PART - 1

INTRODUCTION

Stabismus is a term for ocular misalignment or tendency for misalignment. It typically affects children in early years and subsequently result in ambylopia and impaired binocular single vision. Prevalence of strabismus is around 7.4 per 1000 population according to a study conducted in 2016. The incidence of strabismus worldwide is around 1.3 to 1.7% of all children and in South India the incidence is around 0.7%.

Manifest misalignment is called tropias. Tropias acquired after 6 to 7 years of age causes diplopia.

Before this age , the child will learn to cortically suppress the eye eliminating diplopia. Children who have alternating squint have minimal visual morbidity but constant deviation causes suppression.

Motor coordination of both eyes are necessary for consummate precision of binocular vision. State of apropos oculomotor equilibrium is referred as **orthophoria.**

Imperfect oculomotor balance is called **heterophoria**. It is a latent propensity to deviate. Squint occurs due to defect in fusion faculty. A large phoria difficult to maintain by fusion converts itself into intermittent tropias. Tropias less than 10pd have peripheral retinal fusion with central

fixation on predominant eye and suppression on fellow eye. This phenomenon is referred as monofixation syndrome.

OUTLINE ON EXTRAOCULAR MUSCLES:

Management of various squint requires anatomical knowledge and relationship with other ocular structures.

The six extraocular muscles are terminal end in ocular motor system which executes its yoked agonist and antagonist function.

SPECIALISED COMPARTMENTS OF MUSCLES

1) **GLOBAL COMPARMENT –** controls oculorotatary tension , attached to sclera. It is present near the globe
2) **ORBITAL COMPARTMENT –** orbital layer gets attached to connective tissue pulleys which lies closer to orbit.

OCULAR KINEMATICS are controlled by orbital layer of extraocular muscles which includes LISTING LAW OF TORSION.

ORBITAL LAYER AND GLOBAL LAYER of extraocular muscles differ in metabolic and structural properties.

MUSCULAR PULLEYS:

Muscular pulleys play an important role in extraocular movements. They are found 6 mm behind the scleral insertion. Orbital layer of extraocular muscle joins and end at this site. On contraction of extraocular muscle , muscular pulley should move posteriorly for rectus muscles. Inability of pulleys to translate with extraocular muscle lead do **congenital pulley heterotopy (A OR V PHENOMENON).**

KINEMATICS OF PULLEYS:

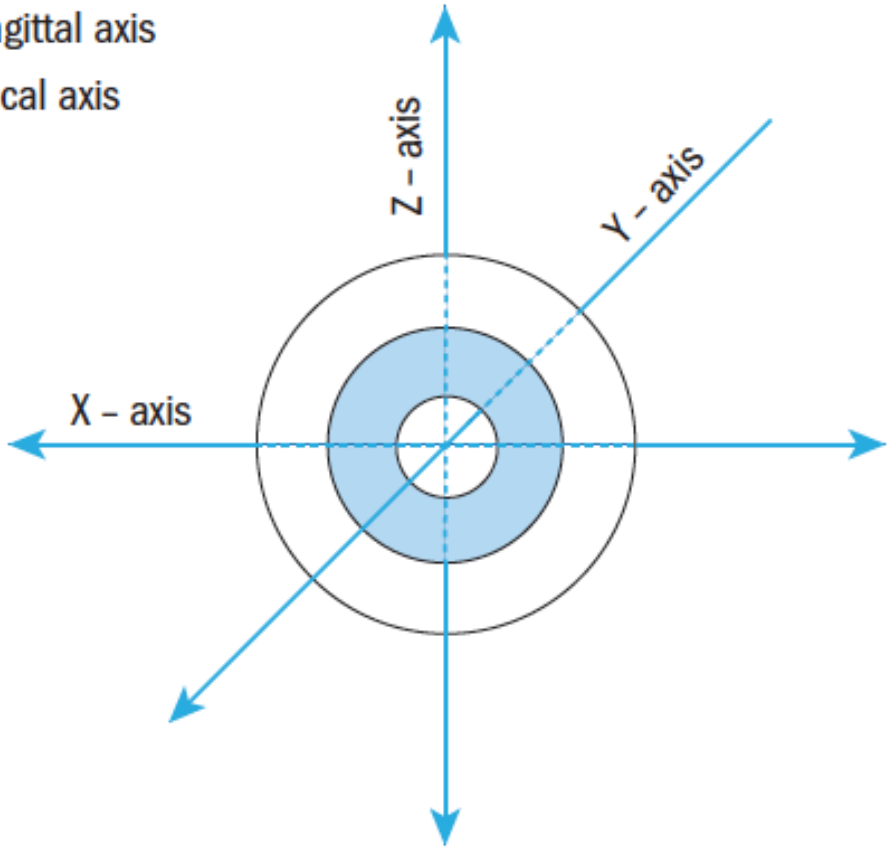
- Rotational scheme of eye pertains to rectus pulleys.
- Eye cannot move in all directions and it is constrained by **LISTINGS LAW AND HALF ANGLE RULE.** It states that eye can translate only by the three ficks axis .
- Listing law is satisfied when rotational axis of ocular movements shifts exactly by half for duction movements.
- Pulleys are responsible for maintaining half angle rule which has to be there for confirming to listing law.

FICKS AXIS AND LISTING PLANE

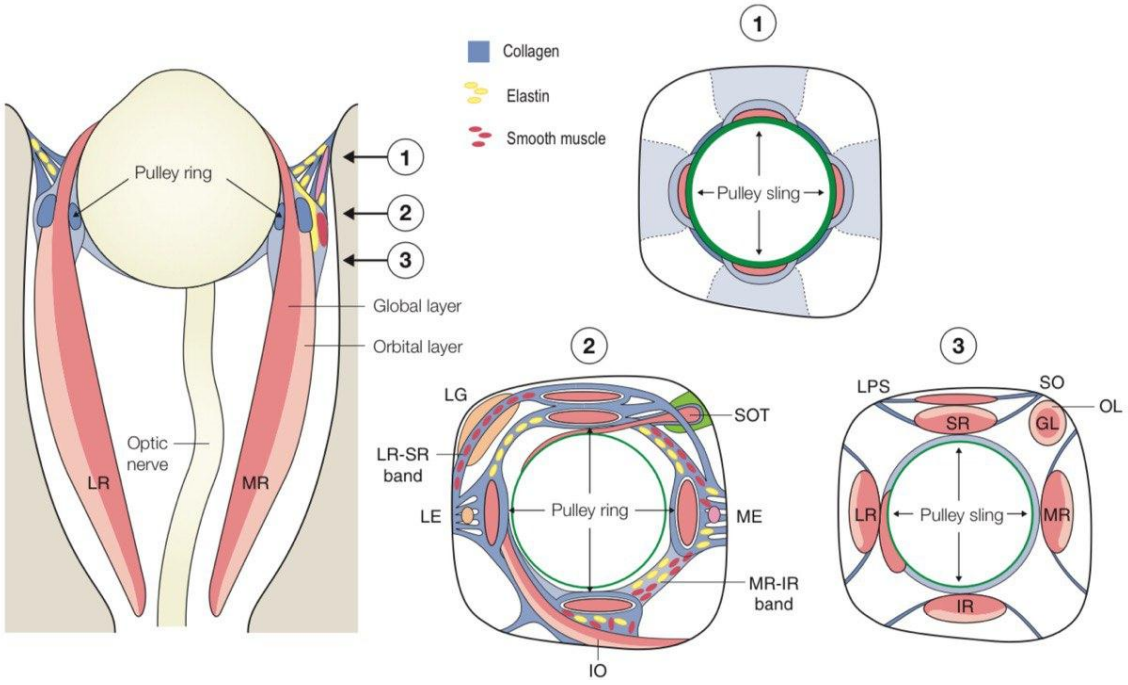
X – axis, horizontal or traverse axis

Y – axis or sagittal axis

Z – axis, vertical axis



Muscular pulleys



Pathological anatomy of muscle pulleys:

1) Congenital pulley heterotopy – a or v phenomenon.
2) Acquired pulley heterotopy
3) Pulley instability- brownes syndrome.
4) Pulley hinderance .

DEMER HYPOTHESIS:

Orbital layer fibres control muscle pulleys which influences rotational force vectors translating during eye movements.

Extraocular muscle fascia contains

1)muscle sleeve or pulley.

2)intermuscular septum

3)anterior tenon capsule

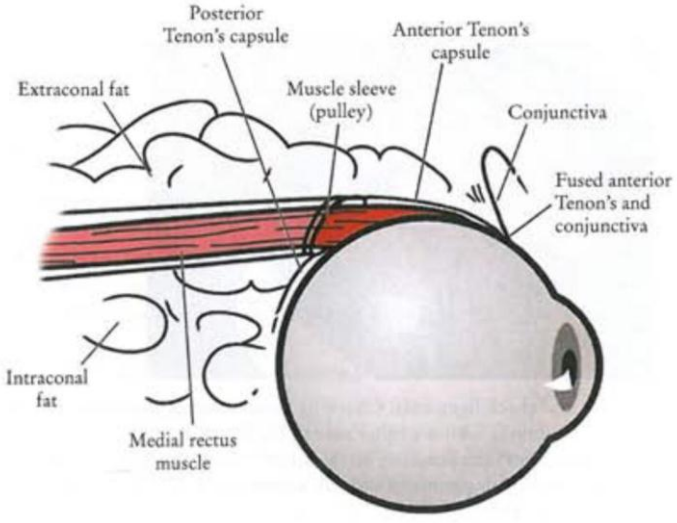
4)posterior tenon capsule

5) check ligaments.

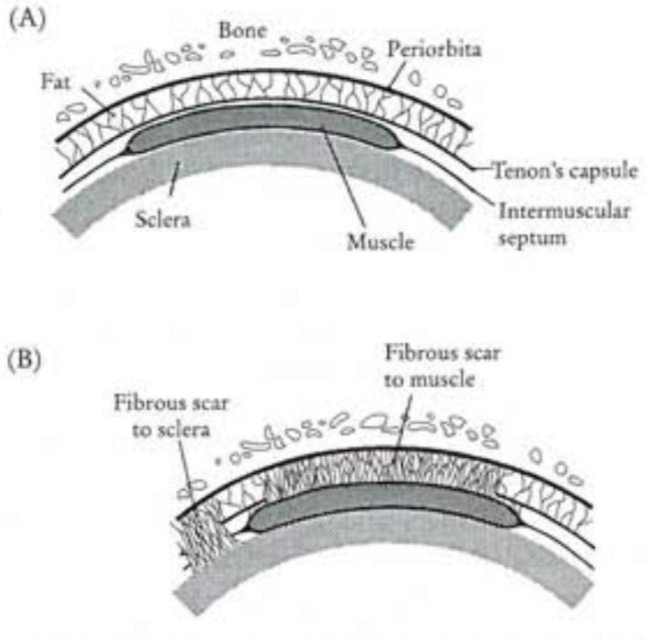
Intermuscular septum: it spans out as a ray of connective tissue between the rectus muscles. Severing them during squint surgery do not cause fat prolapse.

Anterior tenons capsule:It is a whitish structure covering the superior surface of the muscle , attaches to pulley and gets inserted into tendon on insertion site. Improper removal of this structure leads to **slipped or lost muscle.** There will be inadverdent slipping of muscle and the tenons capsule may be mistakenly attached to the sclera.

Posterior tenons capsule: This structure lies beneath the muscle fibres and stops at muscle pulley. Posterior to the pulley lies the intraconal fat. Inadverdent damage to the posterior capsule leads to exposure of intraconal fat and causes **fat adherence.** Fat adherence leads to fibrosis of muscles and can lead to restrictive strabismus. This syndrome is called **FAT ADHERENCE SYNDROME.**



FAT ADHERENCE SYNDROME:



CHECK LIGAMENTS: It is a muscle capsule which connects to bulbar conjunctiva and posteriorly to muscle pulleys. It laminates the vertical muscles to upper lid and lower lid retractors and hence should be severed during vertical muscle surgeries to prevent lid fissures.

ANATOMY OF EXTRAOCULAR MUSCLES:

Muscle	Origin	Insertion	Approx. Length of Muscle (mm)	Tendon Length (mm)	Direction of Pull	Nerve Supply
SR	Common tendinous ring at the orbital apex	7.7 mm from sup. Limbus	40	4.3	23°`	Upper Division of III
IR	Common tendinous ring at the orbital apex	6.5mm from Inferior limbus	40	4.7	23°	Lower Division of III
LR	Common tendinous ring at the orbital apex	6.9 mm from Lateral Limbus	40	7.2	90°	VI
MR	Common tendinous ring at the orbital apex	Sclera 5.5 mm from Nasal Limbus	40	4.5	90°	Lower Division of III
SO	Oribital Apex above annulus of Zinn	Posterior to equator in Supertemporal quadrant of sclera	32	26	51°	IV
IO	Floor of Orbit Behind Naso Lacrimal Fossa	Posterior to equator near macula in the inferior surface	37	1	51°	Lower Division of III

ACTIONS OF EXTRAOCULAR MUSCLES:

Muscle	Primary	Secondary	Tertiary
MR	Adduction	-	-
LR	Abduction	-	-
IR	Depression	Extorsion	Adduction
SR	Elevation	Intorsion	Adduction
SO	Intorsion	Depression	Abduction
IO	Extorsion	Elevation	Abduction

NERVE SUPPLY : Occulomotor nerve supplies the medial, superior , inferior rectus with inferior oblique through the undersurface of the muscle at the junction of posterior third and middle third.

