

# MANAGEMENT OF STRABISMUS & AMBLYOPIA 2010

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# Overview Part 1

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- Why strabismus happens
- When / why to treat
- How to treat

# Overview Part 2

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## ■ Amblyopia: Causes and treatment

## ***CORE SLIDE:***

# **Requirements of a perfect visual system**

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- 1. Straight eyes
- 2. Good & equal vision
- 3. No or low-&-symmetric refractive error
- 4. Normal EOM anatomy / physiology
- 5. Normal occipital lobe physiology

required for normal motor fusion, normal sensory fusion

- 6. Normal visual pathways
- 7. Normal early visual development

# STRABISMUS: END RESULT OF ANY IMPERFECTION IN A COMPLEX JIGSAW PUZZLE

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Abnormalities in one / more of...

- Sensory development
- Refraction
- Orbital anatomy
- EOM anatomy / physiology
- Cortical / supranuclear anatomy, function and development
- Accommodation / convergence

..either cause or are caused by strabismus

# TIME DEPENDENT RESULTS:

*IF YOU HAVEN'T FIXED IT IN 3 MONTHS, REFER*

- You WILL in your career see children with visual loss that is reversible **only** with timely & effective treatment
- Delay in starting effective treatment can have negative life-long outcomes

# 2 STEP MANAGEMENT OF STRABISMUS

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## 1. Straighten the eyes

- **Optically**

- Botox – infrequent option

- **Surgically**

## 2. Improve /equalize acuity

# WHY Straighten the eyes?

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Age < 6mo:

- Best chance for some sensorimotor fusion
- Normal appearance
- ↓↓ risk of amblyopia



# WHY Straighten the eyes?

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Age 3-7:

- Best chance for sensorimotor fusion
- Normal appearance & psychosocial devt
- Better motor skills
- ↓↓ risk of amblyopia

# Age 3-7: Better motor skills

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**Motor coordination in children with congenital strabismus: Effects of late surgery**

[Caputo R](#) .... [Frosini R](#)..... Florence. [Eur J Paediatr Neurol](#). 2007 Mar 31

**... surgical correction of strabismus after age 4 improves general motor function & coordination.**

# Stereo vision enhances the learning of a catching skill.

Montagne G et al Exp Brain Res. 2007 Jun;179(4):723-6.

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- Poor catchers with good (N = 8; Stereo+) and weak (N = 6; Stereo-) stereo participated in an intensive training program over 2w, during which they caught >1,400 tennis balls.
- Stereo+ : improved 18% to 59%
- Stereo- : 10 to 31% - not significant - similar to control group (N = 9) that did not practice at all.

# MAXIMUM READING SPEED

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- ..better with straight eyes

# WHY Straighten the eyes?

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Age >10:

- Best chance to regain some sensory fusion
- Normal appearance / social interactions
- Better field [if ET; worse if XT]

See AAPOS website [www.aapos.org](http://www.aapos.org)

‘Adult Strabismus’

# Opinions of dating agents about strabismic subjects' ability to find a partner

S M Mojon-Azzi,<sup>1</sup> W Potnik,<sup>2</sup> D S Mojon<sup>3</sup>

2008;92;765-769

*Br. J. Ophthalmol.*

## ABSTRACT

**Aims:** To determine the influence of strabismus on the ability to find a partner.

**Methods:** We interviewed Swiss dating agents retrieved from two Swiss online telephone directories using a validated questionnaire to determine whether strabismus has any impact on the ability to find a partner. During the interviews, subjects with internet access could view downloadable, digitally altered photographs of a strabismic man and women, as well as images of other computer-generated facial anomalies.

**Results:** Of the 40 dating agents, 92.5% judged that strabismic subjects have more difficulty finding a partner ( $p < 0.001$ ). Such difficulty was not associated with either gender or age but was perceived as being greater in exotropic than in esotropic persons ( $p < 0.001$ ). Among the seven facial disfigurements, strabismus was believed to have the third largest negative impact on finding a partner, after strong acne and a visible missing tooth. Dating agents also believed that potential partners perceive persons with strabismus as significantly less attractive ( $p < 0.001$ ), erotic ( $p < 0.001$ ), likeable ( $p < 0.001$ ), interesting ( $p < 0.001$ ), successful ( $p < 0.001$ ), intelligent ( $p = 0.001$ ) and sporty ( $p = 0.01$ ).

**Conclusions:** Visible strabismus negatively influences the ability to find a partner. Because strabismus surgery in adults restores a normal functioning condition and reduces not only physical but also psychosocial difficulties, it cannot be considered a cosmetic procedure.

distress, particularly during social interactions that expose the disfigurement to others' gaze and can result in displays of ignorance and negative comments.

The psychosocial problems experienced by strabismic individuals are similar to those of persons with other craniofacial anomalies. Jackson *et al*<sup>6</sup> measured anxiety and depression, social anxiety and QoL 6 weeks before and 3 months after strabismus surgery. The researchers found not only that strabismic individuals experience greater social anxiety and use more social avoidance strategies but that these subject's scores reduce to normal levels following surgery. This finding of strabismus negative impact was confirmed by Satterfield *et al*,<sup>7</sup> who found evidence of problems related to strabismus during school, work, play or sports in subjects over age 14. Nonetheless, the authors identified no difference in the amount of psychosocial impairment between esotropic and exotropic subjects. In a similar study, Menon *et al*<sup>8</sup> showed that patients aged 15–25 who had had a constant squint since childhood had difficulties with self-image and interpersonal relationships, faced ridicule at school and work, and generally avoided activities that brought attention to their defect. Burke *et al*<sup>9</sup> showed that strabismus surgery reduced the psychosocial difficulties reported before surgery and improved the quality of psychosocial functioning. Beauchamp *et al*<sup>10</sup> also

Figure 1. Photographs of a man and woman with and without seven computer-generated facial anomalies. Subject consent has been obtained for publication of this figure.





# WHEN to straighten the eyes?

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**Kids:** should be realigned within **4mo** of constant misalignment to regain best sensorimotor fusion

**Adults:** ...  $\leq$  **12mo** of constant misalignment to frequently regain measurable sensorimotor fusion



# Clues to the causes of strabismus

1

genetic

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Frequent strabismus :

- William's syndrome 75% have congenital ET Chrom 7

⇒ **genetic factor**

# Clues to the causes of strabismus

2:

neurological

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## Frequent strabismus :

1. Neonatal brain injury [IVH / HC]  
75% $\Rightarrow$  acquired/ neurological factors
2. Developmental delay of any sort:  
[genetic / acquired ] 25%

# Clues to the causes of strabismus

3

## genetic & orbital

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### **Comitant Horizontal Strabismus: an Asian**

**perspective.** [Chia A, et al](#) . [BJO](#). 2007 May 2; Singapore.

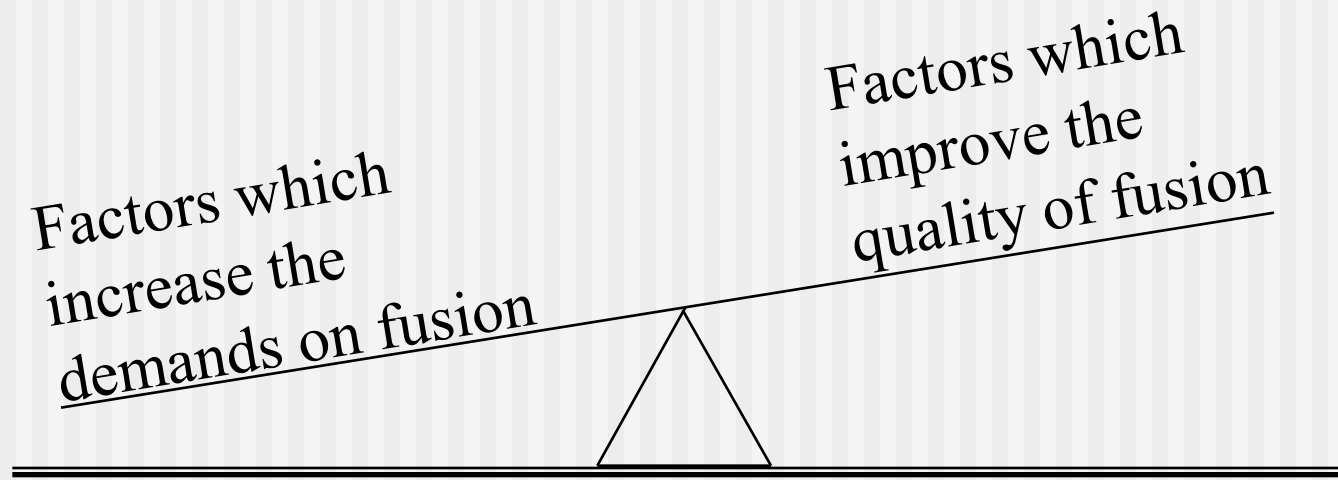
2ce as many Singaporean children  
present with XT than ET

Caucasians ET >> XT.

