MANAGEMENT OF STRABISMUS & AMBLYOPIA 2017

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RED IS FOR …….

REALLY IMPORTANT INFORMATION

Overview Part 1

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

Overview Part 2

- Amblyopia: Causes and treatment

OVERVIEW PART 3
WHY IS IT SO DIFFICULT?

Every clinical decision depends on accurate evaluation of:

- **1. alignment**
- **2. acuity**
- **3. refraction**

….& they are difficult to do reliably in children.

Lectures & textbooks help, but one-one tuition / feedback is essential

OVERVIEW PART 4 *CORE SLIDE:*
REQUIREMENTS OF A PERFECT VISUAL SYSTEM
WE NEED ALL OF:

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

required for normal motor fusion, normal sensory fusion

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

OVERVIEW PART 5

STRABISMUS: END RESULT OF ANY IMPERFECTION IN THIS COMPLEX JIGSAW PUZZLE

Abnormalities in one / more of…

- Sensory development
- Refraction
- Orbital anatomy
- EOM anatomy / physiology
- Relevant brain anatomy, function and development

Visual system takes up ~ ½ the brain!

- Accommodation / convergence

..either cause or are caused by strabismus

OVERVIEW PART 6 TIME DEPENDENT RESULTS:

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

- Delay in starting & completing effective treatment can have negative life- long outcomes
- You WILL in your career see children and adults with visual loss that is /was reversible **only** with timely & effective treatment
- You may never develop the perspective & experience to suspect organic disease eg mild ONHypo, **incomitant ET of 6ths (can be life threatening), ..**

KEY TO SUCCESSFUL MANAGEMENT OF EXPECTATIONS: **EDUCATION**

- ***'HIGHLY RECOMMENDED [FREE!] E-BOOK FOR PATIENTS & PARENTS TO READ'***

- Eye Muscle Problems in Children and Adults: A Guide to Understanding

- Burton J. Kushner, MD

  The John W. and Helen Doolittle Professor of Ophthalmology
  University of Wisconsin Department of Ophthalmology and Visual Sciences, Madison

...LINK ON MY WEBSITE

Burton J. Kushner, MD

- If knowledge is power, one of its powers is to enable us to make wise and informed decisions that influence our future.
- Hopefully after reading this book you will feel more empowered to make considered choices regarding the treatment of your child, yourself, or your loved one.

2 STEP MANAGEMENT OF STRABISMUS

1. Straighten the eye(s) or otherwise compensate for misalignment optically inc Prisms / Surgery / Botox (infrequent option)

….&…..

2. Improve /equalize acuity

..in either order, or simultaneously

WHY STRAIGHTEN THE EYES?

Age < 6mo:

- Best chance for some sensorimotor fusion.

Commonest good result:

- Straight most/all of the time
- impaired sensorimotor fusion
- Normal appearance
- ⇓ risk of amblyopia

WHY STRAIGHTEN THE EYES?

Age 3-7:

- Best chance for sensorimotor fusion
- Normal appearance, **self esteem** & psychological and social devpt [important from prep year]
- Better **motor skills**
- ⇓ risk of amblyopia

Stereo vision enhances the learning of a catching skill. Montagne G et al Exp Brain Res. 2007 Jun;179(4):723-6.

- 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.

WHY STRAIGHTEN THE EYES?

Age >10:

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

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

S M Mojon-Azzi,[1] W Potnik,[2] D S Mojon[3]

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*[6] 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*,[7] 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*[8] 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*[9] showed that strabismus surgery reduced the psychosocial difficulties reported before surgery and improved the quality of psychosocial functioning. Beauchamp *et al*[10] also

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

WHEN TO STRAIGHTEN THE EYES?

