients had stereopsis post surgery



DISCUSSION

The main aim of our study was to analyze the anatomical and functional outcome of strabismus surgery(on horizontal/vertical deviation) with stable third nerve palsy for more than 6 months.

Ours was a prospective study of 16 patients. In our study 56.25% of affected patients belong to the age group of 20-40 years. 5 patients(31.3%) had congenital third nerve palsy and 11 patients(68.8%) had traumatic third nerve palsy. 2 patients with traumatic etiology had aberrant regeneration. (widening of palpebral fissure on adduction)All of the affected people in our study were males. Trauma being more prone in the younger age and also in males could have attributed to this high proportion of cases. The paralysis was found to be more common in Right eye(62.5%)compared to left eye(37.5%).

Anand V Mudgil et al described the third nerve palsy in children of less than 8 years of age. In his study, he found that congenital ,traumatic and neoplastic were the most frequent causes of third nerve palsy in this group according to this study 9 children had aberrant regeneration.[30]

Linda A Schumacher et al in their study on third nerve palsy in 49 children with 53 affected eyes, they showed 20 eyes had congenital palsy and aberrant regeneration was present in 27 eyes.

In this study 3 patients with congenital third nerve palsy,there was poor visual acuity documented in the affected eye preoperatively (2/60,3/60,6/60) as compared to the sound eye due to sensory deprivation/strabismic amblyopia. 2 patients had good visual acuity of 6/9,6/18.

Anand V Mudgil in their study showed that ambylopia causes decrease in visual acuity in 35% of patients and in 25% of the patients it was due to nonambylopic factors. [30]

SURGICAL METHODS:

MR resection and LR recession was the most common surgery done in 13 patients.LR deactivation with medial periosteal globe fixation was done in 2 patients. Medial globe fixation was done in1 patient. Additionally in 2 patients with significant hypotropia SO tenotomy was planned . In 1 patient with hypotropia partial tendon Knapps was done combined with MR resection.

In our study, LR deactivation with medial periosteal globe fixation was done in 2 patients. 1 patient had residual deviation of 30PD and the other had 8PD. Medial globe fixation was done in1 patient and the residual postop deviation was 8PD.

Pradeep Sharma et al described a technique of fixing the globe with a nonabsorbable suture to the nasal periosteum in acquired isolated oculomotor nerve palsies. They studied on 4 patients with isolated oculomotor nerve palsy.LR recession was done in all 4 patients . MR muscle is anchored to the anterior lacrimal crest with 8-10PD in adduction. The patients were followed for a period of 1 year and the outcome was good.[29]

ANATOMICAL SUCCESS:

In our study anatomical success was defined as good if primary deviation was less than 10PD in the third postoperative month ,better if the deviation was between 11-20PD and fair if the deviation was >21PD.In our study 6 patients(37.5%) had good surgical outcome with deviation <10PD. 5 patients (31.3%) had primary deviation between 11-20PD and 5 patients (31.3%) had primary deviation >21PD and the mean postoperative deviation at the end of 3 months was 13.6 PD.

Kose et al did a prospective study on 6 patients with third nerve palsy and they showed in thesis study that mean postoperative deviation after 2 years was11.6PD [36]

Yonghong J et al did a retrospective study on 13 patients who had unilateral third nerve palsy. All patients had undergone large LR recession. The patients were followed a period of 6-27months and the patients showed residual deviation of 0-20 delta exotropia. [22]

Cabrejas et al did a retrospective study on 22 patients with third nerve palsy who had undergone surgery and they showed that the deviation is reduced sin 14 patients (63.6%).[38]

Lin C et al did a retrospective study on isolated third nerve palsy due to trauma in 26 patients .The patients were followed up for a period of about 14.2 months and the deviation was recovered in 83.3%.[37]

Anand V Mudgil et al did a study on congenital third nerve palsy on 41 patients and they found that only 3 patients had complete recovery after third nerve palsy out of the 20 children who underwent strabismus surgery. [30]

OCULAR MOTILITY:

Preoperatively in 13 patients of recess/resect group, 6 Patients had adduction limitation -2, 7 patients had adduction limitation of -2.Postoperatively all patients had improved to -1.