Within the XT and ET groups, the distribution and characteristics and treatment responses of various strabismus subtypes are similar to Caucasians

# CORE SLIDE: Non- syndromic / non- neurological causes of strabismus

- Strabismus develops due to an imbalance between two groups of factors



If this side is heavier,  
there will be strabismus

If this side is heavier, there  
will be no strabismus

# Factors which increase the demands on fusion

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- Hyperopia
- Abnormal AC / A

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Hyperopia is present in a small proportion of children age 6-12 mo... ethnicity affects prevalence...higher in certain subgroups...esp. family history of hyperopia or accommodative ET.

**20% of hyperopic infants ⇒ esotropia**

# Ingram UK

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- $\geq + 3.50$  DS in one axis @ age 12 mo:
- 50% risk of strabismus / amblyopia

# Early prophylactic spectacle correction of hyperopia:

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- fails to prevent strabismus in 3/4 studies
- ↓↓ incidence of strabismus in 1 study
- improves acuity outcomes in 2 studies [by 1 investigator].



# Factors which increase the demand on fusion 2

## Abnormal Accom - Conv relationship

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- Accom → too much convergence, or
- Conv → too much accommodation
- The types of abn Accom- Conv relationship [high AC/A ratio, abn CA/C ratio, proximal convergence, proximal fusion,..] do have precise definitions, but common usage is not precise.
- USA: high AC/A = near eso > distance eso by  $\geq 10\Delta$
- All these subtypes have **same 'final common pathway'**.
- LK preference: **convergence excess** as synonym for all of these terms.

# Abnormal Accom - Conv relationship

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- Presbyopia

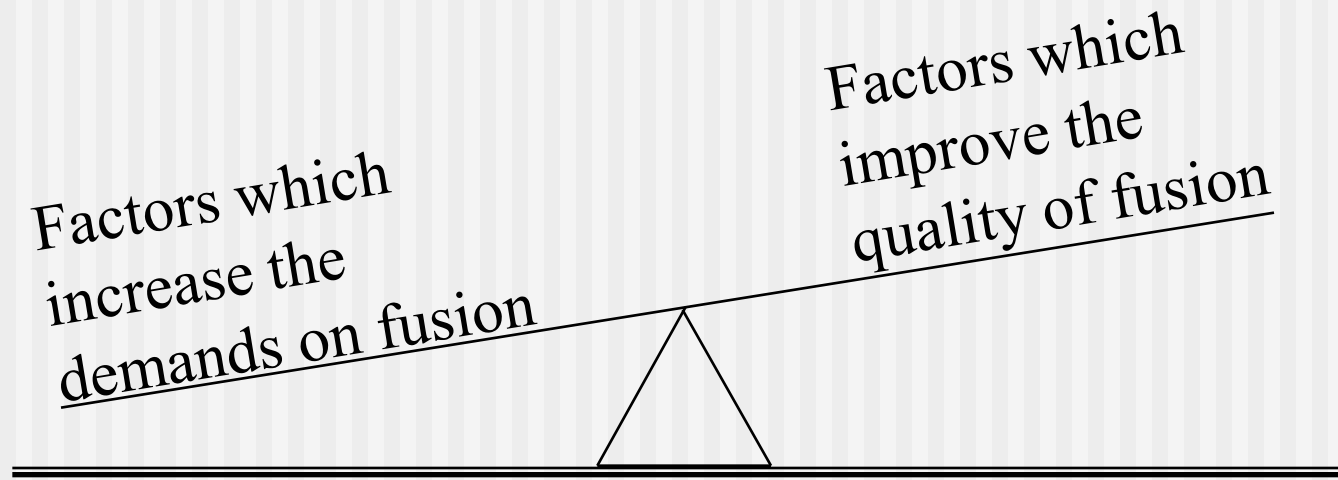
Another age where accommod ET can be seen

- Drugs which interfere with accommodation e.g. Ditropan

Parents don't think of mentioning an enuresis [bed wetting] tablet to the eye Dr

# Factors which decrease the quality of fusion

- Strabismus develops due to an imbalance between two groups of factors



If this side is heavier,  
there will be strabismus

If this side is heavier, there  
will be no strabismus

# Factors which decrease the quality of fusion

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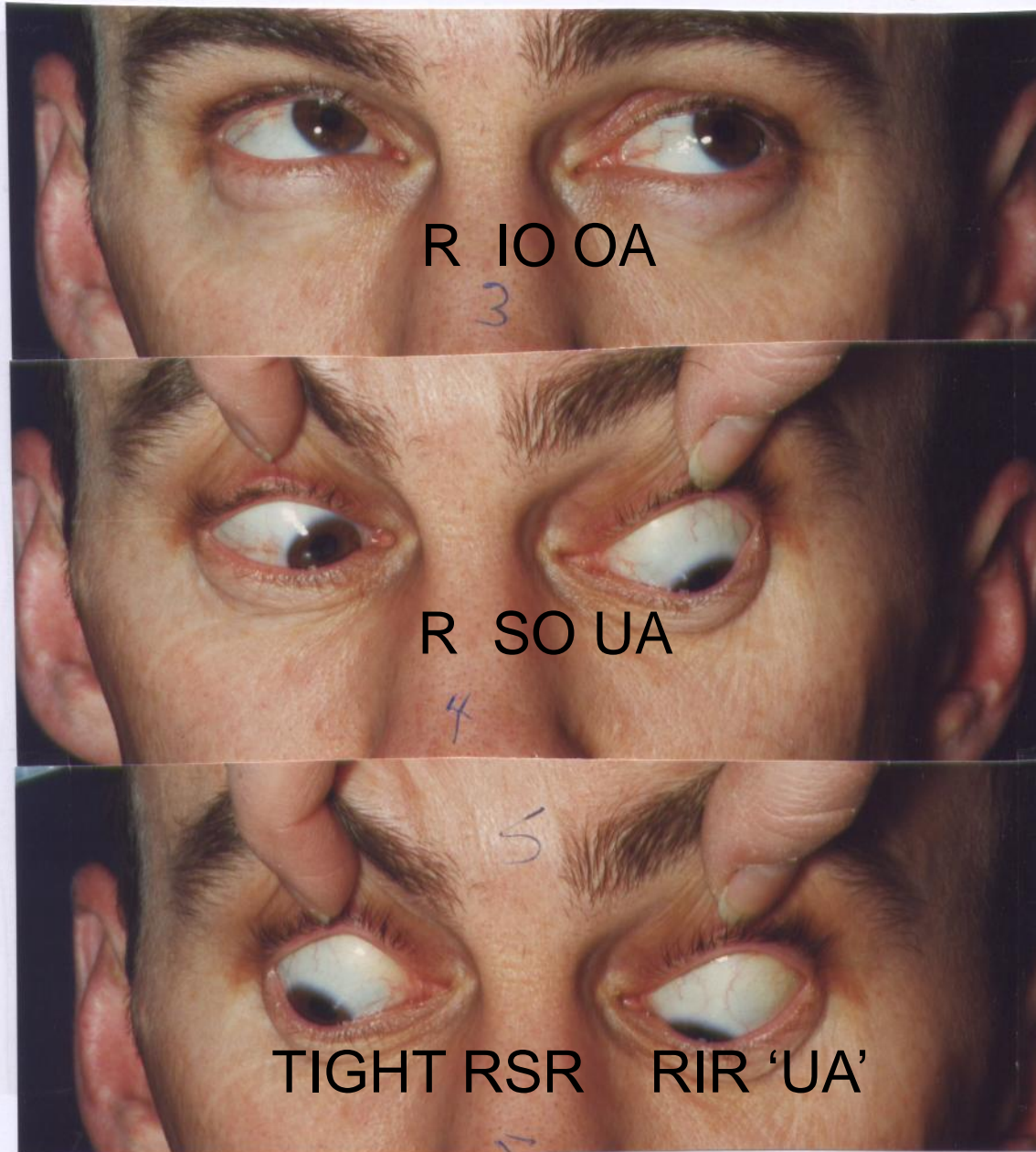
## Mechanical

- **Abnormal oblique anatomy / function**
- **Abnormal orbital pulleys**
- **Abnormal orbit - torted or shallow**

## Neurological

- **Abnormal innervation**
- **Abnormal cortical factors**
- **Amblyopia**
- **Organic visual loss**
- **Head injury**

# Abnormal oblique anatomy / function



# Mechanical Factors which decrease the quality of fusion 1

## Abnormal oblique anatomy / function

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These 4 complex muscles need to be ***built, grow and work in perfect 3D symmetry.***

At BEST they are very finely tuned with little room for error, hence vertical fusional range only  $\pm 2-3 \Delta$ .