Superior oblique is supplied by trochlear nerve through orbital surface.

Nerve supply is not severed during squint surgery since belly not involved.

BLOOD SUPPLY: Muscles are supplied by medial and lateral muscular branches of ophthalmic artery from where arises two anterior ciliary artery for each muscle except lateral rectus and supplies the conjunctiva and

sclera nearing the corneoscleral limbus and pierces the sclera and joins with long ciliary artery in iris to form major ciliary arcade.

Significance : Removing more than two muscles can lead to anterior ischemic syndrome.

OCULAR MOTILITY LAWS

DONDERS LAW : this law states that for specific rotation of the eye , there is specific corneal and retinal postions according to listing plane irrespective of how the position is achieved.

Others neurological laws holding the EOMs in place:

1) Herings law

2) Sherington law

HERINGS LAW:

- Herings law states equal innervation to yoking muscles.
- The paired agonist muscle are referred as yoke muscles. VERSIONS are described by herings law.

SHERINTONS LAW:

The relationship between agonist and antagonist muscle is defined in sheringtons law. There is opposite innervation to agonist and antagonist muscle. DUCTIONS are described by sheringtons law.

OCULOMOTOR REFLEXES:

1) Vestibulo ocular reflex- motor coordination of the eyes when eye moves.
2) Orthostatic reflex- torsional ocular motor coordination.
3) Oculokinetic nystagmus-cycle of smooth pursuit alternating with refixation.

OCULAR MOVEMENTS TERMINOLOGY

MONOCULAR MOVEMENTS	BINOCULAR MOVEMENTS	
DUCTIONS	VERSIONS	VERGENCE
ADDUCTION	DEXTROVERSION	CONVERGENCE
ABDUCTION	LEVOVERSION	DIVERGENCE
SURSUMDUCTION (ELEVATION)	SURSUMVERSION	SURSUMVERGENCE
DEORSUMDUCTION (DEPRESSION)	DEORSUMVERSION	DEORSUMVERGENCE
INCYCLODUCTION	DEXTROVERSION	INCYCLOVERGENCE
EXCYCLODUCTION	LEVOVERSION	EXCYCLOVERGENCE

DUCTION: Uniocular movements are referred as ductions

VERSIONS: binocular conjugate movements are referred as versions.

VERGENCE: DISJUNCTIVE eye movements are referred as vergence.

Versions are fast movements. Vergence are slow movements compared to versions.

VERSIONS CAN IDENTIFY SUBTLE PARESIS OR MUSCLE OVERACTIONS.

BINOCULAR VISION AND VISUAL DEVELOPMENT(1)

The process of binocular single vision depends on sensory fusion and motor fusion.

SENSORY FUSION : The ability of visuomotor cortex to amalgamate the monocular inputs is referred as sensory fusion.

MOTOR FUSION: The harmonized movement of both the eyes in all direction of gazes thereby stationing the corresponding points of the retina in line is referred as motor fusion.

Binocular single vision requires

1) Clear visual acuity
2) Motor fusion
3) Sensory fusion.

FUSIONAL VERGENCE: Ability of the eye to merge the disassociated motor fusion. This is controlled by convergence. It is tool used to measure the vergence power .This is measured by fusional vergence amplitude with the help of PRISMS.

CONVERGENCE is the strongest vergence power hence exodeviations can be strengthened by eye exercises. DIVERGENCE is a weak vergence and esotropia cannot be corrected by exercises.

Normal fusional vergence amplitudes are

Convergence -20 to 30 PD

Divergence-6 to 8 PD

Vertical vergence- 2 to 3PD.

TYPES OF CONVERGENCE

1) **Fusional convergence: binocular vision** determines the motor stability.
2) **Accomodative convergence:** Synkinetic reflex between accommodation and convergence is referred as accommodative convergence. The relationship between accommodation and convergence is given by AC/A ratio.High ratio causes esotropia and low ratio causes exotropia.

3) **TONIC CONVERGENCE:** It's a proprioceptive eye position control that persist even after mono ocular occlusion.
4) **VOLUNTARY CONVERGENCE**
5) **PROXIMAL CONVERGENCE:** Psychological awareness of the object.

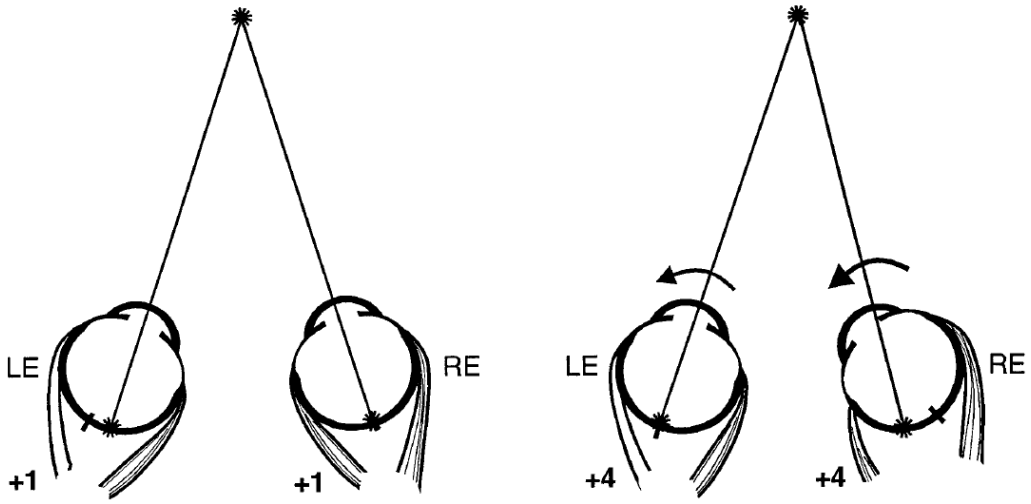
CONCOMITANT VS INCOMITANT STRABISMUS

Concomitant strabismus is when deviation measures same in all gazes. Most of the congenital strabismus are comitant. Occasionaly early onset myasthenia ,bilateral sixth nerve palsy or chronic progressive external ophthalmoplegia might have comitancy in initial stages.

Incomitant strabismus means deviation is different in different gazes which occurs due to restrictive or paretic pathology.

PRIMARY AND SECONDARY DEVIATION:

Primary and secondary deviation works on the principle of Herings law. This happens in incomitant squint. When the eye with limited duction targets an object , there occurs more deviation compared with normal eye with full ductions. When eye with limited duction fixates there occurs more innervation to contralateral agonists causing excessive deviation.



Overaction of any oblique is usually due to previous incomitance either due to prior paresis of ipsilateral antagonist or either due to secondary overaction of agonist muscle.

BINOCULAR AND MONOCULAR VIUSAL DEVELOPMENT:

Monocular visual development peaks at 3 months of age during the critical visual development period and continues to develop till 7 to 8 years of age. Plasticity and development is slower beyond 9 years of age .

BINOCULAR vision is present as early as 1.5months to 2months while stereopsis develops between 3 to 6 months .Binocular cortical neurons are about 60 percent in striate cortex compared to monocular neurons which constitutes only about 30 percent.

EYE ALIGNMENT IN NEONATES:

AT BIRTH – EXODEVIATION -67%

ORTHOPHORIC-30%

ESODEVIATION 1-3%

BY 2 MONTHS – ALL esodeviations resolves

BY 6 MONTHS- 97 % of exodeviations resolves.

Physiologically eye corrects exodeviation due to strong fusional convergence , but correction of esodeviation is poor due to weal fusional divergence.

NORMAL VISUAL DEVELOPMENT:

NEONATES : SACCADIC EYE MOVEMENTS

4 TO 6 WEEKS : ASYMMETRIC SMOOTH PURSUIT.

2 TO 6 MONTHS: BINOCULAR SMOOTH PURSUIT.

6 MONTHS TO 2 YEARS: Central fixation , reach for toys.

3 to 5yrs: 20/40 and no more than two Snellen difference.

>5yrs: 20/30 and no more than two Snellen difference.

ABNORMAL VISUAL DEVELOPMENT:

Inadequate visual stimulation leads to abnormal visual development which leads to amblyopia.

AMBLYOPIA CAN BE DUE TO

1) CORTICAL SUPPRESSION- STRABISMUS
2) PATTERN DISTORSION -RETINAL IMAGE BLUR.

Bilateral pattern distortion which occurs before 2 months of age cause **SENSORY NYSTAGMUS.**

CORTICAL BLINDNESS DOES NOT CAUSE SENSORY NYSTAGMUS because extastriate pathway anterior to occipital cortex supplies fixation reflex.

STRABISMIC AMBLYOPIA:

Because of the fixation preferences ,there occurs suppression of non dominant eye which leads to amblyopia. If there occurs alternation between eyes ,suppression does not manifest but binocular vision and stereopsis is poor. Incomitant strabismus rarely have amblyopia because of their compensatory head posture

AMBLYOPIC VISION is characterized by

1) CROWDING PHENOMENON – because they have a large receptive field , they might not read multiple optotype Snellen chart.
2) NEUTRAL DENSITY FILTER EFFECT-decreased illumination can have effect on normal eye because they use central acuity and fixation rather than abnormal eye which does not use central acuity.
3) ECCENTRIC FIXATION: its presence signifies dense amblyopia . ANAMOLOUS RETINAL CORRESPONDENCE AND ECCENTRIC FIXATION HAVE EXTRAFOVEAL FIXATION but the latter is present in both monocular and binocular conditions whereas ARC is active during binocular condition and reverts back to true fovea when one eye is covered.

EXAMINATION IN A CASE OF SQUINT:

1) GENERAL HEAD POSTURE : Evaluation of face turns.
2) Amblyopia assessment and visual acuity
3) Sensory tests -Diplopia tests and tests for suppression and fusion.
4) Ductions and versions.
5) Measurement of deviation

Corneal reflex test

Krimsky test.

Cover test – for tropias

Alternate cover test

Prism alternate Cover - phorias

+tropias

Simultaneous cover test- tropias less than 10pd -Monofixation

syndromes.

6) Test for measuring restriction and paresis – Forced duction test and Active Forced Generation Test.
7) AC/A ratio – Heterophoria and lens gradient method.
8) Cycloplegic refraction
9) Fundus examinations.

FDT:

1) RECTUS MUSCLE EXAMINATION: Proptose the eye and ask the patient to look in the direction to relax the muscle.

2) OBLIQUE MUSCLE: **GUYTONS EXAGGERATED TRACTION**

TEST

AFGT: Done in case of palsy to assess the amount of muscle power.

RESTRICTION VS PARESIS:

TESTS	**RESTRICTION**	**PARESIS**
FDT	positive	negative
SACCADIC MOVEMENT	Dog on leash movement+	No saccadic movements
EYE BALL RETRACTION AND LID FISSURE NARROWING	POSITIVE	**Proptosis and lid fissure widening**

EXOTROPIA

Exodeviations are quite common and are not necessarily pathological. Transient exodeviation are more common in neonates but resolve within 2 to 4 months. Strong fusional convergence controls exotropia. Intermittent exotropia is the most common cause and constitutes about 90 percent of all exodeviations.

CLASSIFICATION OF EXODEVIATION:

STATE OF FUSION:

EXOPHORIA (X)

INTERMITTENT EXOTROPIA (X[T])

EXOTROPIA (XT)

KENNETH CLASSIFICATION:

INTERMITTENT EXOTROPIA

CONVERGENGENCE INSUFFICIENCY

SENSORY EXOTROPIA

CONGENITAL EXOTROPIA.

DUANES/BURIAN CLASSIFICATION:

1) **BASIC TYPE:** Distance deviation and near deviation are equal or within 15pd .
2) **DIVERGENCE EXCESS:** Distant deviation is more than near deviation >15pd

3) **CONVERGENCE INSUFFICIENCY:** Near deviation is more than distant deviation>15pd.
4) **SIMULATED DIVERGENCE EXCESS:** Deviation is larger in distance than near apparently but near deviation excess is masked by persistent convergent innervation.

KUSHNER CLASSIFICATION:(1)

He introduced two new groups -pseudo divergence with tenacious proximal fusion and divergence with high AC/A ratio.

	BURIAN	**KUSHNER**
BASIC TYPE XT -	Distance=near	normal AC/A ratio
CONVERGENCE INSUFFICIENCY	near > distance	low AC/A ratio Fusional convergence insufficiency Pseudo convergence insufficiency.
DIVERGENCE INSUFFICIENCY	distance >near	True divergence excess Simulated divergence (tenacious proximal fusion).