Preoperatively, in globe anchorage procedures such as lateral rectus deactivation and medial globe fixation procedures, there was an addiction limitation of -4 .Postoperatively, abduction also got restricted to -4 which could be attributed to the globe fixation. .Even though cosmetically good results were obtained, gross restriction of extraocular movements was noted with these procedures.

In our study 4 patients with traumatic etiology had diplopia preoperatively which got corrected in 3 patients, whereas 1 had residual diplopia with 18PD of residual exotropia. Binocular single vision and stereopsis improved postoperatively in 1 patient.

In a retrospective study done by Merino P et al, postoperative diplopia was present in 4 patients who were followed for a period of 27.9 months.

Anand V Mudgil et al in their study showed that 3 patients had measurable stereopsis post surgery. [30]

Linda A Schumacher in their study they showed that it was difficult to restore binocular single vision but they achieved it in some patients with partial third nerve palsy. [32]

In our study we found out if the age of the patient is <10 years of age the surgical outcome was poor. The surgical outcome was independent of the preop amount of deviation and duration of Squint.

Frontalis sling surgery was done in 2 of our patients with congenital third nerve palsy one having moderate ptosis and the other with severe ptosis.

There was minimal complication with recess/resect surgery including conjunctival congestion.LR deactivation did not have any significant complications. Patients who underwent MR globe fixation with LR deactivation had congestion and chemosis near the medial canthus. However procedures like lateral rectus deactivation and MR globe fixation requires surgical expertise.

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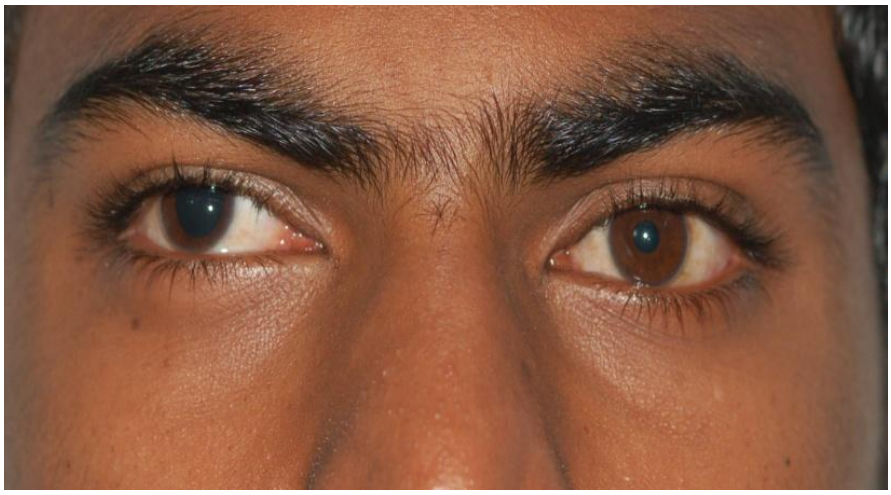
CONCLUSION

In our study we found that there was significant reduction in primary deviation post surgery in maximum number of patients.. Most common procedure done was MR resection and LR recession and the patients had minimal restriction of ocular motility post surgery. LR deactivation when alone or combined with MR globe fixation resulted in gross limitation of ocular motility .However as the selection process of surgical protocol was based on the clinical findings, the results cannot be applicable for comparison. May be a randomised surgical protocol ,little larger sample size associated with a long term follow up might bring out a better comparative outcome.

EYE IN PRIMARY POSITION



RIGHT EYE NORMAL ABDUCTION

RIGHT EYE LIMITED ADDUCTION

RIGHT EYE LIMITED DEPRESSION

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STUDY PROFORMA

NAME: M.R.NO.:

AGE: PROFORMA NO:

SEX: DATE:

ADDRESS:

CONTACT NO:

CHIEF COMPLAINTS:

Deviation of eye: right eye /left eye/alternating eye

Duration:

Direction:

Progression :

Noticed by:

Noticed at the age of:

H/O Drooping of upper eyelid:

Duration

Contant/Intermittent

Diurnal variation

Marcus gunn jaw winking phenomenon

H/O of Diplopia

Diminution of vision:

Eye pain and fatigue:

Neurologic disorder:

Trauma:

Others: DM/HT

ABNORMAL HEAD POSTURE:

BIRTH HISTORY:

HISTORY OF NEUROIMAGING DONE:

FAMILY HISTORY:

H/O squinting among family members:

Family tree:

TREATMENT HISTORY:

Age:

Place:

Type:Occlusion:

Orthoptic exercises:

Optical correction:

Surgical correction:

EXAMINATION:

Visual acuity:

3-5 years:Sheridan Gardner test/Cambridge Matching card.