Any imperfection will interfere with motor fusion, and predispose to tropia

# Abnormal oblique anatomy / function

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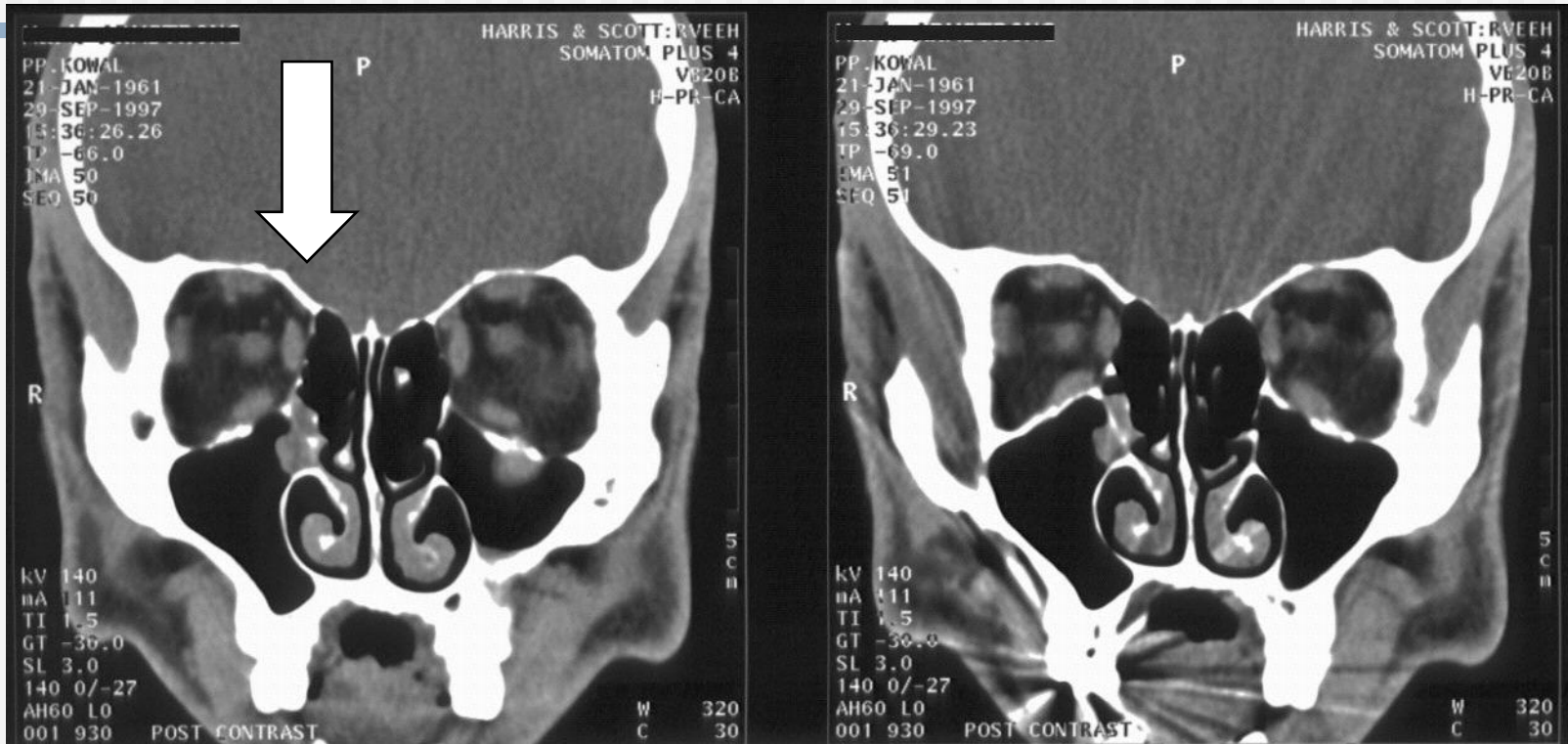
## 1. Atrophic superior oblique

It never developed or

Damaged by falling off change table  
/ bike ...

# Mechanical Factors which decrease the quality of fusion 1

## Superior oblique atrophy



LSO OK

RSO ?absent



# Abnormal oblique anatomy / function

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## **2. Plagiocephaly & other craniostenoses -**

misshapen foreheads - result in  
asymmetry of oblique muscle  
geometry

## Abnormal oblique anatomy / function

### 2. Plagioccephaly, other craniostenoses, and posteriorly placed trochlea

Postero- placed trochlea → abn mechanical action of LSO

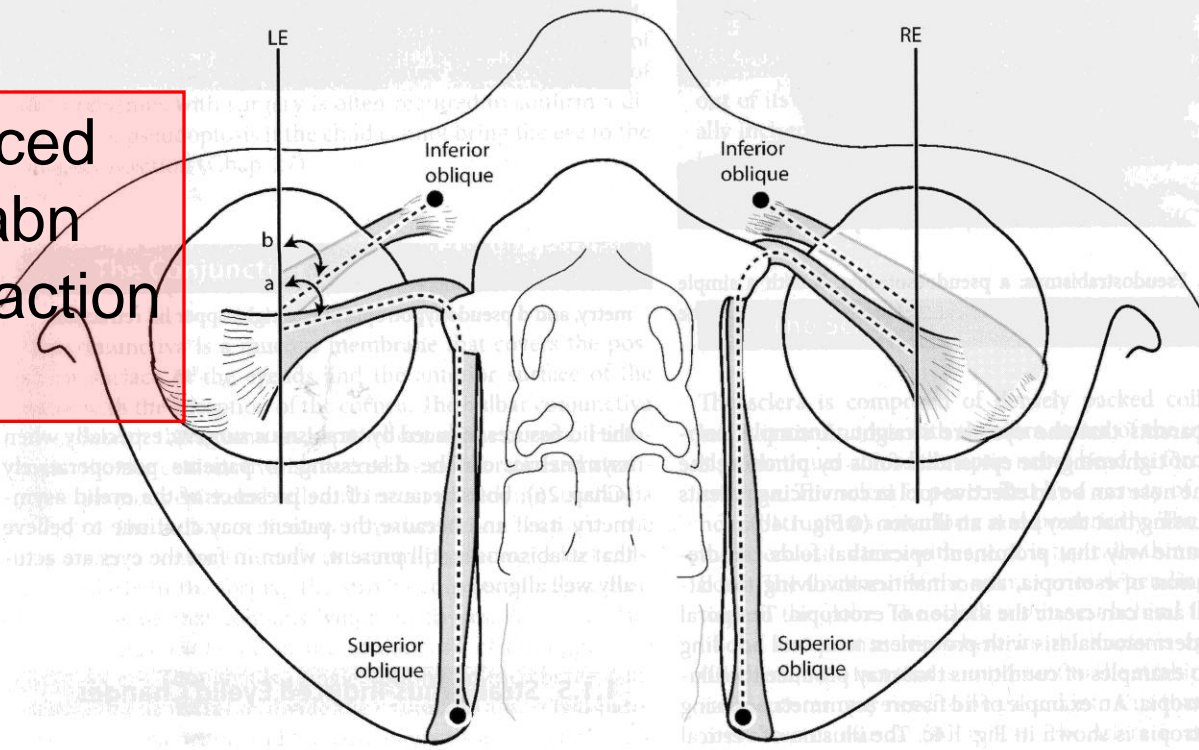


Fig. 1.3. Failure of the trochlea to advance anterior to the equator in a patient with unilateral coronal synostosis may result in reduction of depressing action on the globe with contraction of the superior oblique muscle

# Strabismus in Unicoronal Synostosis: Ipsilateral or Contralateral?

Macintosh et al [Oxford J Craniofac Surg.](#) 2007 May;18(3):465-469.

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Unicoronal synostosis [ premature fusion of a coronal suture] : **looks like a slightly misshapen forehead** ⇒ increased prevalence of strabismus.