DIVERGENCE -EXCESS TYPE

THEORIES PERTAINING TO DEVELOPMENT OF EXODEVIATIONS:(2)

1) **DUANES THEORY – INNERVATIONAL IMBALANCE** that upsets reciprocal relationship between active convergence and divergence mechanism. He assumed divergence is an active process.
2) **BIELSCHOWSKY THEORY – ANAMOLOUS POSITION OF REST**

   Anatomical and mechanical factors of extra bulbar tissue play a role in development of exodeviation.
3) **WEISS THEORY – LENGTH AND INSERTION OF HORIZONTAL RECTI -**may influence the functional equilibrium between medial and lateral muscle action.
4) **BURIAN THEORY – STATIC (MECHANICAL) AND DYNAMIC (INNERVATIONAL)** factors interplay for alignment of the eyes.
5) **CHAVASSE THEORY- EXUBERANT CONVERGENCE** may obscure basic exodeviation -simulated divergence excess.

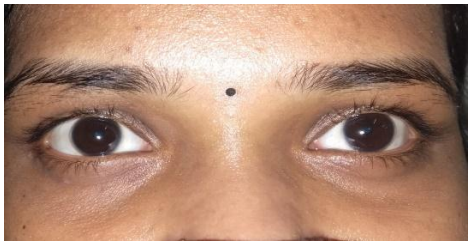
6) **DONDERS THEORY – UNDERSTIMULATION** of convergence in case of myopia.
7) **JAMPOLSKY THEORY – UNEQUAL CLARITY** may facilitate suppression and can contribute to exodeviation.

INTERMITTENT EXOTROPIA 😊 X(T):

Intermittent exotropia is a strabismic condition where exotropia is interspersed with episodes of orthophoria. Intermittent exotropia is the most common and account for half of cases of exotropia. The prevalence of intermittent exotropia less than 11 years of age is one percent.

CLINICAL FEATURES:

1) Onset – second to third year of life.
2) Monocular eye closure – photophobia- strong photopic stimulus can disrupt the fusion and can cause diplopia.
3) Episodes of binocular stereoacuity and suppression alternates.



CLINICAL EVALUATION :

PROGRESSION SHOULD BE EVALUATED FOR X(T): Assessing control of intermittent exotropia determines its management. This is done by scoring systems.

Two scores

1) THE MAYO SCORE – it is based on time observation alone.

2)THE NEWCASTLE SCORING SYSTEM – popularized by Rosenbaum as a tool for surgical management of intermittent exotropia. It includes home control and clinical control. Surgery should be considered when it is present 50 percent of time and poorly controlled on examination.

THE MAYO SCORING SYSTEM :

MAYO SCORING SYSTEM FOR CONTROL IN EXTROPIA:

5- CONSTANT EXOTROPIA

4-EXOTROPIA >50% OF THE EXAM BEFORE DISSOCIATION.

3-EXOTROPIA <50% OF THE EXAM BEFORE DISSOCIATION.

2-NO EXOTROPIA UNLESS DISSOCIATED , RECOVERS IN >5SECONDS.

1-NO EXOTROPIA UNLESS DISSOCIATED , RECOVERS IN 1-5 SECONDS.

0-NO EXOTROPIA UNLESS DISSOCIATED ,RECOVERS IN <1 SECOND.

THE REVISED NEW CASTLE SCORE FOR INTERMITTENT EXOTROPIA:(3)

HOME CONTROL (XT OR MONOCULAR EYE CLOSURE):	SCORE
NEVER	**0**
<50 % OF TIME FIXING IN DISTANCE	1
>50 % OF TIME FIXING IN DISTANCE	2
>50 % OF TIME FIXING IN DISTANCE AND NEAR	3
CLINIC CONTROL (SCORED FOR NEAR AND DISTANCE FIXATION):	
IMMEDIATE REALIGNMENT AFTER DISSOCIATION	**0**
REALIGNMENT WITH AID OF BLINK	1
REMAINS MANIFEST AFTER DISSOCIATION /PROLONGED FIXATION	2
MANIFEST SPONTANEOUSLY	3

MANAGEMENT OF INTERMIITENT EXOTROPIA:

1) OCCLUSION : In the presence of constant unilateral predominance of intermittent exotropia, occlusion for 4 to 6 hours per day for 3-6 weeks can be tried.
2) OVERMINUS LENSES: In cases of high AC/A ratio , minus lenses up to 2 diopters can be tried.
3) CORRECTION OF HYPERMETROPIC refractive errors.
4) **SURGICAL MANAGEMENT :** If constancy of exotropia is present more than 50 percent of time, surgical management is indicated.

But recurrence is common in operating cases of intermittent exotropia.

Lateral rectus weakening and medial rectus strengthening procedure can be carried out.

INFANTILE EXOTROPIA:

JAMPOLSKY pointed out that exodeviation usually begin as exophoria then progresses to intermittent exotropia and exotropia. Fusion and tonic convergence plays an important role in this transition. But not all exodeviations progress , many are constant in its own form.

Infantile exotropia is a term used for exodeviation that manifest upto age of 1 year. Ocular and systemic disorders are most common in exotropia than in esotropia.

CLINICAL FEATURES:

1) The deviation may vary from 20 to 90 diopters and are constantly increasing in angle.
2) Amblyopia occurs in 25 percent of cases.
3) Asthenopic symptoms – eye strain, photophobia.
4) Myopia is the most common refractive error.

EXAMINATION :

1) Physical features and general behavior suggests systemic association.
2) Fundus and cycloplegic refraction are mandatory.
3) Cover test to differentiate from pseudo exotropia.
4) Infantile strabismic complex should be looked for-DVD , OBLIQUE overactions. X deviations – presence of tight lateral rectus should be ruled out .
5) Marlow's occlusion test or plus 3 lens test- to differentiate between true divergence or pseudo divergence.
6) Mitsui Magician forceps phenomenon- based on henry's law, on adducting the fixing eye ,other eye abducts.
7) Lateral gaze angles- Park recommends if angle of deviation is lesser in lateral gaze, amount of lateral rectus recession should be reduced.

MANAGEMENT:

CHOICE OF PROCEDURE:

Surgery is carried out after refractive error and amblyopia correction.

Timing of surgery :

Aligning the eyes before age of 24 months had significant effect on fusion and binocular single vision. This optimal window is required for better sensory and motor outcome.

The primary aim is to overcorrect 10 -15 pd post operatively especially in children with developmental delay and cerebral palsy to prevent post operative drift.

Divergence excess- bilateral lateral rectus recession.

Basic /simulated divergence excess- lateral rectus recession with medial rectus resection.

If angle of deviation is less than 50pd – bilateral lateral rectus recession alone. If more than 50 pd – lateral rectus recession with medial rectus resection or supramaximal amounts of recession or resection of unilateral medial and lateral rectus muscles.

Coexisting dissociated vertical deviations can be corrected by transposition of horizontal muscles if deviation is more than 20pd.

Dissociated vertical deviation and superior or inferior oblique overactions can be corrected in same sitting or as secondary procedure.

SURGICAL DOSE- MODIFIED PARKLAND FORMULA:

BILATERAL RECESS RESECT

DEVIATION	RECESSION	RESECTION
15PD	4.5	3.0
20	5	3.5
25	5.5	4.0
30	6.0	4.5
35	6.5	5.0
40	7.0	5.5
>50	8.0	6.0

RECESSION OF BOTH LATERAL RECTUS

DEVIATION	RECESSION
15PD	4MM
20	5MM
25	6MM
30	7MM
35	7MM
40	8MM
>50	7+MR / 4 MUSCLE

REVIEW OF LITERATURE

1) **S. Al Mahdi Huda et al**(4) **,** showed the outcome results of the surgical correction and as well as the effects of some factors on the outcome and surgical response of primary exotropia.
2) **Hanan S. Hegazy et al** (5)**,** investigated the factors such as sex, age of patients, and age at initial surgery, family history, preoperative angle of deviation, type of surgery, the tendon width of lateral rectus muscle, refractive error, near binocular single vision with postoperative alignment.
3) **R Ramesh Murthy et al**(6) showed a better motor outcome of about 67 percent which is comparable to other studies.
4) **Ivan Lai Yoon Kit et al**(7) showed , primary exotropia had larger preoperative angle than secondary exotropia and the response to surgery was positively correlated with the preoperative angle of deviation.
5) **U.A. Faridi, T.A. Saleh,**(8) showed surgical treatment for exotropia is effective and the dose response is correlated to the preoperative angle of deviation and average visual acuity. Poor or no preoperative stereopsis was associated with better response to surgery.
6) **H. Kordic, V. Sturm et al**(9) **,** showed better long term follow up of patients of exotropia compared to immediate follow up.

7) **Haixiang Wu , Jianning Sun et al ,**showed patients with intermittent exotropia had better postoperative sensory outcome than with constant exodeviation.

8) **Maya Eibschitz-Tsimhoni et al** , showed management of exodeviations , contemporary concepts in management of intermittent and sensory exotropia.

9) Chee-Ming Lee, Ming-Hui Sun et al(10)**,** showed larger preoperative angle resulted in poorer surgical outcome in intermittent exotropia.

10) Y. Lai, S. L. Ting, et al , also showed primary exotropia had a better surgical results than secondary exodeviations.

11) Sathyan et al(11) , showed surgical correction of exotropia between 4 to 12 years showed a better outcome at alignment and preop angle to be significant .

PART 2

AIM :

To assess the ocular alignment following surgery in primary exotropia.

PRIMARY OBJECTIVE :

Factors affecting visual and surgical outcome in exotropia.

METHODOLOGY

Design of study :

Prospective study

Study Population :

All patients with primary exotropia attending RIOGOH are taken up for study after consent from the patients.

SAMPLE SIZE : 27

Inclusion criteria :

Infantile and intermittent exotropia.

Exclusion criteria :

Neurological causes for exotropia

Consecutive exotropia

Incomitant exotropia.

METHODS:

1) Patients are enquired about the age of onset and progression of deviation along with symptoms such as diplopia or micropsia .
2) In case of intermittent exodeviations , duration of deviation enquired.
3) Neurological and systemic examination done to rule out secondary exotropia

OCULAR EXAMINATION:

1) Visual acuity with snellens chart or picture chart .
2) Cycloplegic refraction with retinoscopy
3) Fundus examination.
4) Amount of deviation assessed for both distant and near using prism bar cover test
5) Patients are also assessed for amount of anisometropia and amblyopia along with A or V deviations
6) Binocular vision and stereopsis are assessed.
7) In case of intermittent exotropia , Newcastle score is evaluated taking home controls and clinical controls and graded severity

Surgical management or refractive error correction with convergence exercises is decided according to values of cycloplegic refraction and severity of exotropia.

Bilateral or unilateral lateral rectus recession is done for deviation upto 40dioptres.

Bilateral lateral rectus recession with bilateral medical rectus resection done for large deviations . Surgical correction is decided according to severity and using modified parks formula.

Post operative follow up:

Evaluation at 2nd, 6th and 8th week done.

- Visual acuity along with orthoptics done.
- Presence of residual deviation along with binocular evaluation and stereopsis assessed.

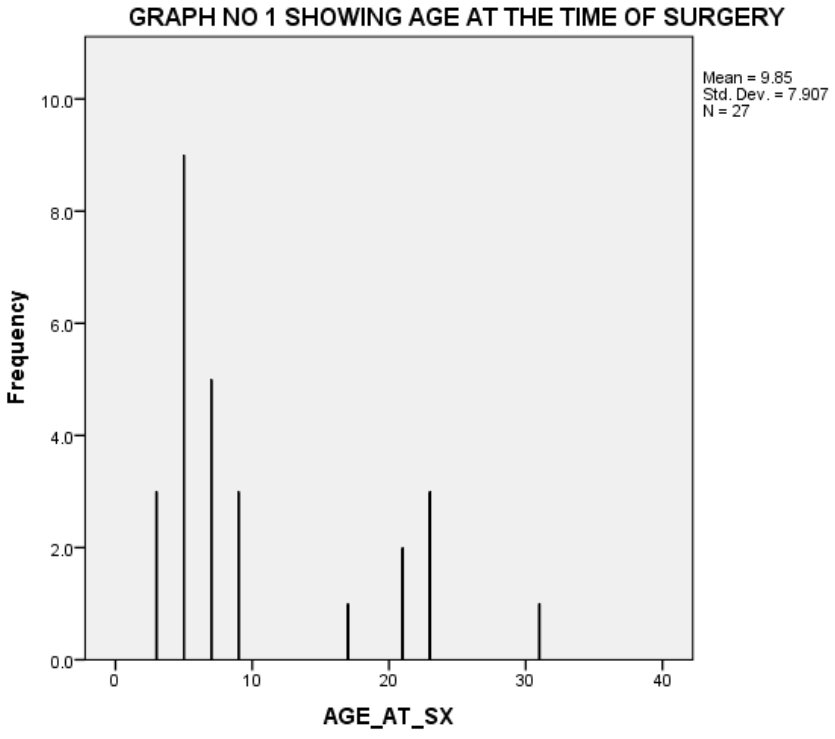
Factors determining outcome such as age of onset, age at surgery , presence of anisometropia , visual acuity , preoperative deviation and surgical correction are computed and results are assessed.