>5 years: Snellen's chart.

Without glasses:

With glasses:

REFRACTION AND CORRECTION:

Retinoscopy:

(RE) (LE)

Correction:

	Sphere	Cylinder	Axis	V/A
RE				
LE				

ANTERIOR SEGMENT EVALUATION:

With slit lamp bio microscopy:

(RE) (LE)

Pupil –involved/spared

Ptosis -severity

POSTERIOR SEGMENT EVALUATION:

(RE) (LE)

STRABISMUS EVALUATION:

1. Motor examination of eyes:

Head posture: Face turn : .....

Chin Position: .....

Head tilt : .....

Corneal Reflex: Fixing right : .....

Fixing left : .....

Cover Test (without Glass) : Near :

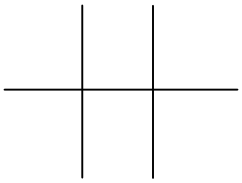
Distance:

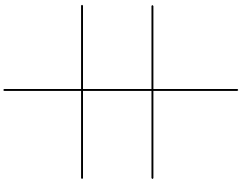
Cover Test (with Glass) :

Near :

Distance:

Ocular movements RE: LE:





Fissure Changes:

Lid Retraction:

Nystagmus:

Prism cover test (Fixing right/fixing left)

For distance:

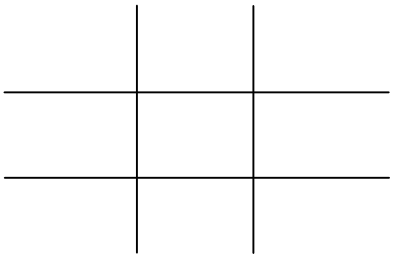
Prism Fusion: (without/with glass) Near:

Distance:

BSV with prism correction : Near:

Distance:

Diplopia charting (Red before right eye)



Diplopia charting interpretation:

Hess charting Interpretation:

Other Special Test:

Torsion

FDT:

FGT:

Fundus:

Maddox rod:

DIAGNOSIS:

SURGICAL MANAGEMENT:

Date:

Type of surgery:

Operating surgeon:

Anaesthesia

Time interval bt onset and surgery

FOLLOW UP:

1st visit at 1 month

2nd visit at 3 month

(At each visit following points to be noted)

1. Visual acuity:(BCVA)

   3-5 years:Sheridan Gardner test/Cambridge Matching card.

   >5 years: Snellen's chart.

2. .Anteroir segment

Pupil

Ptosis

3. Motor examination of eyes:

   - Head posture:
   - Hirschberg's test:
   - Cover test:(with refractive correction)
   - Prism cover test:(in 9 positions of gaze)
   - Angle of deviation:

4. Sensory status:

a)Binocular single vision:

by Worth's 4 dot test:

b)Stereopsis:by TNO book.