Kids:

should be realigned within 4mo of constant misalignment to regain best sensorimotor fusion …usually not achieved

Adults:

…≤ 12mo of constant misalignment to frequently regain measurable sensorimotor fusion…usually not achieved

….many exceptions : many good results can also be seen after prolonged delays to alignment

CLUES TO THE CAUSES OF STRABISMUS
1. GENETIC

Frequent strabismus :

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

⇒ ***genetic factor***

CLUES TO THE CAUSES OF STRABISMUS 2: NEUROLOGICAL

Frequent strabismus :

1. Neonatal brain injury IVH / HC : most have Infantile Onset Strabismus [IOS]

1. Developmental delay of any sort: genetic / acquired 25%

2. ASD / ADD/ ADHD population
   Increased frequency

THE CAUSE OF INFANTILE STRABISMUS LIES UPSTAIRS IN THE CEREBRAL CORTEX, NOT DOWNSTAIRS IN THE BRAINSTEM TYCHSEN, L EDITORIAL ARCHIVES OPHTHAL AUG 2012

- Infantile-onset strabismus is a combo of abnormal ocular motor behaviors: eye misalignment; subnormal binocular fusion; a type of nystagmus; dissociated vertical & horizontal deviations.
- Children at greatest risk are those who suffer cerebral lesions around the time of birth, esp PVL =**P**eri **V**entricular **L**euko Malacia, damage to the posterior-most fibers of the optic radiations, the binocular inputs to striate cortex).
- **PVL: >30 fold greater risk of IOS**

CLUES TO THE CAUSES OF STRABISMUS
3 GENETIC & ORBITAL

Comitant Horizontal Strabismus: an Asian perspective. Chia A, **et al** . BJO. **2007 May 2;** Singapore.

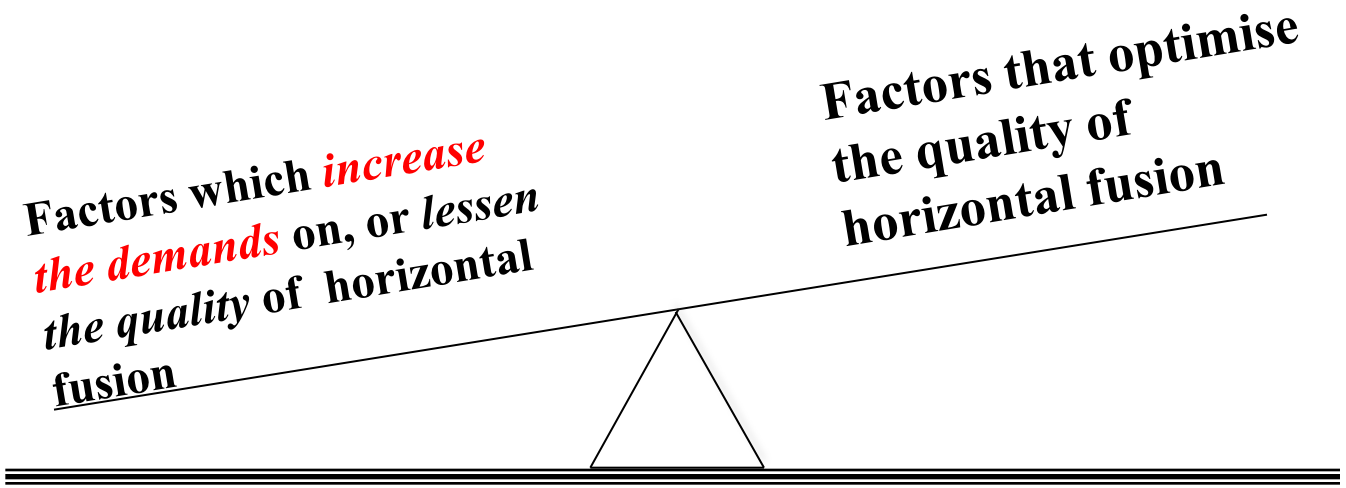
2ce as many Singaporean children present with XT than ET

Caucasians ET >> XT.