RESULTS AND ANALYSIS OF THE STUDY

DESCRIPTIVE STATISTICS

TABLE NO 1 : SHOWING MEAN AGE AT PRESENTATION

	N	Minimum	Maximum	Mean	Std. Deviation
AGE_AT_SX	27	3.00	30.00	9.8519	7.90669
Valid N (listwise)	27				



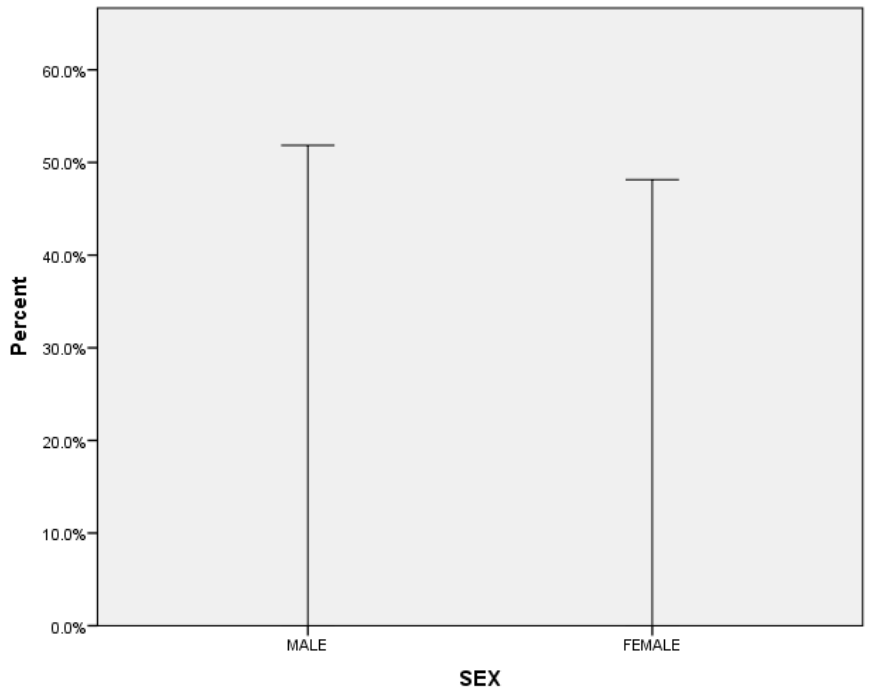
S

The mean age at presentation and surgery is 9.85 years with range of presentation from 3yrs to 30 yrs of age.

TABLE 2: SHOWING GENDER DISTRIBUTION

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	MALE	14	51.9	51.9	51.9
	FEMALE	13	48.1	48.1	100.0
	Total	27	100.0	100.0	

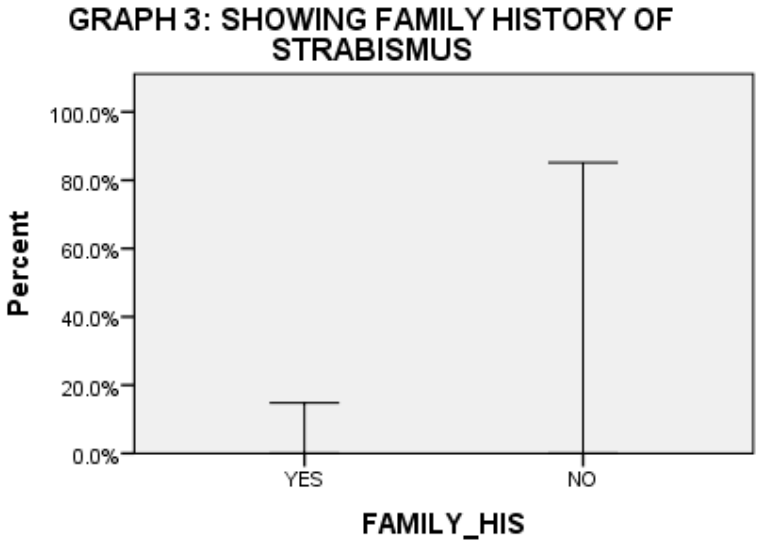
GRAPH 2: SHOWING GENDER DISTRIBUTION



Distribution of exotropia is more in males about 51 % compared to females which is about 48 %.

TABLE 3: SHOWING FAMILY HISTORY OF STRABISMUS

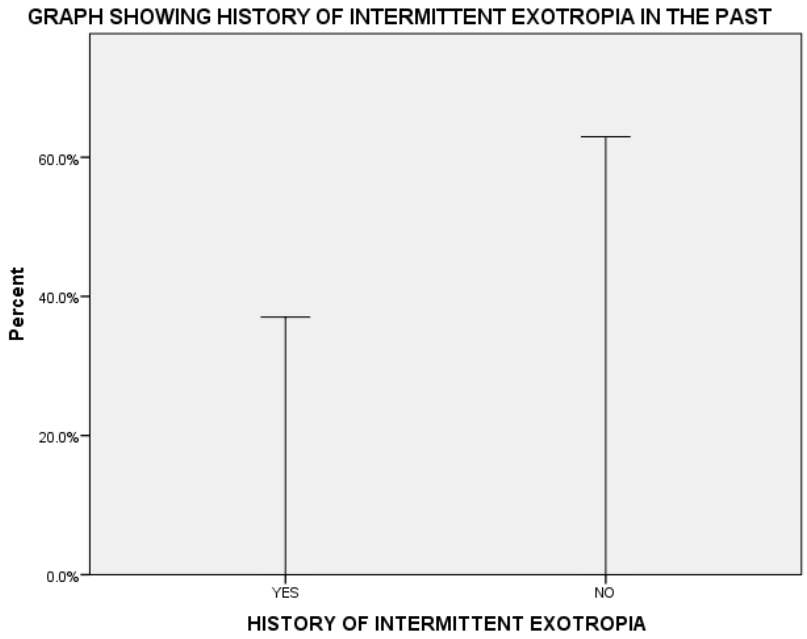
	Frequency	Percent	Valid Percent	Cumulative Percent
YES	4	14.8	14.8	14.8
NO	23	85.2	85.2	100.0
Total	27	100.0	100.0	



About 14 percentage of children with exotropia showed positive family history of strabismus.

TABLE SHOWING :HISTORY OF INTERMITTENT EXOTROPIA

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	YES	10	37.0	37.0	37.0
	NO	17	63.0	63.0	100.0
	Total	27	100.0	100.0	



History of previous intermittent occurrence of exotropia was found in 37 % of children. This showed significant amount of proportion converted to decompensated exotropia from intermittentness.

TABLE 5 SHOWING PRESENCE OF AMBLYOPIA

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	PRESENT	14	51.9	51.9	51.9
	ABSENT	13	48.1	48.1	100.0
	Total	27	100.0	100.0	

AMBLYOPIA is present in 51.9 % of individuals . Amblyopia plays a important role in post operative surgical outcome .

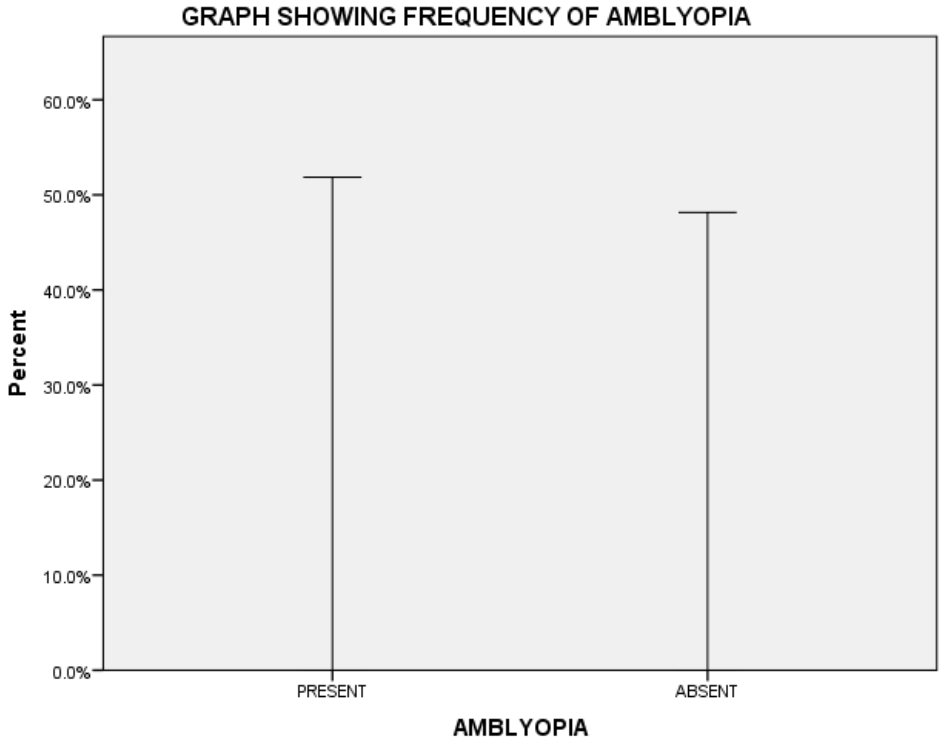
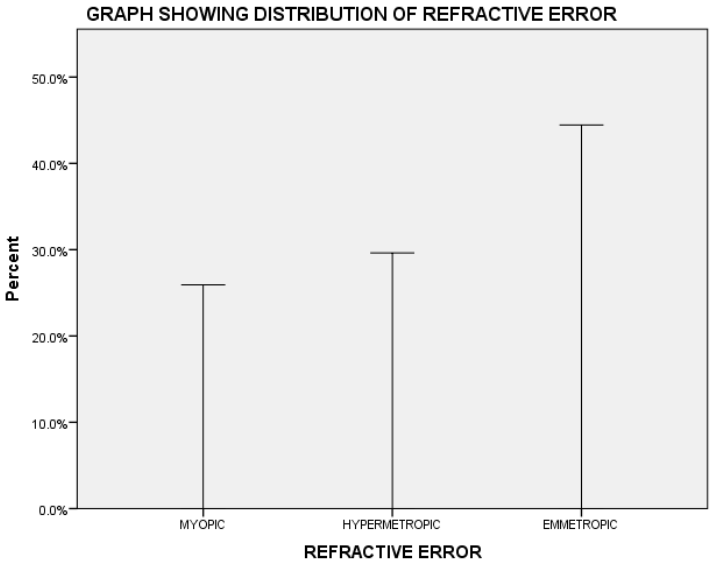


TABLE 6 SHOWING DISTRIBUTION OF REFRACTIVE ERROR

	Frequency	Percent	Valid Percent	Cumulative Percent
MYOPIC	7	25.9	25.9	25.9
HYPERMETROPIC	8	29.6	29.6	55.6
EMMETROPIC	12	44.4	44.4	100.0



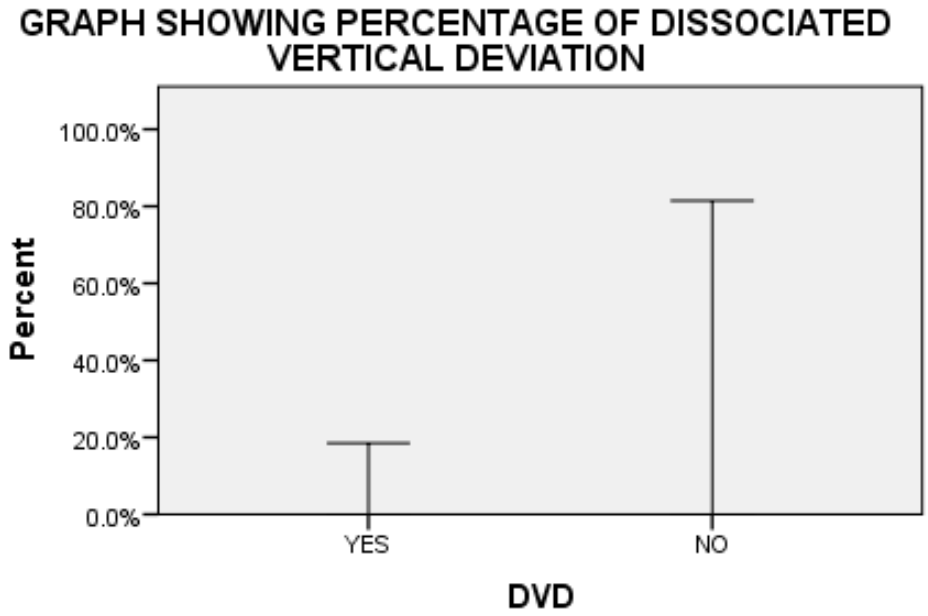
Even though studies showed myopia to be more prevalent in exotropia, our study showed emmetropic distribution to be 44% which is significantly greater than myopic error.