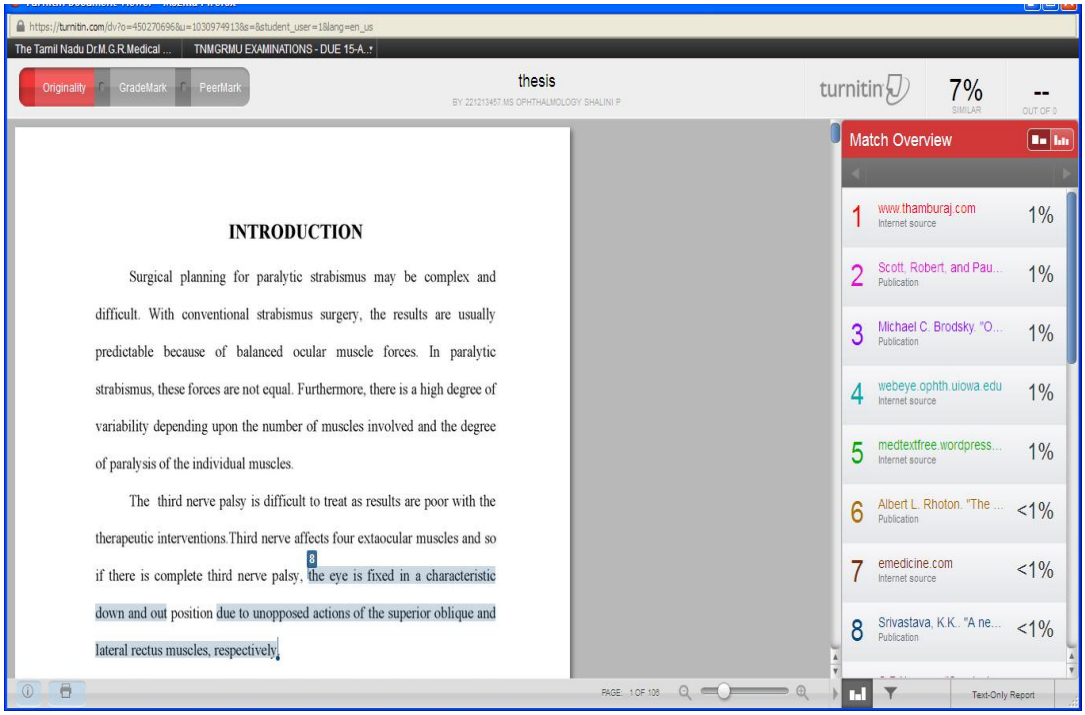
ABBREVIATIONS

RE	-	Right eye
LE	-	Left eye
SO	-	Superior oblique
IO	-	Inferior oblique
MR	-	Medial rectus
LR	-	Lateral rectus
IR	-	Inferior rectus
SR	-	Superior rectus
ET	-	Esotropia
XT	-	Exotropia
PD	-	Prism diopters
Pre-op	-	Pre operative
BSV	-	Binocular single vision