Manifest strab in primary position **58%**

ET with vertical was most common - 61% of all strabs

**Apparent IOOA 51%, bilateral 24%**

**Mechanical Factors which decrease the quality of fusion -  
subtle abnormalities in orbital anatomy** 2

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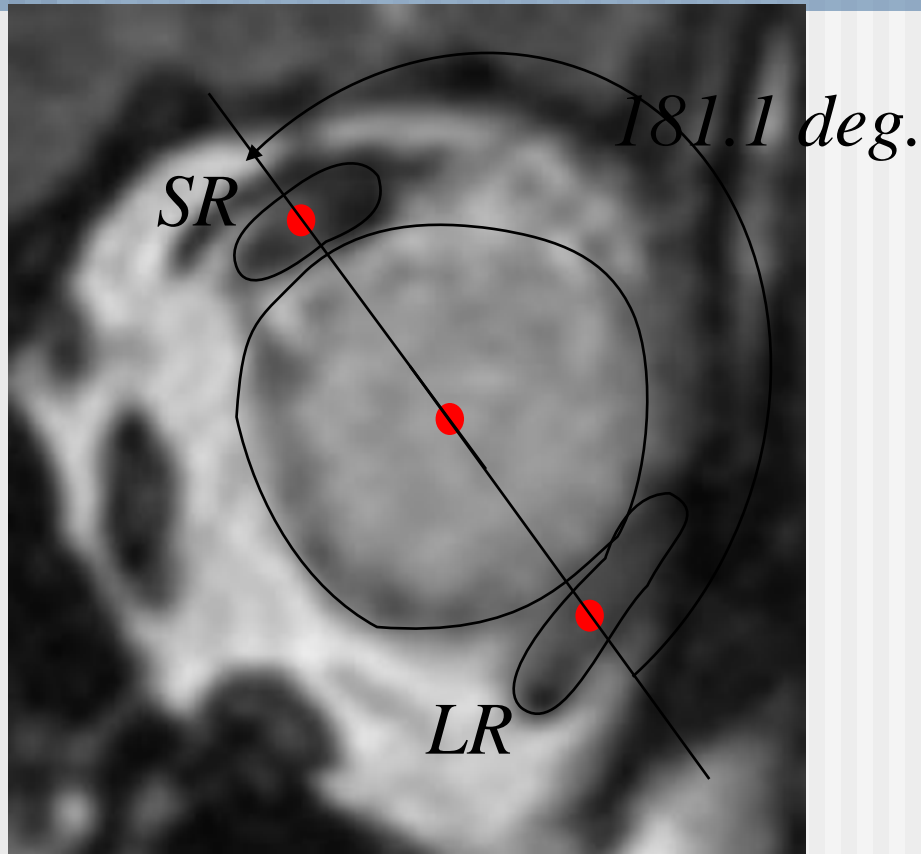
- **Orbital pulley heterotopy**

**Changes muscle actions**

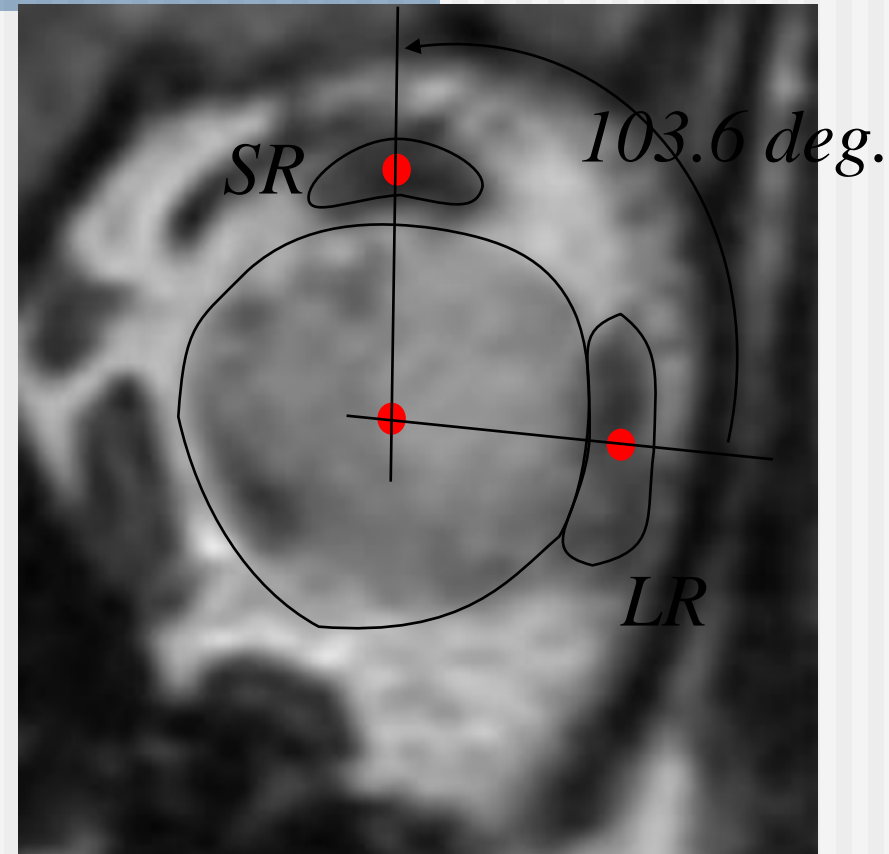
- **Intorted / extorted orbit**

**More prone to alphabet patterns**

*Extreme myopia : Huge globe distorts the surrounding muscle pulleys and changes muscle function → esotropia / hypotropia*



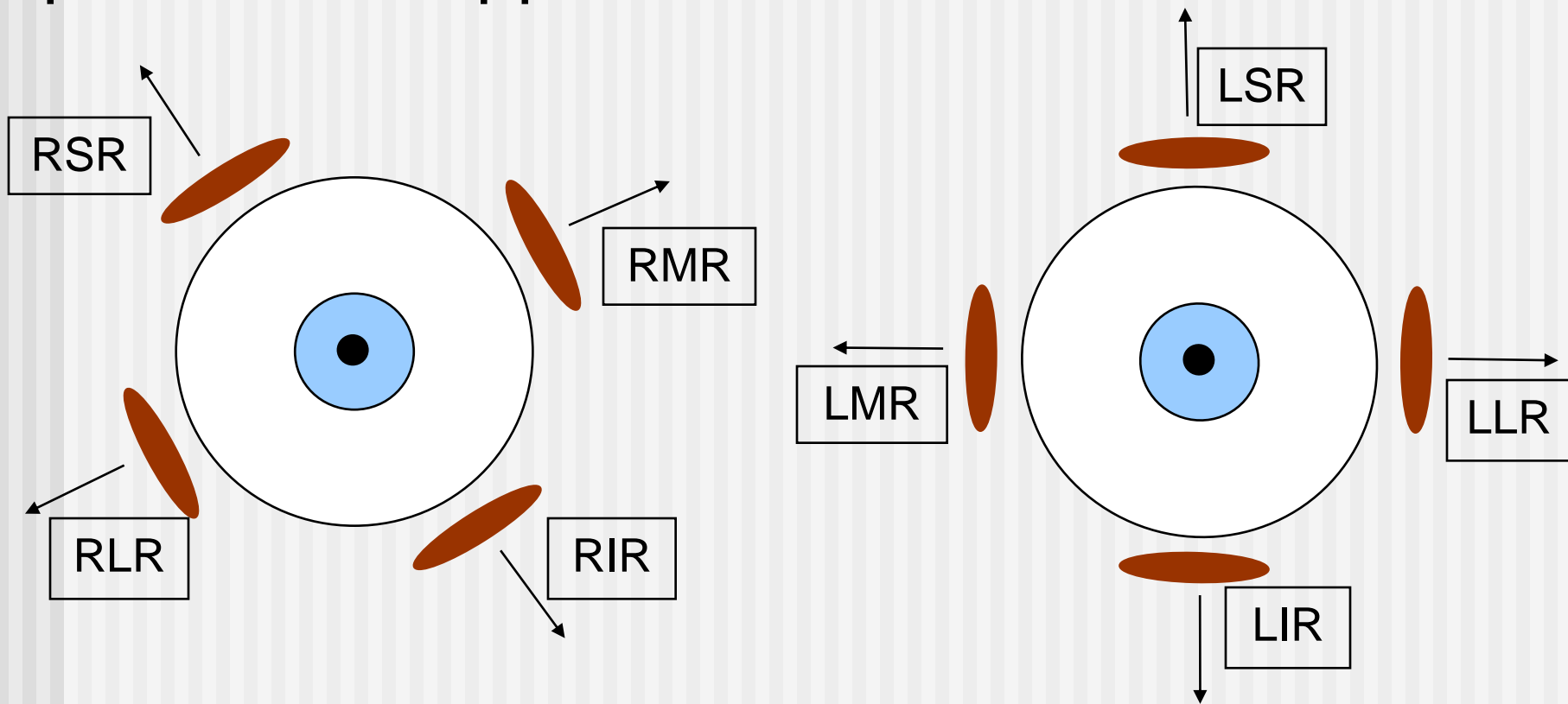
*Preoperative LE: LR pulley displaced down, SR displaced nasally*



*Postoperative LE: LR & SR pulleys repositioned*

# Extorted orbit

- Extorted right orbit and globe will cause a V-pattern and apparent IO-OA



# Mechanical Factors which decrease the quality of fusion 4

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## ■ *Shallow / deep orbit*

Shallow: more prone to exotropia

Orbital shape differences might explain [part of] difference between Caucasian and ...