Table 7 : SHOWING FREQUENCY OF DVD

	Frequency	Percent	Valid Percent
YES	5	18.5	18.5
NO	22	81.5	81.5
Total	27	100.0	100.0

TABLE 8: SHOWING FREQUENCY OF SO/IO OVERACTION

	Frequency	Percent	Valid Percent
YES	4	14.8	14.8
NO	23	85.2	85.2
Total	27	100.0	100.0



Dissociated vertical deviation was present in 18 % of children and SO/IO overaction was present in 14 % of exotropias. All DVD and SO/IO overaction showed less than 15 prism dioptre deviation and surgery was not done for it. If the angle exceeds 20 prism dioptres horizontal transposition procedures or R/R procedures can be done.

TABLE 9 : SHOWING FREQUENCY OF ASSOCIATED OCULAR PATHOLOGY

	Frequency	Percent	Valid Percent
YES	3	11.1	11.1
NO	24	88.9	88.9
Total	27	100.0	100.0

TABLE 10 : SHOWING FREQUENCY OF ASSOCIATED SYSTEMIC ILLNESS

	Frequency	Percent	Valid Percent
YES	2	7.4	7.4
NO	25	92.6	92.6
Total	27	100.0	100.0

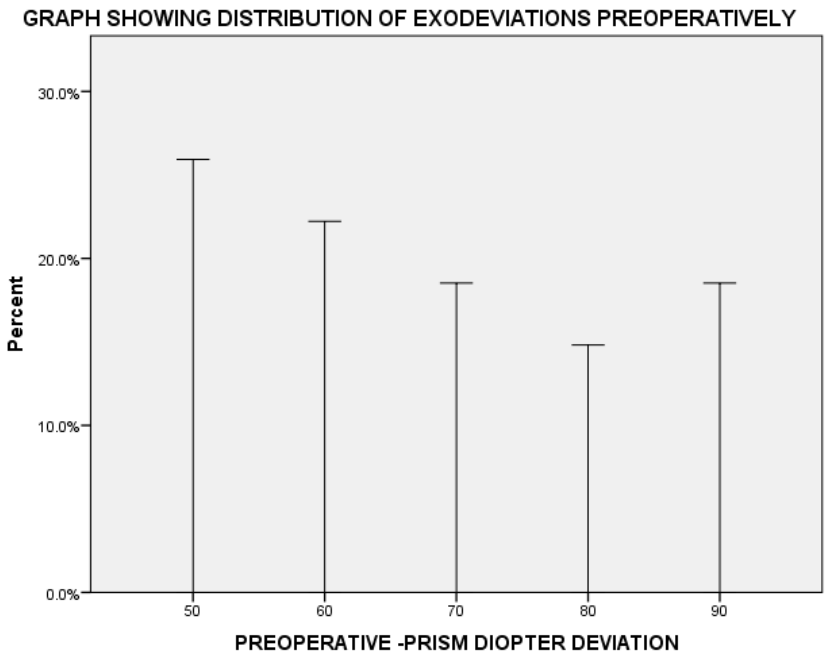
Even though exotropia are associated with systemic pathologies commonly, our study showed only seven percent had systemic pathologies. The commonest pathologies were global development delay.

TABLE 9 SHOWING DESCRIPTIVE VARIABLES OF DISTRIBUTION OF PREOPERATIVE ANGLE OF DEVIATION

	Minimum	Maximum	Mean	Std. Deviation
PREOP_PD	50	90	67.78	14.763

TABLE 10 : SHOWING FREQUENCY OF DISTRIBUTION OF PREOP ANGLE

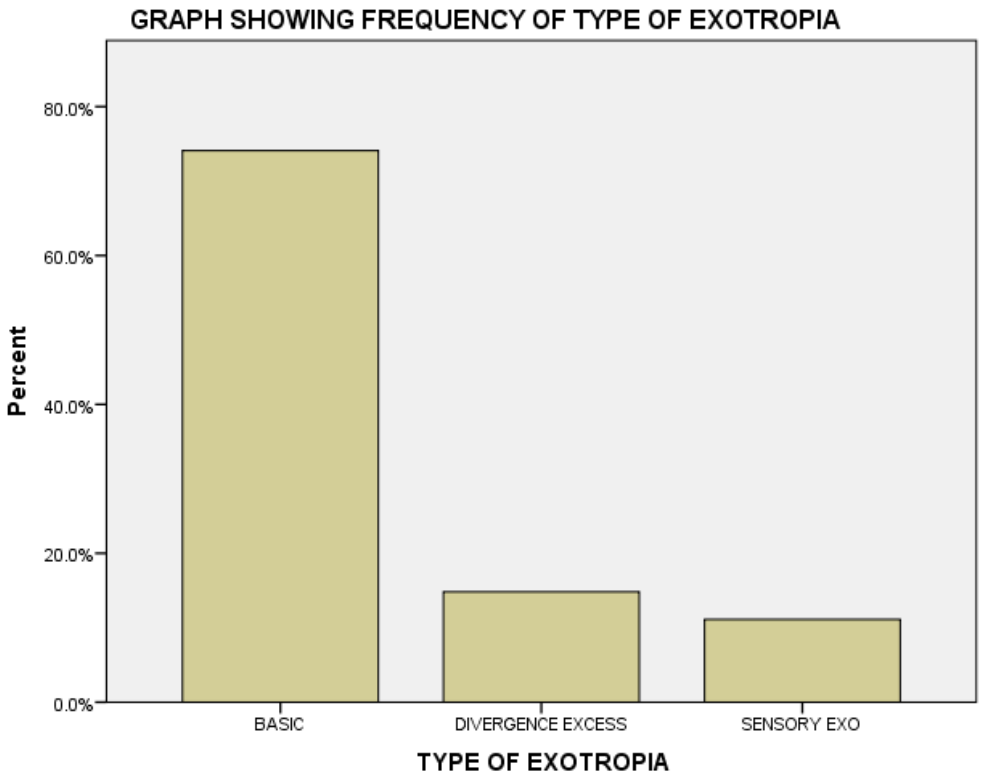
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	50	7	25.9	25.9	25.9
	60	6	22.2	22.2	48.1
	70	5	18.5	18.5	66.7
	80	4	14.8	14.8	81.5
	90	5	18.5	18.5	100.0
	Total	27	100.0	100.0	



The mean angle of preoperative deviation is 67.78 prism diopters. The minimum and maximum angles ranges from 50 to 90 prism diopters. About 25 % of exotropia are in rangle of 50 to 60 prism diopters.

TABLE 11 : SHOWING DISTRIBUTION OF TYPE OF EXOTROPIA

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	BASIC	20	74.1	74.1	74.1
	DIVERGENCE EXCESS	4	14.8	14.8	88.9
	SENSORY EXO	3	11.1	11.1	100.0
	Total	27	100.0	100.0	



Basic type of exotropias predominated about 74 percentage , followed by divergence excess type of about 14.8 percentage. Convergence excess type of exotropias did not present to our clinic.

About 11% percent of exotropias are sensory and are associated with ocular pathology mainly- macular scar, post corneal tear suturing and trauma.

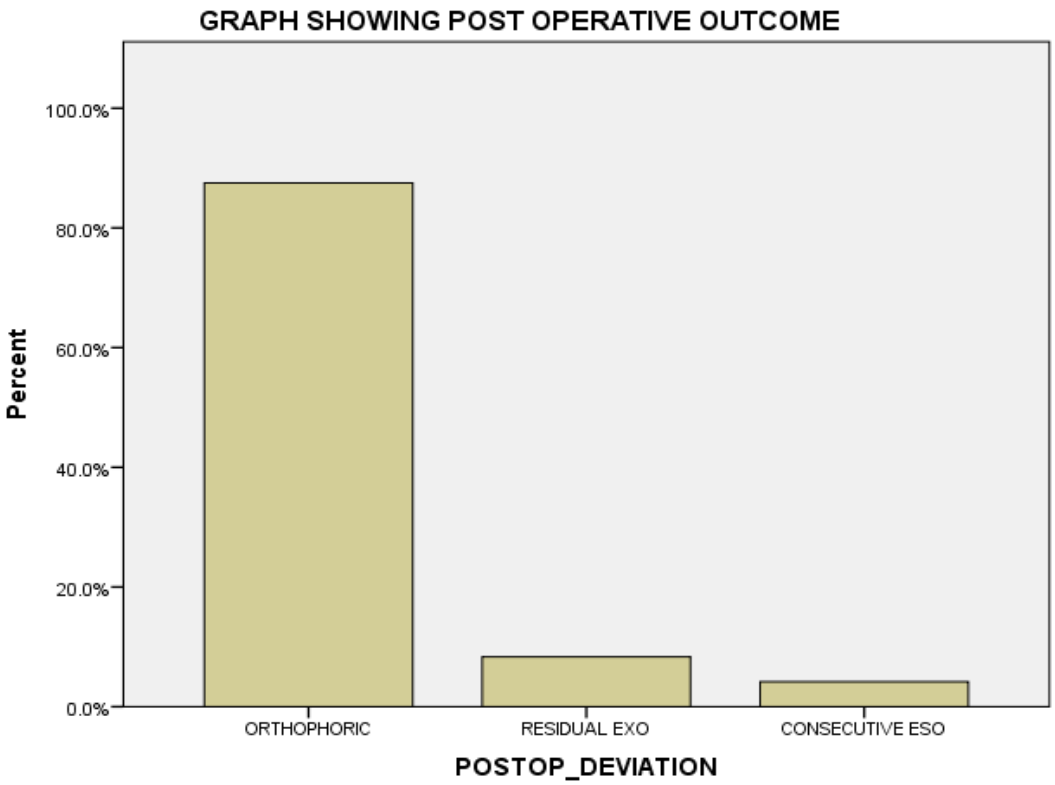


TABLE 12 : SHOWING POSTOPERATIVE SURGICAL OUTCOME

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	9	33.3	33.3	33.3
	5	4	14.8	14.8	48.1
	10	6	22.2	22.2	70.4
	15	4	14.8	14.8	85.2
	20	3	11.1	11.1	96.3
	25	1	3.7	3.7	100.0
	Total	27	100.0	100.0	

TABLE 13: DESCRIPTIVE STATS ON POSTOPERATIVE ANGLE OF DEVIATION

	N	Minimum	Maximum	Mean	Std. Deviation
POSTOP_PD	27	0	25	8.33	7.721
Valid N (listwise)	27				

About 85 .2 percentage of patients are orthophoric . Remaining 14.8 % showed a residual exotropia of less than 25 prism diopters. The mean residual angle of exotropia is about 8.33 prism dioptre.

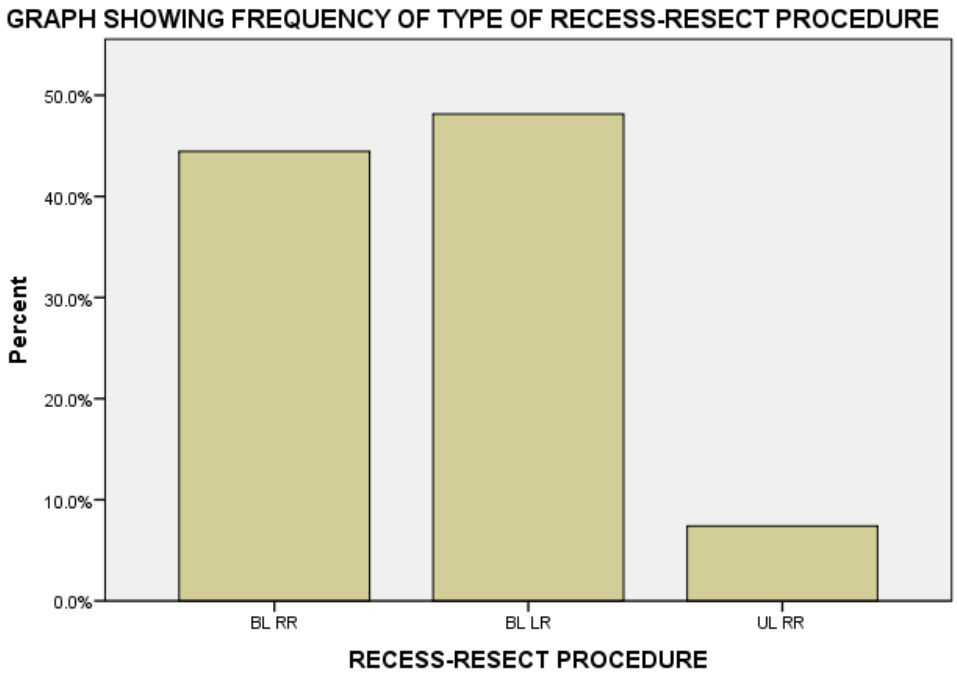


TABLE 14 : DISTRIBUTION OF SURGICAL RR PROCEDURES

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	BL RR	12	44.4	44.4	44.4
	BL LR	13	48.1	48.1	92.6
	UL RR	2	7.4	7.4	100.0
	Total	27	100.0	100.0	

Bilateral lateral rectus recession procedures are done in greater proportions about 48 % followed by bilateral lateral rectus recession with medial rectus resection (four muscle surgery) -44%. Unilateral RR procedures are done for sensory exotropia. Since preoperative prevelance of deviation are more in the range of 50-60PD , bilateral lateral rectus recession procedures have high frequency.