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

4. 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 THAT INCREASE THE DEMANDS ON FUSION

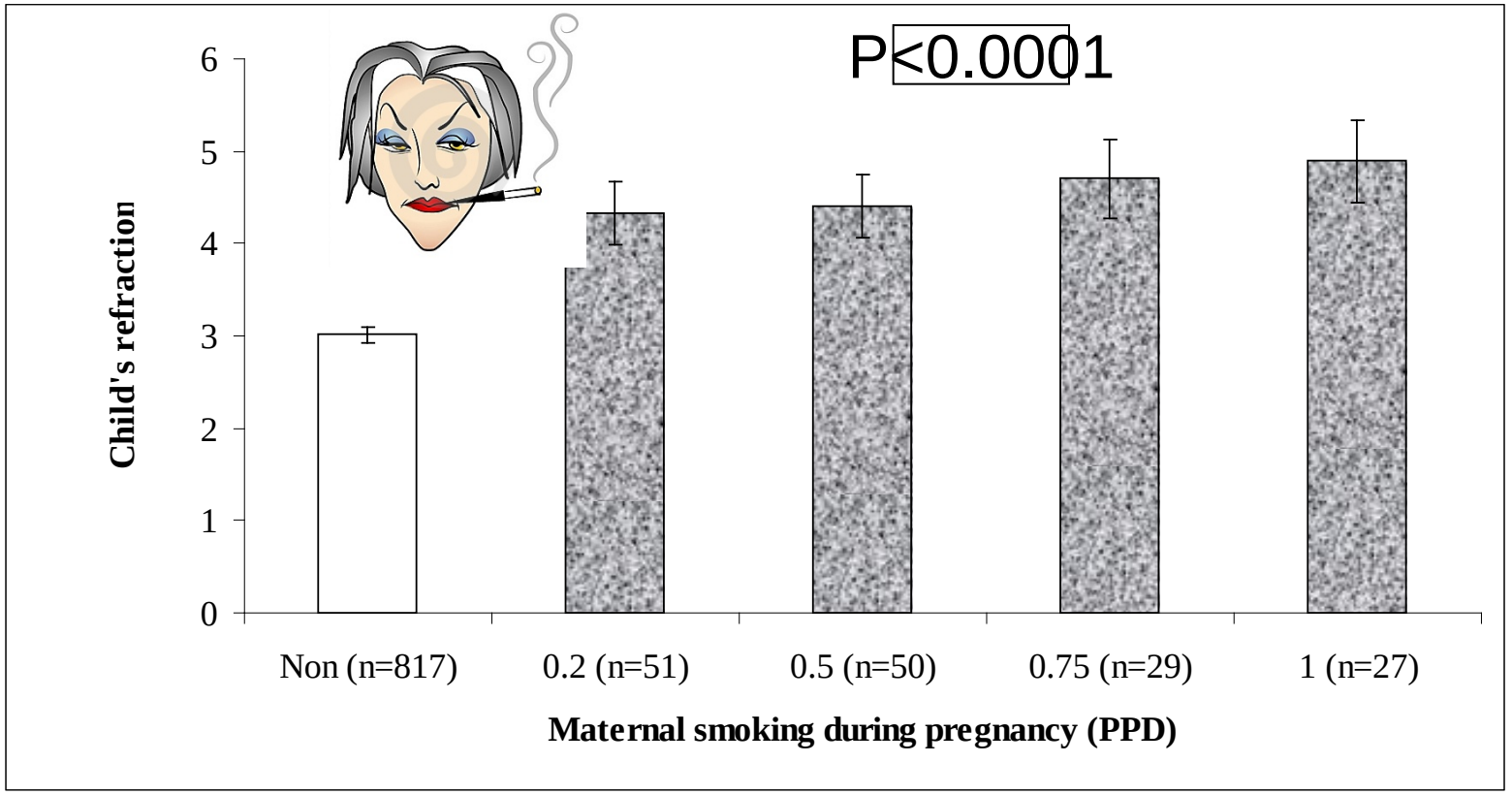
- Hyperopia
- Abnormal accomm – convergence relationship [high AC / A & other /similar factors]