- Oriental strabismus: XT more common
- South American Indian strabismus : Alphabet patterns more common

# Factors which decrease the quality of fusion

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## **Mechanical**

- **Abnormal oblique anatomy / function**
- **Abnormal orbital pulleys**
- **Extreme myopia**
- **Abnormal orbit - torted or shallow**

## **Neurological**

- **Abnormal innervation**
- **Abnormal cortical factors**
- **Amblyopia**
- **Organic visual loss**
- **Head injury**



# Factors which decrease the quality of fusion - abnormal innervation 5

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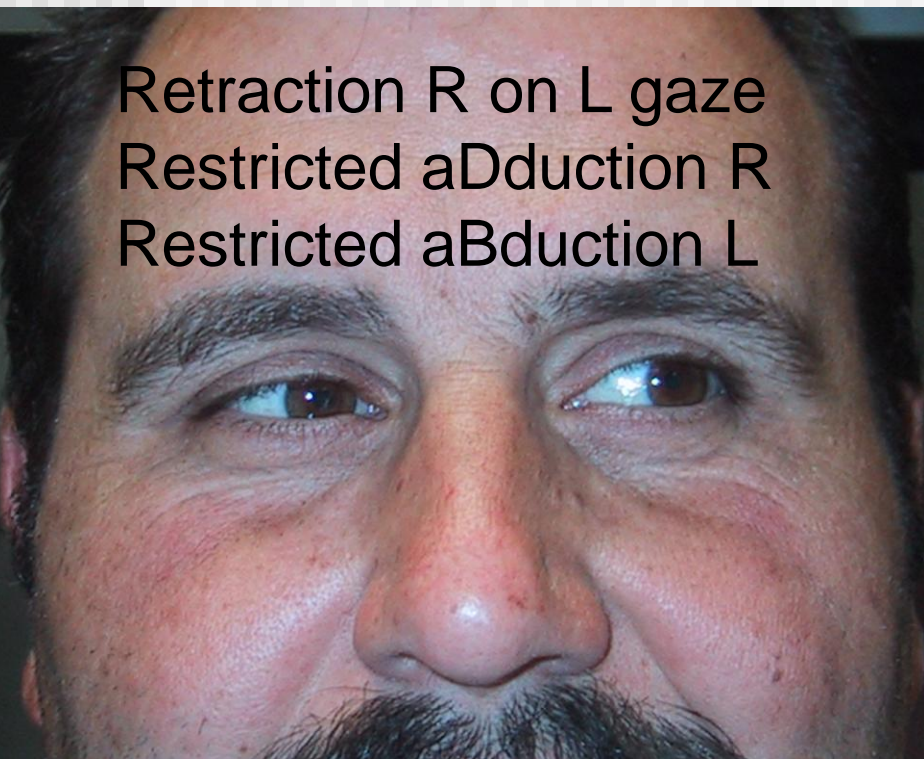
## ■ Duane's

LR supplied by both 6th and 3rd

Subtle variations may be more common than suspected

# Duane's Retraction on adduction

Retraction R on L gaze  
Restricted aDduction R  
Restricted aBduction L



Retraction L on R gaze  
Restricted aDduction L



Co-firing Lateral rectus on aDduction

# Cortical Factors which decrease the quality of fusion 1

## Poor Sensorimotor Fusion

- ↓↓ motor fusion

oculomotor 'shock absorber' / 'glue' that tries to keep eyes straight despite attempts to misalign them

- ↓↓ sensory fusion

stereopsis

- Abnormal binocular columns

# Cortical Factors 2: New kid on the block: **PVL** **Peri Ventricular Leukomalacia**

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Stroke @ 32 weeks gestation.

- & congenital nystagmus [both types]
- & optic n hypoplasia
- & reading problems
- & reduced acuity for cortical reasons
- & .....

# Non-mechanical Factors which decrease the quality of fusion 3

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## ■ Amblyopia

- e.g. anisometropic amblyopia, amblyopia from congenital cataract, strabismic amblyopia

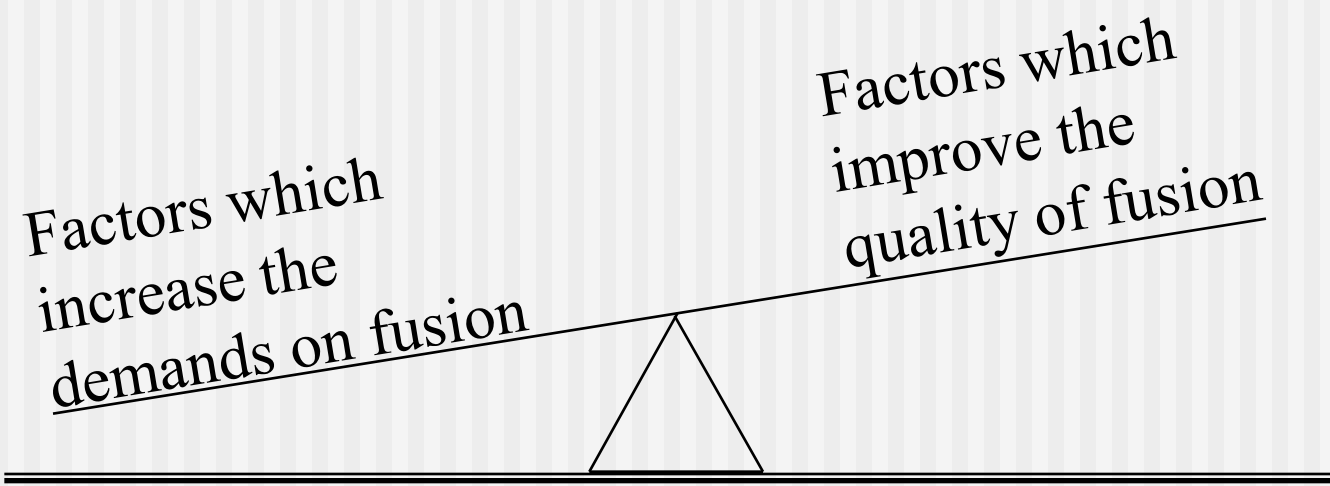
## ■ Decreased vision from organic causes

- Retinal disease - any visual pathway disease

## ■ Head injury

# Strabismus develops due to an imbalance between two groups of factors

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If this side is heavier,  
there will be strabismus

If this side is heavier, there  
will be no strabismus

# IMPAIRED SENSORIMOTOR FUSION:

ET happens more readily [with lower or no +]

## ■ Chromosomal defect / devptl delay

Amblyopia

Orbital anomaly

PVL etc

Factors which  
increase the  
demands on fusion

Factors which  
improve the  
quality of fusion

THIS  
SIDE  
NOW  
LIGHTER

If this side is heavier,  
there will be strabismus

If this side is heavier, there  
will be no strabismus

# TYPES OF STRABISMUS

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- **1. Derived from refractive disorders : ESOTROPIA**
- 2. ... from abnormal early visual development
- 3. Orbital causes
- 4. Neurological



# Pseudo-ET:

*Beware of dismissing an ? ET (not present during your testing) as a pseudo-ET*

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- Demonstrate to parents how to interpret light reflexes
- Offer email follow up of any suspicious photos
- UK study: **10%** will end up with strabismus –  
**2-3 TIMES THE BACKGROUND RATE**

# R pseudo ET

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Do a **thorough search for strabismogenic and amblyogenic factors**

MUST include cycloplegic retinoscopy for latent hyperopia



# Pseudo-ET

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**Determine if 6<sup>^</sup> BI will ⇒ ET** [poor fusional divergence = 'almost ET']

- MUST check for oblique dysfunction - predisposes to ET in a hyperope
- Every 'ET by history, normal by exam' could have the rare ***cyclic ET*** : ***one day ET, one day straight***