BILATERAL LATERAL RECTUS RECESSION WITH MEDIAL RECTUS RESECTION


BILATERAL LATERAL RECTUS RECESSION


UNILATERAL MR RESECTION WITH LR RECESSION

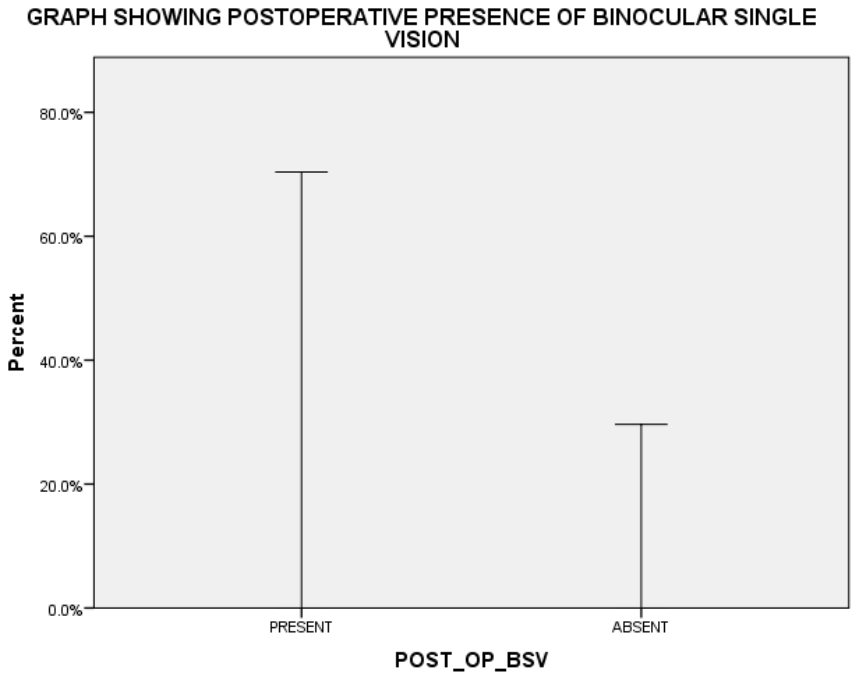



TABLE 15 :SHOWED POSTOP BSV

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	PRESENT	19	70.4	70.4	70.4
	ABSENT	8	29.6	29.6	100.0
	Total	27	100.0	100.0	

70 percent of exotropia have Binocular vision following surgery . There is a negative correlation between preoperative angle of deviation and binocular single vision (r=-0.37). Larger the angle of deviation preop , less possibility of bsv postop but significance is less (p=0.078 About).

TABLE 16: NEGATIVE CORRELATION

BETWEEN BSV AND PREOP PD

		POST_OP_ BSV	PREOP_ PD
POST_OP_ BSV	Pearson Correlation	1	-.348
	Sig. (2-tailed)		.075
	N	27	27
PREOP_PD	Pearson Correlation	-.348	1
	Sig. (2-tailed)	.075	
	N	27	27

ANALYTICAL STATISTICS

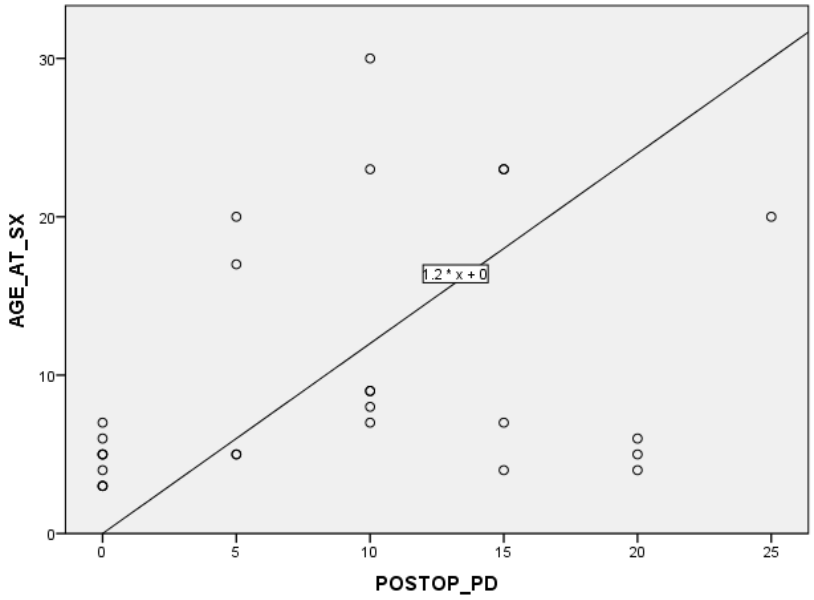
1) CORRELATION BETWEEN AGE AT SURGERY AND POST OPERATIVE ANGLE OF DEVIATION:

TABLE 17: CORRELATION BETWEEN AGE AT SX AND POSTOPERATIVE ANGLE OF DEVIATION

		AGE_AT_SX	POSTOP_PD
AGE_AT_SX	Pearson Correlation	1	.336*
	Sig. (1-tailed)		.043
	N	27	27
POSTOP_PD	Pearson Correlation	.336*	1
	Sig. (1-tailed)	.043	
	N	27	27

*. Correlation is significant at the 0.05 level (1-tailed).

There is a positive correlation between age at the time of surgery and postoperative angle of deviation (r=0.33) with good significance (p= 0.043). Higher the age , there is more chance of residual exotropia.



SCATTER PLOT SHOWING CORRELATION BETWEEN AGE AT THE TIME OF SURGERY AND POST OPERATIVE OUTCOME

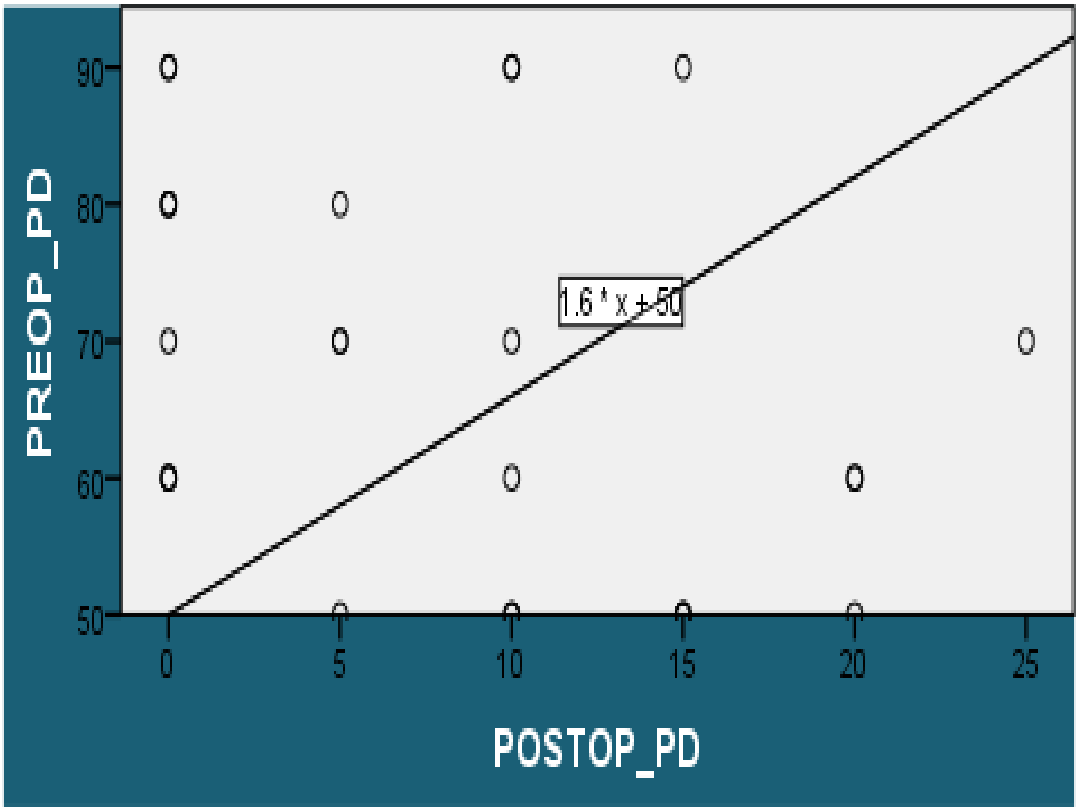
2) CORRELATION BETWEEN PREOPERATIVE DEVIATION AND POST OPERATIVE OUTCOME :

TABLE 18: CORRELATION BETWEEN PREOP AND POST OP ANGLE OF DEVIATIONS

		PREOP_PD	POSTOP_PD
PREOP_PD	Pearson Correlation	1	-.354*
	Sig. (1-tailed)		.035
	N	27	27
POSTOP_PD	Pearson Correlation	-.354*	1
	Sig. (1-tailed)	.035	
	N	27	27

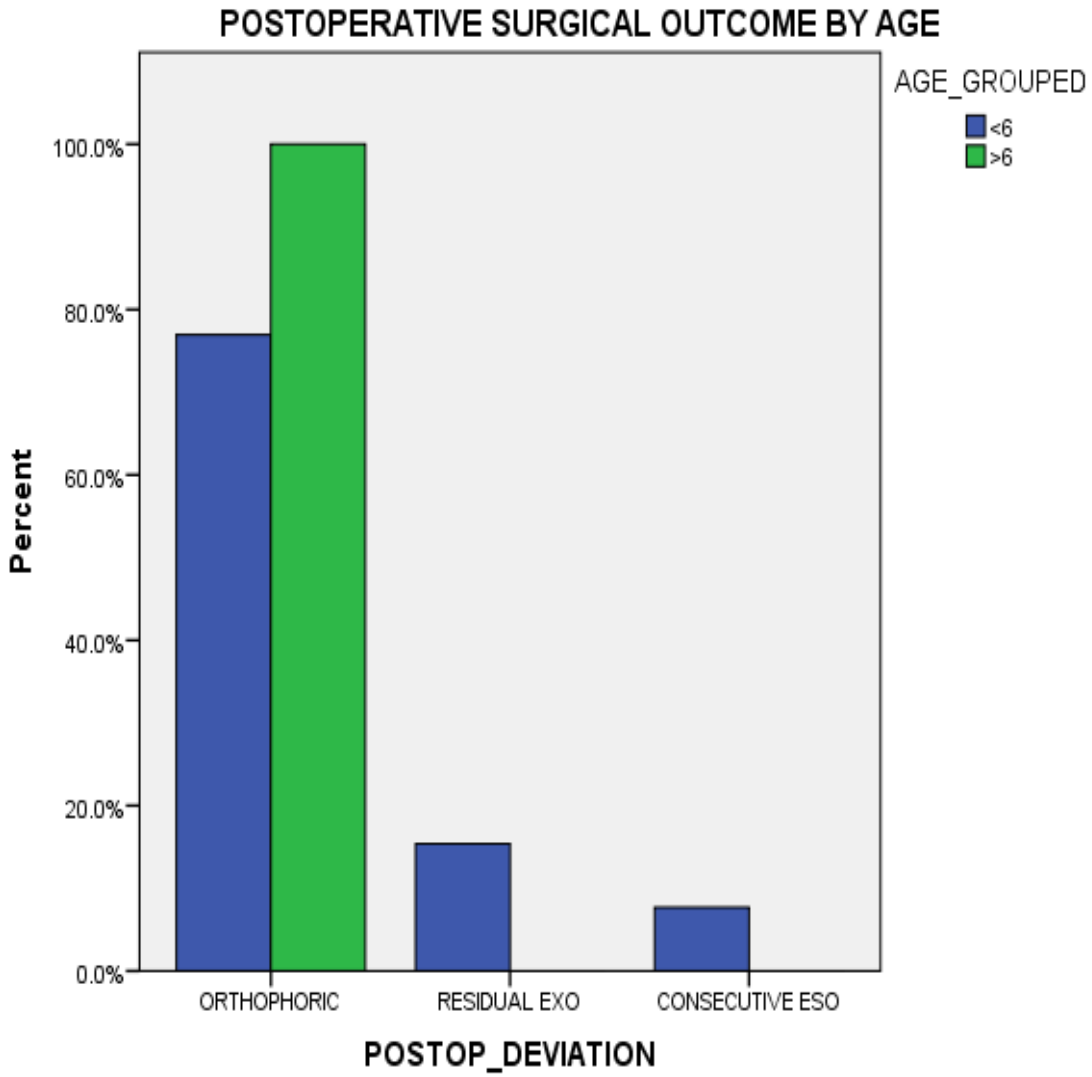
*. Correlation is significant at the 0.05 level (1-tailed).