S NO	NAME	MR NO	AGE	SEX	DURATION OF SQUINT	EYE	VISUAL ACUITY		DIPLOPIA	PTOSIS	PUPIL INVOLVEMENT	DIAGNOSIS	PRIMARY DEVIATION IN PD		BSV(W4DT)		STEREOPSIS	ABERRANT REGENERATION	TYPE OF SURGERY	POST OP VISUAL ACUITY		POST OP DIPLOPIA	PRIMARY DEVIATION IN 1 MONTH POSTOP IN PD		BSV		STEREOPSIS	PRIMARY DEVIATION IN 3 MONTH POSTOP IN PD		BSV		STEREOPSIS	ETILOGY
							RE	LE					N	D	N	D				RE	LE		N	D	N	D		N	D	N	D		
1	GANGHADHARA	3549780	29	M	7 MONTHS	RE	6/9	6/12	YES	MILD	YES	RE TRAUMATIC THIRD NERVE PALSY WITH PUPIL INVOLVEMENT	35	30	RE SUPRESSION	RE SUPRESSION	ABSENT	NO	RE-MR 5mm RESECTION WITH 8mm DOWNSHIFT	6/9	6/9	NO	2	4	RE SUP	RE SUP	ABSENT	3	2	RE SUP	RE SUP	120 ARC/SEC	TRAUMATIC
2	THANGAMARIAPPAN	2989933	27	M	5 MONTHS	LE	6/6	6/6	NO	MILD	YES	LE TRAUMATIC THIRD NERVE PALSY WITH PUPIL INVOVLEMENT	3	60	LE SUPRESSION	LE SUPRESSION	ABSENT	YES	LE- MR RESECTION 6mm	6/6	6/6	NO	10	30	LE SUP	LE SUP	ABSENT	10	30	LE SUP	LE SUP	ABSENT	TRAUMATIC
3	MUNEESH KUMAR	3466905	20	M	SINCE BIRTH	LE	6/6	4/60	NO	MILD	NO	LE CONGENITAL THIRD NERVE PALSY	>50	>50	LE SUPRESSION	LE SUPRESSION	ABSENT	NO	LE- LR DEACTIVATION,MR TUCK DONE,SO TENOTOMY	6/6	6/36	NO	10	15	LE SUP	LE SUP	ABSENT	0	8	LE SUP	LE SUP	ABSENT	CONGENITAL
4	ESWARAIAH	3439854	30	M	6 MONTHS	LE	6/6	6/9	no	NO	YES	LE-TRAUMATIC THIRD NERVE PALSY WITH PUPIL INVOLVING	25	30	present	present	120 ARC/SEC	NO	LE-MR RESECTION 5mm ADJUSTABLE,LR RECESSION 7mm	6/6	6/9	YES	6	18	PRESENT	PRESENT	120 ARC/SEC	6	12	PRESENT	PRESENT	120 ARC/SEC	TRAUMATIC
5	DEEPU DIWAKARAN	3484286	22	M	1 YEAR	LE	6/6	6/6	YES	MILD	YES	LE-TRAUMATIC THIRD NERVE PALSY WITH PUPIL INVOLVING	25	20	LE SUPRESSION	LE SUPRESSION	120 ARC/SEC	NO	LE -MR RESECTION 6mm ,PARTIAL TENDON KNAPP DONE	6/6	6/6	NO	10	15	LE SUPR	LE SUPR	120ARC/SEC	20	18	LE SUP	LE SUP	120 ARC/SEC	TRAUMATIC
6	RAJAVELU	3283646	21	M	2 YEARS	RE	6/6	6/6	NO	MILD	YES	RE-TRAUMATIC THIRD NERVE PALSY WITH PUPIL INVOLVING	35	30	RE SUPRESSSION	RE SUPRESSSION	240 ARC/SEC	NO	RE -LR RECESSION 9 mm	6/6	6/6	NO	10	35	RE SUP	RE SUP	240 ARC/SEC	10	40	RE SUP	RE SUP	24O ARC/SEC	TRAUMATIC
7	LUKMAN JAMAL	3263170	2	M	SINCE BIRTH	RE	6/12	6/9	NO	MODERATE	NO	RE -CONGENITAL THIRD NERVE PALSY	25	35	ABSENT	ABSENT	ABSENT	NO	RE-MR RESECTION 4mm, LR RECESSION 5mm WITH UPWARD	6/12	6/9	NO	6	25	ABSENT	ABSENT	ABSENT		30	ABSENT	ABSENT	ABSENT	CONGENITAL
8	PALANI	3550170	44	M	4 YEARS	RE	6/6	6/6	YES	MODERATE	YES	RE-TRAUMATIC THIRD NERVE PALSY WITH PUPIL INVOLVING	45	35	RE SUPRESSSION	RE SUPRESSSION	120 ARC/SEC	NO	RE -MR TUCKING 4.5 mm,LR RECESSION 7mm,	6/6	6/6	NO	30	7	PRESENE	PRESENE	PRESENT	6	7	PRESENT	PRESENT	PRESENT	TRAUMATIC
9	ANBARASAN	3273760	28	M	2 YEARS	RE	6/9	6/6	YES	MILD	YES	RE-TRAUMATIC THIRD NERVE PALSY WITH PUPIL INVOLVING	3	30	RE SUPRESSION	RE SUPRESSION	120 ARC/SEC	NO	RE-MR RESECTION 6mm, LR RECESSION 8mm	6/9	6/6	NO	15	16	PRESENT	PRESENT	PRESENT	30	16	PRESENT	PRESENT	PRESENT	TRAUMATIC