# Developing an esotropia...

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## THE UNCORRECTED HYPEROPE

Prolonged accommodation →  
tendency to prolonged  
inappropriate convergence and  
**increased tone in medial recti**  
[vergence tonus]

# Developing an esotropia...2

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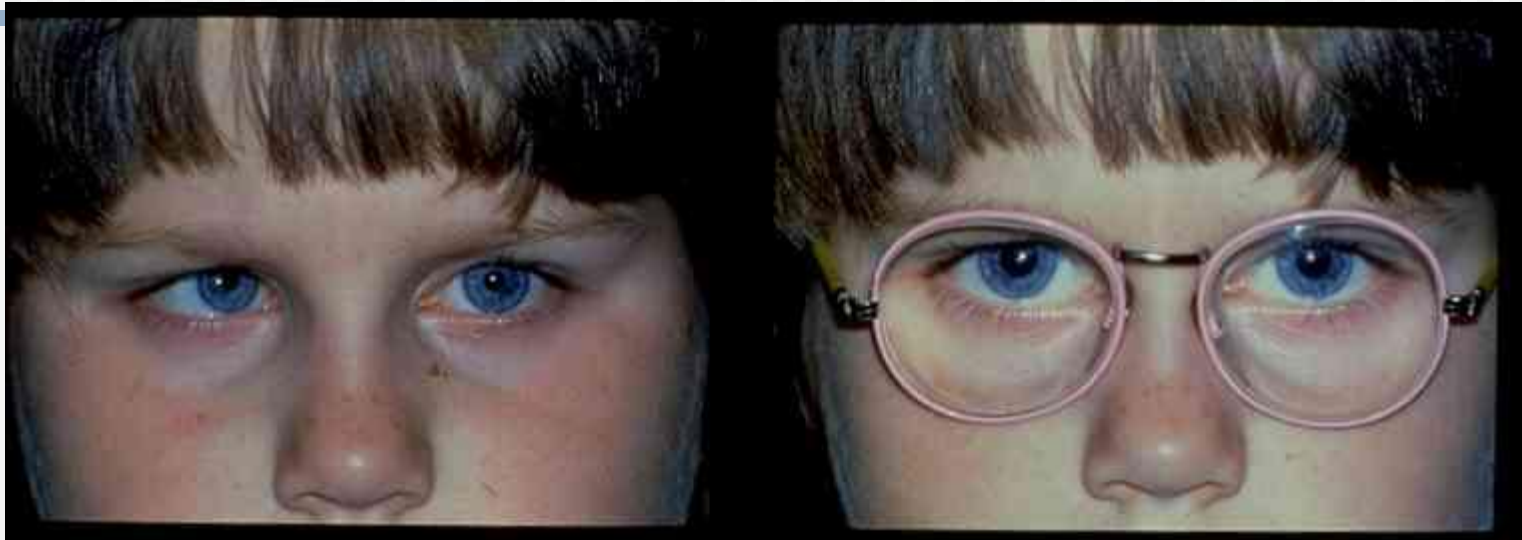
- Increased tone will lead to changes in Tension / Length ratio and eventually to structural changes in muscle that eventually exceed motor fusional reserve and → **esotropia!**
- Then muscle starts to permanently shorten

# 'OPTOMETRIC' ESOTROPIA



- e.g. +4 : Abnormal [& appropriate!] degree of accommodation required to see clearly
- Abnormal amount of accommodative convergence is generated
- Glasses required to make the child normal

# 'OPTOMETRIC' ESOTROPIA



- Exactly the same can happen with low + and abnormal accommodative - convergence relationship = **convergence excess**

# Developing an esotropia...

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- Initially reversible with glasses
- If correction is inadequate, eventually the **medial rectus shortens** so much that ***the mechanical part of the misalignment now becomes the main problem.***
- Reversing the refractive part of the esotropia will no longer be sufficient to straighten the eyes - botox or surgery are now required to change the mechanical properties of the muscle[s].
- Glasses still required to prevent recurrence [and, when older, for clear vision]



# Accommodative esotropia

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- Usually 2-5 yrs old

Second small peak in middle age

- Usually moderate +
- Sometimes low / normal + with convergence Xs
- Background of **normal** visual devtpt in first 6mo of life - normal sensorimotor fusion can be regained

# Esotropia ET

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- ET: core problem is [or becomes] a **tight medial rectus**, often driven by accom convergence

Fixing the medial rectus length & tension should return the alignment & mechanics to normal

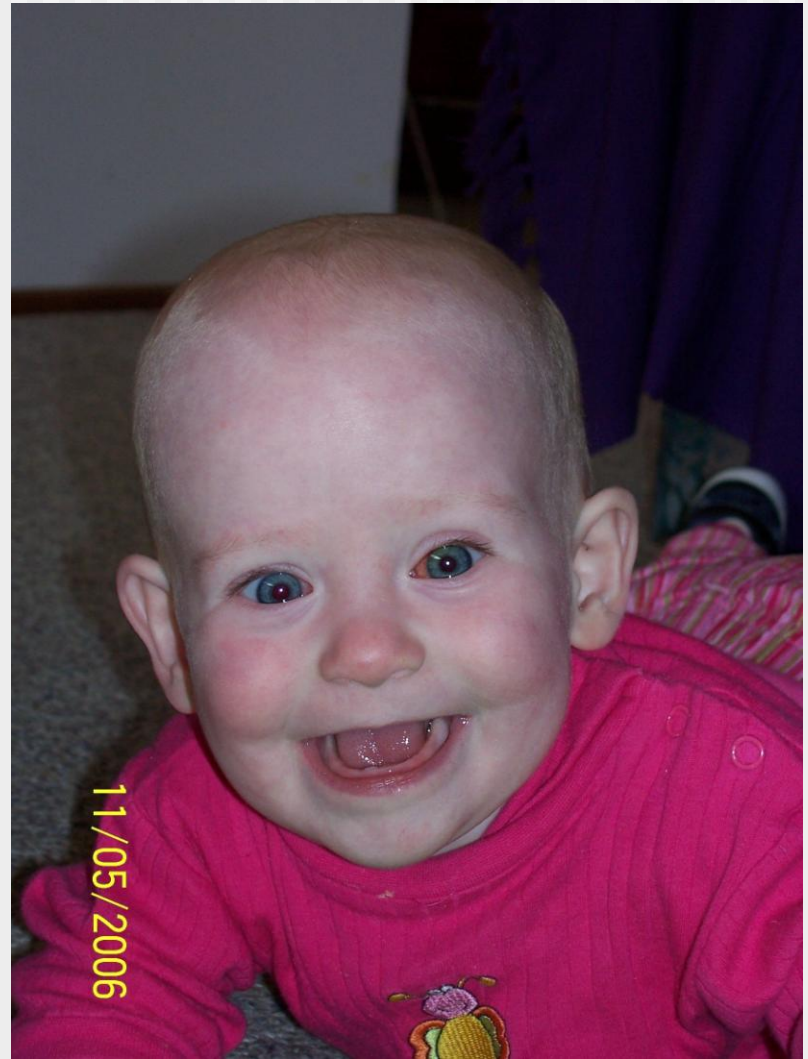
# TYPES OF STRABISMUS

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- 1. Derived from refractive disorders  
ESOTROPIA
- **2. Derived from abnormal  
early visual development**
- 3. Orbital causes
- 4. Neurological

# CONGENITAL ESOTROPIA

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# ASSOCIATIONS OF Congenital ET

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- Down's 30%
- Severe neonatal course IVH / HC  
>>50%
- PVL it's a radiological diagnosis : need prospective series to know %

# PRINCIPLES OF TREATMENT OF ANY ET

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- 1. **Give full +** [cyclo if young, manifest if older].
- + *for amblyopic eye is to optimise vision in the amblyopic eye*
- + *for fixing eye is optimise alignment of the amblyopic eye*
- 2. Rx any amblyopia
- 3. Consider realignment for any residual ET after best amblyopia result and + has been re-checked

## BENEFITS OF REALIGNMENT OF ET

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- Normal appearance
- Better peripheral field
- Chance for sensory fusion
- Better chance to treat resistant amblyopia

# TECHNIQUES FOR REALIGNMENT OF ET

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SURGERY

BIMEDIAL RECESSION or

RECESS / RESECT ONE EYE

Conv Xs: BMR

Amblyopia: R-R

$<35\Delta$  same results



# SURGERY

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AIM: perfect early alignment

- Expectation: 80- 90%

Medium term expectations:

Depends on:

- Sensorimotor fusion
- 1st 12 mo: 10% reoperation – issues with healing, bell curve for surgical doses
- Subsequent: 1% per year consec XT – the operation that has repositioned the muscles doesn't 'grow with the patient'

# TECHNIQUES FOR REALIGNMENT OF ET : 2

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## MEDIAL RECTUS BOTOX

- 50+% success for 10 -20 $\Delta$  ET
- 15% temporary ptosis
- 1% permanent acquired vertical

Small number of Drs get GREAT results

- LK 40 p.a. [= 40% of country]

# CONGENITAL ET

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Alignment **has** to be mechanically perfect.