There is a negative correlation(r=-0.354) between preoperative angle of deviation and post operative surgical outcome. If the preoperative angle is large , post operative deviation is less . Larger the angle , better the outcome (p=0.035)



SCATTER PLOT SHOWING CORRELATION BETWEEN PREOPERATIVE DEVIATION WITH POSTOPERATIVE OUTCOME

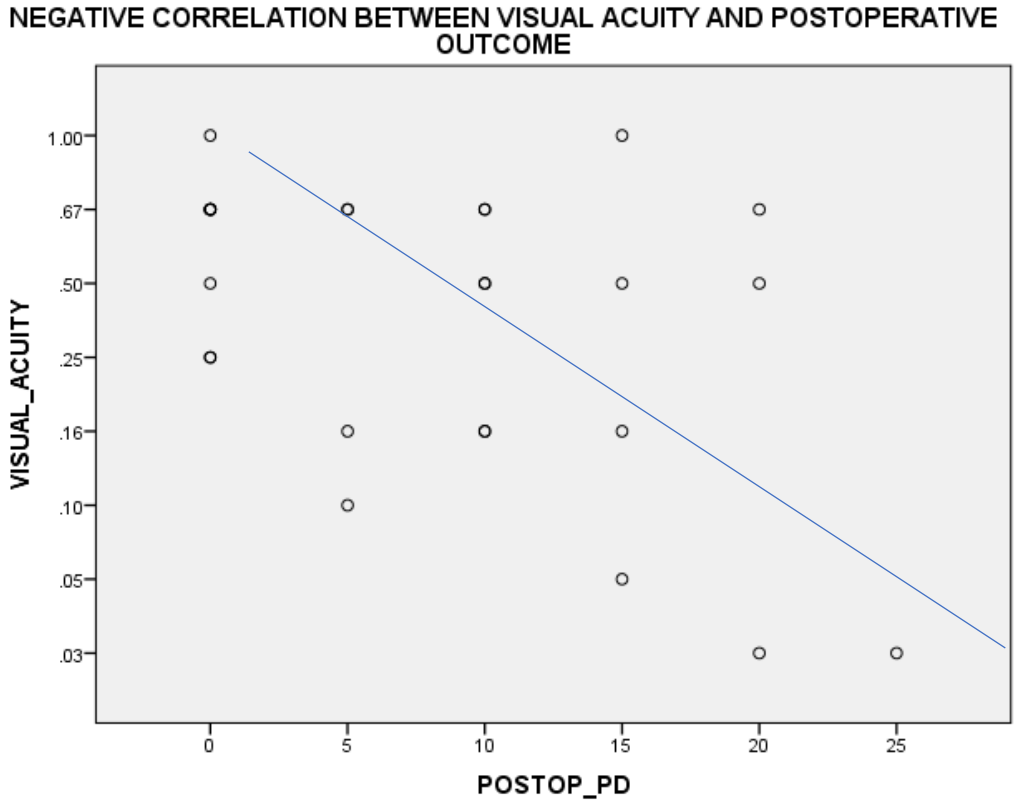
3) Post operative surgical outcome by age :



4) CORRELATION BETWEEN VISUAL ACUITY AND POST OPERATIVE OUTCOME:

TABLE 19: NEGATIVE CORRELATION BETWEEN VISUAL ACUITY AND POSTOPERATIVE OUTCOME

		VISUAL_DECIMAL	POSTOP_PD
VISUAL_DECIMAL	Pearson Correlation	1	-.339
	Sig. (2-tailed)		.083
	N	27	27
POSTOP_PD	Pearson Correlation	-.339	1
	Sig. (2-tailed)	.083	
	N	27	27



There is a negative correlation between visual acuity and postoperative outcome (r=-0.337).

Better the visual acuity , post operative deviation is more. But the significance is less in this correlation.

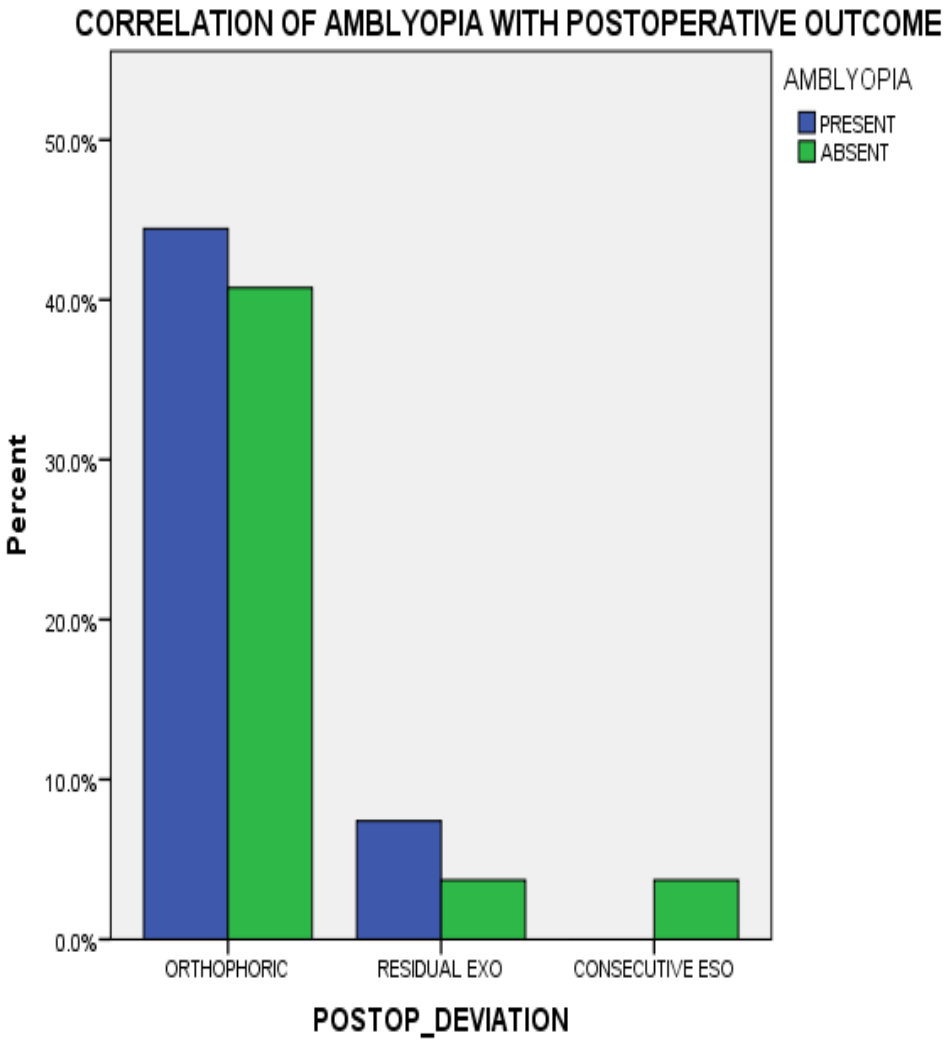
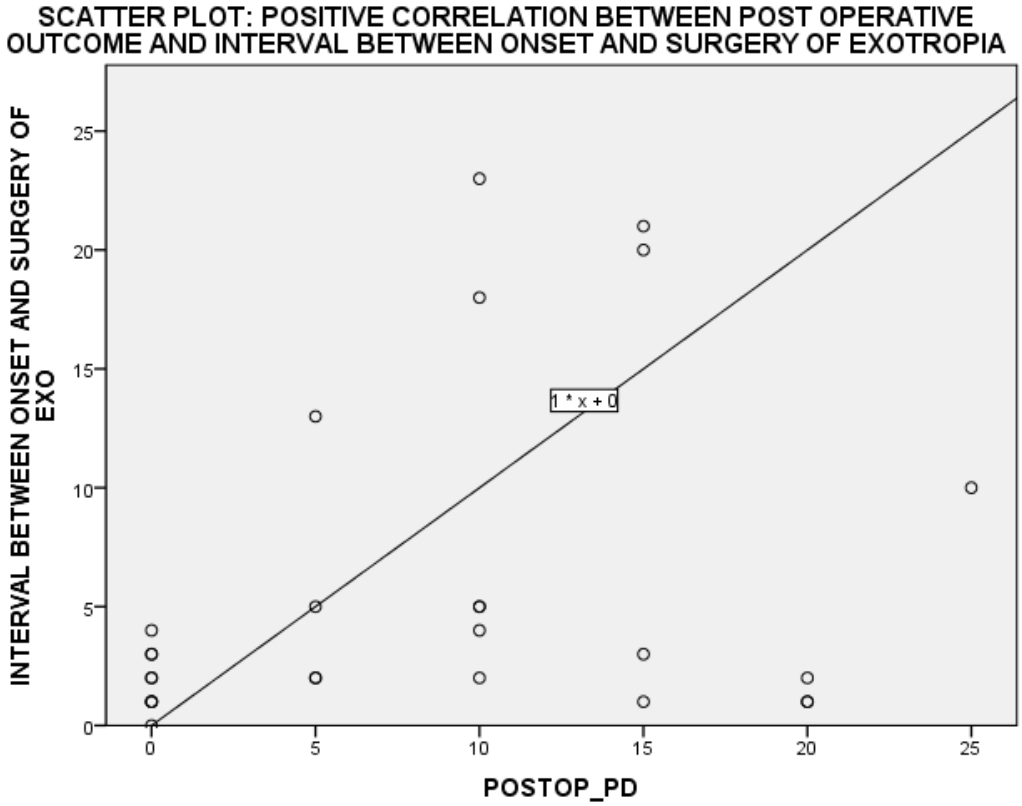

CORRELATION OF AMBLYOPIA WITH POSTOPERATIVE OUTCOME
AMBLYOPIA
PRESENT
ABSENT
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
Percent
ORTHOPHORIC
RESIDUAL EXO
CONSECUTIVE ESO
POSTOP_DEVIATION

TABLE 20: NEGATIVE CORRELATION BETWEEN AMBLYOPIA AND POST OPERATIVE SURGICAL OUTCOME

		POSTOP_PD	AMBLYOPIA
POSTOP_PD	Pearson Correlation	1	-.228
	Sig. (2-tailed)		.252
	N	27	27
AMBLYOPIA	Pearson Correlation	-.228	1
	Sig. (2-tailed)	.252	
	N	27	27

Presence of amblyopia have a better surgical outcome . If amblyopia is more , post operative surgical deviation is less , but its significance is poor.



There is a positive correlation between post operative outcome and interval between onset and surgery of exotropia (r =0.284) but significance is less (p=0.1)

REGRESSION ANALYSIS

By compiling the data values of amount of medial rectus resection and lateral recession with preoperative angle of deviation , there was a strong positive correlation of r=0.8, hence prediction equation using regression analysis was formulated. formula can be used to calculate how much medial or lateral rectus should be recessed or resected with independent variable of pre operative angle of deviation The.

CORRELATION OF MR AND PREOP ANGLE

		PREOP_PD	MR
PREOP_PD	Pearson Correlation	1	.851**
	Sig. (1-tailed)		.000
	N	27	27
MR	Pearson Correlation	.851**	1
	Sig. (1-tailed)	.000	
	N	27	27

**. Correlation is significant at the 0.01 level (1-tailed).

CORRELATION OF LR WITH PREOP ANGLE OF DEVIATION

		PREOP_PD	LR
PREOP_PD	Pearson Correlation	1	.852**
	Sig. (1-tailed)		.000
	N	27	27
LR	Pearson Correlation	.852**	1
	Sig. (1-tailed)	.000	
	N	27	27

**. Correlation is significant at the 0.01 level (1-tailed).

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.373	.652		3.640	.001
	PREOP_PD	.076	.009	.852	8.131	.000

a. Dependent Variable: LR

Y = 0.076 X + 2.37

LR RECESSION = 0.076 X PREOPERATIVE ANGLE +2.37

Instead of using squint surgery chart, this formula can be used.

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-9.803	1.665		-5.887	.000
	PREOP_PD	.195	.024	.851	8.113	.000

a. Dependent Variable: MR

Y = 0.195 X -9.8

MR RESECTION = 0.195 X PREOPERATIVE ANGLE – 9.8 .

But the significance of medial rectus formula is lesser with error of +/-1.8 mm, since the study had more prevalence of lateral rectus recession.

DISCUSSION

The mean age at presentation and surgery of the patients in our study is 9.85 years with range from 3 to 30 years which is nearly compatible with other studies. **.Nusz KJ, Mohney BG and Diehl NN et al**(12)**,** showed a female predominance in exotropia. Contrary to that we had nearly equal preponderance with slight male predilection of about 51.9 %. The family history of strabismus was found to be 14.8 %. Significant amount of patients had previous history of intermittency before shifting to decompensation of about 3 % .