10	ABJITH	3466420	3	M	SINCE BIRTH	LE	6/18	6/18	NO	SEVERE	NO	LE -CONGENITAL THIRD NERVE PALSY WITH SEVERE PTOSIS	40	50	ABSENT	ABSENT	ABSENT	NO	LE- IR RECESSION 8mm,FRONTALIS SLING SX	6/18	6/12	NO	10	30	ABSENT	ABSENT	ABSENT	>50		ABSENT	ABSENT	ABSENT	CONGENITAL
11	ABDUL BASHEER	3652441	4	M	SINCE BIRTH	RE	2/60	6/6	NO	MILD	YES	RE -CONGENITL THIRD NERVE PALSY WITH PUPIL INVOLVEMENT	12	30	ABSENT	ABSENT	ABSENT	NO	RE-MR RESECTION 8 mm,LR RECESSION 6mm WITH 6mm	3/60	6/6	NO	14	10	ABSENT	ABSENT	ABSENT	12	15	ABSENT	ABSENT	ABSENT	CONGENITAL
12	ILANGOVAN	3361690	87	M	7 YEARS	RE	6/6	6/6	NO	SEVERE	YES	RE -TRAUMATIC THIRD NERVE PALSY WITH PUPIL INVOLVING	25	25	RE SUPRESSSION	RE SUPRESSSION	120ARC/SEC	YES	RE-MR RESECTION 5mm,LR RECESSION 4 mm	6/6	6/6	NO	30	18	RE SUP	RE SUP	120ARC/SEC	16	20	RE SUP	RE SUP	120ARC/SEC	TRAUMATIC
13	NASAR ALI	3467726	22	M	SINCE BIRTH	RE	6/60	6/6	NO	NO	YES	RE-CONGENITAL THIRD NERVE PALSY	20	30	RE SUPRESSION	RE SUPRESSION	ABSENT	YES	RE-MR PLICATION 6 mm, LR DEACTIVATION	6/60	6/6	NO	6	30	RE SUP	RE SUP	120ARC/SEC	20	30	RE SUP	RE SUP	12OARC/SEC	TRAUMATIC
14	MANOJ KUMAR BOYAL	3384564	29	M	12 YEARS	LE	6/6	6/6	NO	NO	NO	LE -TRAUMATIC THIRD NERVE PALSY	24	30	PRESENT	PRESENT	60ARC/SEC	NO	LE-MR RESECTION 6mm,LR RECESSION 8mm	6/6	6/6	NO	18	6	LE SUPPRESSION	LE SUPPRESSION	60 ARC/SEC	6	6	LE SUP	LE SUP	60ARC/SEC	TRAUMATIC
15	RAM BHUPAL REDDY	3579181	23	M	SINCE BIRTH	RE	6/6	6/6	NO	NO	N0	RE CONGENITAL THIRD NERVE PALSY	35	40	RE SUPRESSION	RE SUPRESSION	ABSENT	NO	RE MR RESECTION 5mm ,FULL TENDON KNAPPS WITH BROOKS	6/6	6/6	NO	8	12	RE SUPRESSION	RE SUPRESSION	120ARC/SEC	14	10	RE SUP	RE SUP	120ARC/SEC	CONGENITAL
16	NASEER BASHA	3577380	15	M	9 YEARS	RE	6/12	6/6	NO	NO	NO	RE -TRAUMATIC THIRD NERVE PALSY PUPIL SPARING	30	35	ABSENT	ABSENT		NO	RE -MR FIXATION TO MPL	6/12	6/6	NO	8	8	RE SUPRESSION	RE SUPRESSION	ABSENT	8	8	RE SUP	RE SUP	ABSENT	TRAUMATIC

KEY TO MASTER CHART

RE	-	Right eye
LE	-	Left eye
SO	-	Superior oblique
IO	-	Inferior oblique
MR	-	Medial rectus
LR	-	Lateral rectus
IR	-	Inferior rectus
SR	-	Superior rectus
PD	-	Prism diopters
BSV	-	Binocular single vision
N	-	Near
D	-	Distance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INTRODUCTION
Surgical planning for paralytic strabismus may be complex and difficult. With conventional strabismus surgery, the results are usually predictable because of balanced ocular muscle forces. In paralytic strabismus, these forces are not equal. Furthermore, there is a high degree of variability depending upon the number of muscles involved and the degree of paralysis of the individual muscles.
The third nerve palsy is difficult to treat as results are poor with the therapeutic interventions.Third nerve affects four extaocular muscles and so if there is complete third nerve palsy, the eye is fixed in a characteristic down and out position due to unopposed actions of the superior oblique and lateral rectus muscles, respectively.
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INTRODUCTION