- Expectation of alignment : 80- 90%

Poor motor fusion: insufficient 'capture range' to 'collect' a near- perfect mechanical realignment.

The repositioned muscles may not grow in perfect mechanical balance with growth in the eye & orbit; recurrent tropia more common

# ACQUIRED ET:

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- Expectation of alignment: 80- 90%

Alignment has to be CLOSE. Presence of motor fusion: sufficient 'capture range' to 'collect' a near- perfect mechanical realignment. If a large tropia is improved to a small phoria: success\* .

The repositioned muscles may not grow in perfect mechanical balance with growth in the eye & orbit, and motor fusion will often look after that.

*\*if there was no motor fusion, this would be tropia= failure*

# TYPES OF STRABISMUS

---

- 1. Derived from refractive disorders :  
ESOTROPIA
- 2. Derived from abnormal early visual development
- **3. Orbital causes : EXOTROPIA**
- 4. Neurological

# Esotropia & Exotropia

## ET & XT

- ET: core problem is [or becomes] a **tight medial rectus**, usually driven by normal or Xs accom convergence
- XT: core problem is usually **subtle anomaly in orbital anatomy** [*not a tight lateral rectus*]
- ET / XT ARE NOT MIRROR IMAGE CONDITIONS

# Exotropia

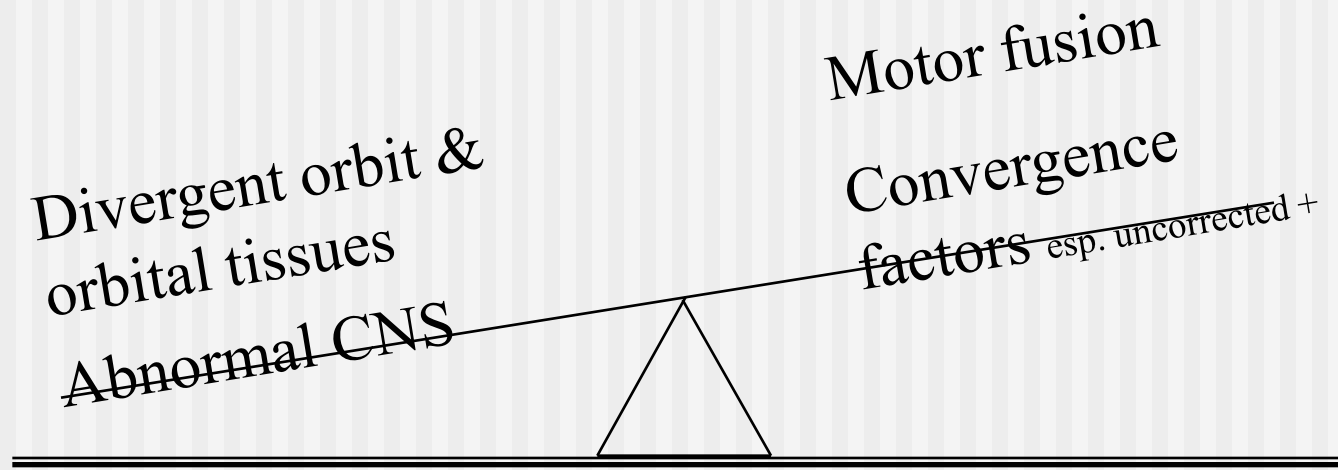
# XT

- XT: core problem is usually **subtle anomaly in orbital anatomy** [not a tight lateral rectus]
- Fixing the lateral rectus length & tension tries to compensate for the XT and improve the alignment & mechanics, but will not return the mechanics of this abnormal orbit to normal

# EXOTROPIA - BASICS

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- Abnormal mechanical balance of orbital tissues vs. motor fusion



If this side is heavier,  
there will be exotropia

If this side is heavier, there  
will be no exotropia



# TYPES OF XT

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- Intermittent XT,  $D > N$
- Usu 2-7 yo \*
- Little / no amblyopia

Because often straight

- Motor fusion better for N, so XT worse for D

\*but can deteriorate to 'clinically significant' @ any later age

# INTERMITTENT X.F.

## Mayo Clinic study

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- Very high incidence of myopia
- Higher incidence of psychiatric disease

# Basics of treatment of XT

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- Check manifest / cyclo refraction
- High +: give full + to improve peripheral fusion
- Treat any amblyopia

# Basics of treatment of XT

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- < 4y: patching
- 4-8: minus lenses
- > 6: surgery

# Basics of treatment : **Minus lens treatment...**to promote accommodation convergence

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LK: as much minus as will not interfere with near threshold

Typically -2 to -3.5 over the cyclo

WHY?: only good alternative is surgery  $\Rightarrow$  >10% persistent ET  $\Rightarrow$  risk of amblyopia / troublesome diplopia depending on age

Usually NOT a long term solution

Uncertain risk of promoting / exacerbating any myopic tendency. Wisconsin study: little / no risk

Useful temporising measure to age 7-8

## Basics of treatment : **Surgery**

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**Kushner** 1998 **seminal** series of articles in Archives of Ophthalmology on examination techniques and treatment protocols

### **Different types of XT**

Divergence Xs

Simulated divergence Xs

Basic

Convergence insufficiency

# Who gets XT surgery?

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Better outcome if :

- not quite constant XT
- Medium angle rather than large angle
- Pre-op stereo

## Basics of treatment : XT surgery

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>50% early ET [5-10 $\Delta$  desirable]

>10% persistent ET  $\Rightarrow$  **risk of amblyopia / troublesome diplopia** depending on age

Some sense in deferring surgery till out of the amblyogenic age, hence minus lenses & patching



# TYPES OF STRABISMUS

---

- 1. Derives from refractive disorders :  
ESOTROPIA
- 2. Derives from abnormal early visual development
- 3. Orbital causes
- **4. Neurological**

# 'Pure' neurological strabismus

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- **True cong sup obl palsy**

- 6th

- CFEOM [hypoplasia sup div 3rd; KIF mutation]

..have 2ary effects that are dependent on age of onset and associated factors such as refraction

# RED FLAGS

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- ET greater for distance than near
- ET or XT greater to lateral gaze
- Strabismus that varies a lot from morning to evening
- Any vertical  $> 5^\Delta$
- A recently symptomatic vertical of any size
- Recent onset nystagmus / oscillopsia
- Recent / variable ptosis

## Overview Part 2

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- New approaches to amblyopia – causes and treatment

# AMBLYOPIA

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- Normal morphology
- Reversible to some degree
- ?Often ?usually very asymmetric bilateral condition

Small list of associated / causative factors:

1. Anisometropia, astigmatism
2. Strabismus
3. Any vision- reducing pathology, on wch amblyopia is superimposed

# Normal morphology .. or is it?

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Frequent findings:

- Bilaterally abnormal disc morphology
- Bilaterally abn globe morphology
- Thickened macula on OCT in eye with resistant amblyopia

# Why treat amblyopia?

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## **Better spare tyre**

More accurate presurgical strabismus measurements

Better sensory fusion :  $\uparrow\uparrow$  stereo  $\Rightarrow$  better function

# AMBLYOPIA ACRONYMS

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## **PEDIG [USA]:**

- Large numbers of clinics / patients
- Simulates community treatment

## **MOTAS [UK]:**

- Few clinics
- High tech electronic patch



# PEDIG: Glasses alone

- 6/12 to 6/75
- 27% cured
- Another 50%  $\geq$  2 lines better
- Took up to 7 mo

# MOTAS

## Glasses alone

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- 65 newly diagnosed children
- VA improved ( $p=0.001$ ) from 0.67 [6/24-] to 0.43 [6/15-] logMAR

### ‘REFRACTIVE ADAPTATION’

\*is this why the CAM stimulator ‘worked’?

*Br J Ophthalmol 2004;88:1552-1556.*

# Anisometric Amblyopia Treated with Spectacle Correction Alone: Possible Factors Predicting Success and Time to Start Patching.