Amblyopia is present in about 51.9 percent of the exodeviation which is quite higher compared to other studies.

Even though previous bibliography stated myopia is more prevalent in exotropia, recent studies especially **Hanan S. Hegazy et al**(5), showed emmetropia to be prevalent which is consistent with our study -44%.

Dissociated vertical deviation and so/io overaction was found to be less than 20 PD and was not operated in our study. The frequency was about 18 % and 14% respectively. If angle of deviation was more than 20 PD , transposition of horizontal rectus muscles can be done or recess resect procedure can be done.

Frequency of systemic illness associated with exodeviation was about 7 % and the most common pathology is global developmental delay followed by hypoxic ischemic encephalopathy sequalae.

Ocular pathology constitutes about 11 percent and the most common etiology include trauma followed by macular scar leading to sensory exotropia.

Ivan Lai Yoon Kit et al(7) **,** showed a mean preoperative angle of 50.67 PD, which is nearly consistent with our study. The minimum and maximum angle ranges from 50 to 90 prism diopters. About 25 % of exotropia are in range of 50 to 60 prism diopters.

U.A. Faridi, T.A. Saleh et al(8) **,** showed basic type of exotropia to be prevalent which is consistent with our study . Our study showed a frequency of 74 percent for basic exodeviation which is predominant followed by divergence excess exodeviation.

Ivan Lai Yoon Kit et al and U.A. Faridi, T .A. Saleh et al showed a surgical success rate of 67% and 71% respectively. Our study shows a success rate of 85.2 % . Remaining 14.8% showed residual exotropia of less than 20 PD . The mean residual angle is about 8.33 PD.

Bilateral lateral rectus recession procedures are done in greater proportions about 48 % followed by bilateral lateral rectus recession with medial rectus

resection (four muscle surgery) -44%.Bilateral lateral rectus recession are done for exotropia less than 50 PD and those who have divergence excess type .Four muscle surgeries are preferred for deviations more than 70PD . Unilateral RR procedures are done for sensory exotropia. Since preoperative prevelance of deviation are more in the range of 50-60PD , bilateral lateral rectus recession procedures have high frequency.

70 percent of exotropia have Binocular vision following surgery. There is a negative correlation between preoperative angle of deviation and binocular single vision (r=-0.37). Larger the angle of deviation preop , less possibility of bsv postop but significance is less (p=0.078).

Sathyan et al(11)**,** showed a better ocular alignment post op following surgical correction of age between 4 to 12 years of age. Our study showed a positive correlation of age at the time of surgery and postoperative angle of deviation with good significance. Higher the age , more chance of residual exotropia.

Sathyan et al, Ivan Lai Yoon Kit et al , U.A. Faridi, T .A. Saleh et al, Hanan S. Hegazy et al -all of them showed a good correlation between preoperative angle and post operative angle of deviation. Larger angle showed better surgical outcome with higher significance.

Lie et al (13)**,** showed poorer visual acuity and amblyopia had better post operative visual outcome which is consistent with our study . There is a negative correlation between visual acuity and postoperative outcome (r=-0.337).

Better the visual acuity , post-operative deviation is more. But the significance is less in this correlation.

We had compiled data values of amount of medial rectus resection and lateral recession with preoperative angle of deviation , there was a strong positive correlation of r=0.8, hence prediction equation using regression analysis was formulated which is used to calculate amount of medial or lateral rectus to be recessed or resected can be calculated .

The formula for lateral rectus recession showed a better significance compared to medial rectus. Since the amount of surgical correction differs by a straddling amount from modified parks formula, this formula has been proposed from our previous surgical dose data.

CONCLUSION

SURGICAL ALIGNMENT of primary exotropia showed a satisfactory post-operative orthophoric outcome of about 85 %. Age at the time of surgery and preoperative angle of deviation have positive correlation with post-operative surgical outcome with good significance. Poor visual acuity and amblyopia have a better surgical outcome but significance is poor in our study. The use of lateral rectus recession regression formula is found to have significant results . Since medial rectus resection have been done quite lesser compared to lateral rectus recessions in our study due to high prevalence of deviations less than 60pd, there is a lesser significance and error of 1.8mm using medial rectus regression formula. We need more data and sample size to work subsequently on this regression analysis.

LIMITATION OF OUR STUDY :

More amount of data samples is needed for comparing further more variables and for proving significance. For refinement of the regression formula , to mitigate the errors , we need further data samples to evidence significant derivation of formula.

PART - 3

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PROFORMA

Name Squint Clinic No.

Address Date

Age Unit

Sex OP/IP No.

Complaints:

Duration:

History :

Age on Onset

Progression

Growth & Development.

Mile Stones

Past History:

Previous Treatment : Glasses / Medical/ Orthoptic / Surgery

Birth History : Birth Weight

Type of Delivery : Normal / Forceps / Caesarian/Premature

Family History : Consanguinity

Family h/of Glaucoma/ Diabetes / Squint / Refr. Error./Other Eye Diseases

Examination of Patients :

General Examination:

Systemic Examination : CNS

RS

CVS

Abdomen

<u>Ophthalmic Examination</u>:

Epicanthic fold / Ptosis

Head Posture

Nystagmus

Ocular Movements

Abduction limitation

Cross Fixation

A & V – Pattern

DVD

Hirschberg's test

Cover test

- Cover uncover test
- Alternate cover test

Prism Cover Test

Angle of deviation - Distance

Near

Various positions of Gaze

Worth Four Dot Test

Distance

Near

Maddox Wing Test

Maddox Tangent Screen

Convergence

Accommodation

SYNOPTOPHORE

Angle of Deviation

	Without Glasses	With Glasses
FR		
FL		

Status of BSV

SMP

Fusion

Stereopsis

Fusional Range	Abduction	Adduction
V/A	With Glasses	Without Glasses

Retinoscopy

Fundus & Fixation

Amblyopia

Diagnosis

Advice – Glass / Medical / Orthoptic / Surgical

Plan of surgery

Procedure Done

Post Operative Followup

Immediate Post OP

Angle of Deviation

BSV – Status

One Month

Six Months

Post Op Treatment

Pre Op Photograph Post Op Photograph

MASTER CHART

NAME	AGE_AT_SX	AGE_GROUPED	SEX	FAMILY_HIS	HIS_INTEXO	AGE_PRESENTATION	BSV_PREOP	SPHERICAL_EQUI	AMBLYOPIA	INTERVAL_BETWEEN	DVD	IO_SO_OVERACTION	IPD	OCULAR_PATHOLOGY	SYSTEMIC_ILLNESS	VISUAL_ACUITY	VISUAL_DECIMAL	PREOP_PD	POSTOP_PD	POST_OP_BSV	CONSECUTIVE_ESO	RR	MR	LR	TYPE_EXO	POSTOP_DEVIATION
DHARSHAN	5.00		1	2	2	1	2	2	2	3	2	2	43	2	2	6/9	.67	80	0	1	2	1	6	8	1	1
PREETHI	23.00		2	1	1	3	2	1	1	20	1	1	56	2	2	6/36	.16	90	15	1	2	1	7	9	1	1
RAJESH	20.00		1	2	2	10	2	1	1	10	2	2	54	1	2	2/60	.03	70	25	2	2	3	7	9	4	2
MYTHREAN	7.00	2.00	1	1	1	3	2	3	2	4	1	1	47	2	2	6/9	.67	60	0	1	2	2	0	7	1	1
DHAKSHAN	5.00	1.00	1	2	2	3	2	2	2	2	2	2	45	2	2	6/12	.50	50	20	2	2	2	0	6	1	2
PRIYANKA	6.00	1.00	2	2	2	4	2	3	1	2	2	2	46	2	2	6/24	.25	80	0	1	2	1	6	8	1	1
BENNY	17.00	2.00	1	2	1	4	2	1	1	13	1	2	50	2	2	6/36	.16	80	5	1	2	1	7	9	1	1
VARSHITHA	7.00	2.00	2	2	2	4	2	2	1	3	2	2	43	2	2	6/12	.50	50	15	2	2	2	0	7	2	1
AJITH	3.00	1.00	1	2	1	2	2	1	1	1	2	2	43	2	2	6/12	.50	90	0	1	2	1	8	10	1	1
MEERA	30.00	2.00	2	2	1	7	2	3	1	23	2	2	55	2	2	6/36	.16	90	10	2	2	1	7	9	1	1
HARINI	7.00	2.00	2	1	2	5	2	3	2	2	2	2	45	2	2	6/9	.67	60	10	1	2	2	0	6	1	1
DEVRAJ	3.00	1.00	1	2	2	2	2	2	2	1	2	2	43	2	2	6/9	.67	70	0	1	2	1	6	8	1	1
IYYAPPAN	23.00	2.00	1	2	1	2	2	2	2	21	1	1	56	2	2	6/6	1.00	50	15	2	2	2	0	6	1	1
LAVANYA	5.00	1.00	2	2	2	3	2	3	2	2	2	2	42	2	2	6/9	.67	70	5	1	2	2	0	7	2	1
MAHESHWARI	4.00	1.00	2	2	2	4	2	3	2	1	1	1	45	2	2	6/9	.67	60	20	2	1	2	0	9	1	3
RUBINI	5.00	1.00	2	2	1	5	2	2	1	3	2	2	45	2	2	6/24	.25	90	0	1	2	1	6	9	2	1
MARIYA	9.00	2.00	2	1	1	5	2	1	1	4	2	2	49	2	2	6/12	.50	50	10	1	2	2	0	6	1	1
SHARATH	20.00	2.00	1	2	2	17	2	3	1	5	2	2	53	1	2	6/60	.10	70	5	1	2	1	7	9	4	1
SUSHMITHA	23.00	2.00	2	2	2	5	2	2	1	18	2	2	55	2	2	6/36	.16	90	10	1	2	1	7	9	1	1
BALMURI	4.00	1.00	2	2	2	3	2	3	1	1	2	2	40	2	1	3/60	.05	50	15	2	2	2	0	7	2	1
SANTHOSH	6.00	1.00	1	2	2	5	2	3	1	1	2	2	40	1	2	2/60	.03	60	20	2	2	3	6	8	4	2
SHAKTHI	3.00	1.00	1	2	2	3	2	3	2	0	2	2	36	2	1	6/6	1.00	60	0	1	2	2	0	7	1	1
KEVIN	5.00	1.00	1	2	1	3	2	2	2	2	2	2	39	2	2	6/9	.67	50	5	1	2	2	0	6	1	1
HARSHINI	9.00	2.00	2	2	2	4	2	1	1	5	2	2	39	2	2	6/12	.50	70	10	1	2	1	6	7	1	1
HENRY	8.00	2.00	1	2	2	3	2	3	2	5	2	2	45	2	2	6/9	.67	50	10	1	2	2	0	6	1	1
SINDHU	4.00	1.00	2	2	1	3	2	3	2	1	2	2	39	2	2	6/9	.67	80	0	1	2	1	7	9	1	1
PUNITH	5.00	1.00	1	2	2	3	2	1	2	2	2	2	40	2	2	6/9	.67	60	0	1	2	2	0	7	1	1

KEY TO MASTER CHART

1) AGE GROUPED – VALUES 1- age less than 6 years 2-age more than 6 years.
2) SEX -VALUES 1 – male 2- female
3) FAMILY HISTORY 1- present 2- absent.
4) HISTORY OF INTERMITTENT EXOTROPIA 1- present 2 – absent.
5) AGE AT ONSET
6) BSV BEFORE SURGERY 1 – present 2- absent.
7) SPHERICAL EQUIVQLENT 1- myopia 2- hypermetropia 3- emmetropia.
8) AMBLYOPIA
9) INTERVAL BETWEEN ONSET AND SURGERY.
10) DVD 1- present 2- absent
11) SO/IO OVERACTION 1- present 2- absent.
12) OCULAR PATHOLOGY 1- present 2- absent
13) SYSTEMIC ILLNESS 1- present 2 – absent
14) VISUAL ACUITY
15) VISUAL DECIMAL – 6/6 -1 6/9 0.67 6/12 0.5 6/ 36- 0.16 6/24- 0.25
16) PREOPERATIVE PRISM DIOPTER.

17) POSTOPERATIVE PRISM DIOPTER.

18) POST OPERATIVE BSV.

19) CONSECUTIVE ESOTROPIA

20) RESECT RECESS PROCEDURE

1- bilateral lateral rectus recession.

2- bilateral lateral rectus recession with medial rectus resection.

3- unilateral medial rectus resection with lateral recession.

21) MR / LR – amount of mr / lr resected or recessed.

22) TYPE OF EXOTROPIA – 1- basic 2- divergence excess 3- convergence excess 4- sensory exotropia.

23) POST OPERATIVE DEVIATION – 1- orhophoric 2- residual exotropia 3- consecutive esotropia.