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Chen PL, ... Taiwan. Am J Ophthalmol. **Oct 2006**

... time course of VA improvement in children 3-7y with anisometric amblyopia **treated with spectacles alone.**

n=60, mean age 5.3 y, mean anisometropia 3D.

Amblyopia improved by  $\geq 2$  log MAR lines in 93% and resolved in 45%; mean improvement in VA of 0.38 log MAR.

↑ VA in the amblyopic eye was considerable at 4-12 weeks then reached a plateau, after which it improved only slowly.

## **Anisometropic Amblyopia Treated with Spectacle Correction Alone: Possible Factors Predicting Success and Time to Start Patching.**

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**CONCLUSIONS:** With spectacle correction alone, 3-7y children with previously untreated anisometropic amblyopia achieved approximately four-line improvement and resolved in nearly half.

**After 4mo with no improvement in VA, occlusion therapy or atropine penalization may be considered**

# 6/12 - 6/24

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- 2h/ d = 6h/d
- Weekend A = daily A
- 10%: change in strabismus - better or worse

6/30 -6/120

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- 6h/d = full time or FT-1 h
- 6/15 usual endpoint

# WHEN to treat amblyopia?

Success rates @ different ages

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3-7 y	75- 85%
7-17 y	25 - 50%
Adult	$\leq 10\%$

# MOTAS ...several studies

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## **1 line gain:**

- needs ~ 120h occlusion

## **2 line gain:**

- 4y: needs 170h
- 6y: needs 236h



# Dose-response @ different ages

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## < 4 years old:

- low dose rates (<3 h/d) are effective, with slight ( $p=0.54$ ) additional gains for doses >3h/d

## > 4 years old:

- significant differences between <3h/d & 3-6h/d
- no difference between 3-6h/d & 6-12h/d

## > 6 years old:

- <3h/d had little effect; need >3h/d

# Maybe more isn't always better...

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## MOTAS:

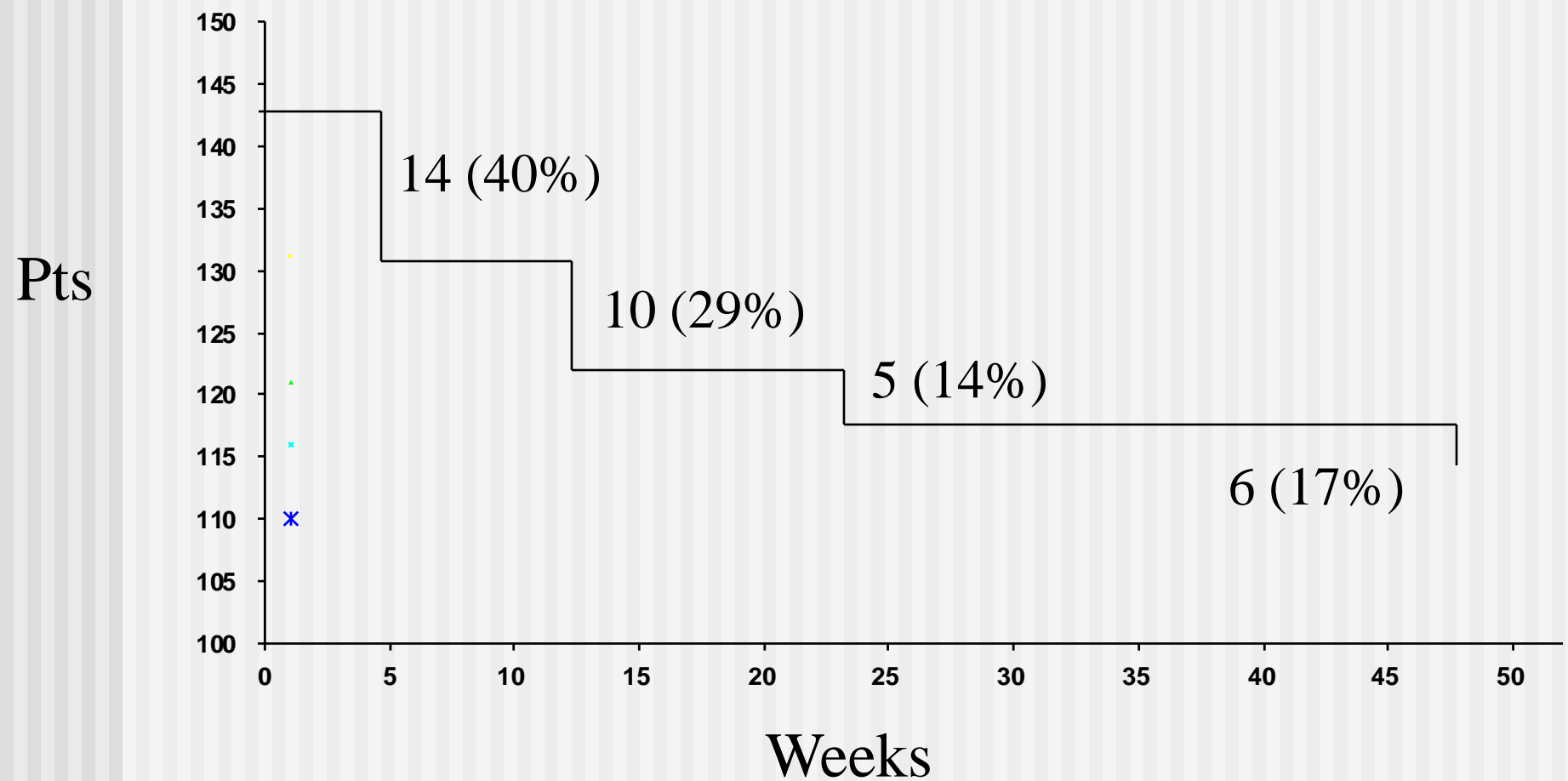
- Higher dose rates achieve the best outcome more rapidly but at a risk of accumulating excessive non-therapeutic hours of patching....patching for all waking hours is almost certainly excessive....

# Conclusions of Amblyopia Recurrence Study

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- $\frac{1}{4}$  of successfully amblyopic children experience a recurrence over 1 year of f/u
- Recurrence risk similar for stopping patching and stopping atropine
- Most recurrences occur  $< 3$  mo – early follow-up is critical, but long term follow-up is also important
- If  $\geq 6$ h of patching stopped – **recurrence risk is lower if patching is reduced to 2h/d before cessation – “weaning” is beneficial**

# Timing of the 35 recurrences



# When it doesn't work for your patient: is it the Parents?

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- Parents avoid parading an obviously defective child & will not patch in public
- Parents don't like inflicting discomfort on their child

# Recruiting parents to treat their children

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HAVE TO TREAT THE **FAMILY**



# Types of parents .....

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- Type A - no excuses:

on Thursday we only did 5h 20m, so we made up for it on Friday with 6h 40m

- Type B:

We're careful to do it all the time.. but we forget sometimes when we're busy....

- Type C - great excuses:

s/he hates it.... we haven't managed for the last week....  
s/he was sick... we were on vacation... we let the nanny look after it.... s/he only does it @ school...

Awan M, Proudlock FA, Gottlob I The effect and compliance of strabismic amblyopia monitored with the ODM [abstract].

Invest Ophthalmol Vis Sci 44[Suppl]: S199, 2003]164,483).

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- Parent diaries overestimate actual patching time by a **factor of 2-3** even when they know it is monitored by an electronic Occlusion Dose Monitor and will be checked!



# Strabismic Amblyopia

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- Does alignment result in better response to amblyopia therapy?...or no need for amblyopia therapy?

# Timing of amblyopia therapy relative to strabismus surgery

Lam GC, Repka MX, Guyton DL Ophthalmology. 1993 Dec

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- 47 children < 8 y with both amblyopia and esotropia.
- 26 : amblyopia fully treated before surgery
- 21 : surgery before completing amblyopia therapy.
- **5/21 did not require amblyopia therapy after surgery even though they were still amblyopic before operation.**

# Helping the parents: Therapeutic environment

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- Some parents need help to maintain enthusiasm for a task which everyone finds difficult
- Keep the therapeutic environment alive / active e.g. ring daily

# Post- Darwinian treatments

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- 1. Refractive surgery

- 2. Drugs

L- DOPA

PROZAC

# Refractive surgery

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- Works in a significant minority of anisometropic amblyopes
- Safe in short term, probably in medium term
- Personal experience 0

# I'VE MADE IT QUITE COMPLEX, BUT REMEMBER THE BASIC 2 STEP MANAGEMENT OF STRABISMUS

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1. Improve /equalize acuity

2. Straighten the eyes

- Optically

- Botox

- Surgically