HYPEROPIA

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

MATERNAL SMOKING DURING PREGNANCY [ISRAEL; 2012]



INGRAM UK

- ≥ + 3.50 DS in one axis @ age 12 mo:
- **50% risk of strabismus / amblyopia**

FACTORS THAT INCREASE THE DEMAND ON FUSION 2

ABNORMAL ACCOM - CONV RELATIONSHIP

- **High AC/A ratio, abn CA/C ratio**, proximal convergence, proximal fusion,.. all have precise definitions, but common usage is not precise.
- USA: 'high AC/A' = near eso > distance eso by ≥10Δ
- All these subtypes have **same 'final common pathway'**.
- LK preference : **convergence excess** as synonym for all of these terms [after GvN].

ABNORMAL ACCOM - CONV RELATIONSHIP

- Presbyopia

Another age where accomm ET can be seen in pts with fragile motor fusion

- Drugs which interfere with accommodation e.g. Ditropan, some antidepressants

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

UNDERSTUDIED SUBGROUPS

ASD/ ADHD/….&/or their treatments

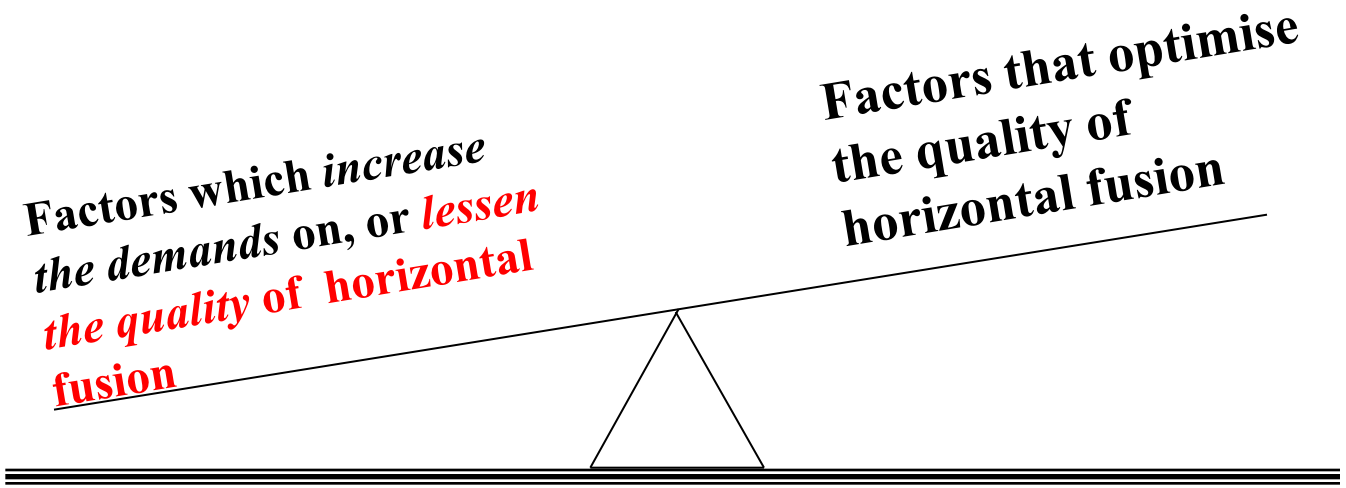
- Labile convergence and accommodation
- Will not accept / respond ‘normally’ to sensible glasses
- Surgery less reliable

HEAD INJURY

- Labile / inappropriate accommodation [under ≈ presbyopia, over = pseudomyopia] & convergence [under ≈ XT or CI, over ≈ convergence Xs ET].

FACTORS THAT 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

LOOONG LIST OF FACTORS THAT DECREASE THE QUALITY OF FUSION

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**

MECHANICAL FACTORS THAT DECREASE THE QUALITY OF FUSION 1

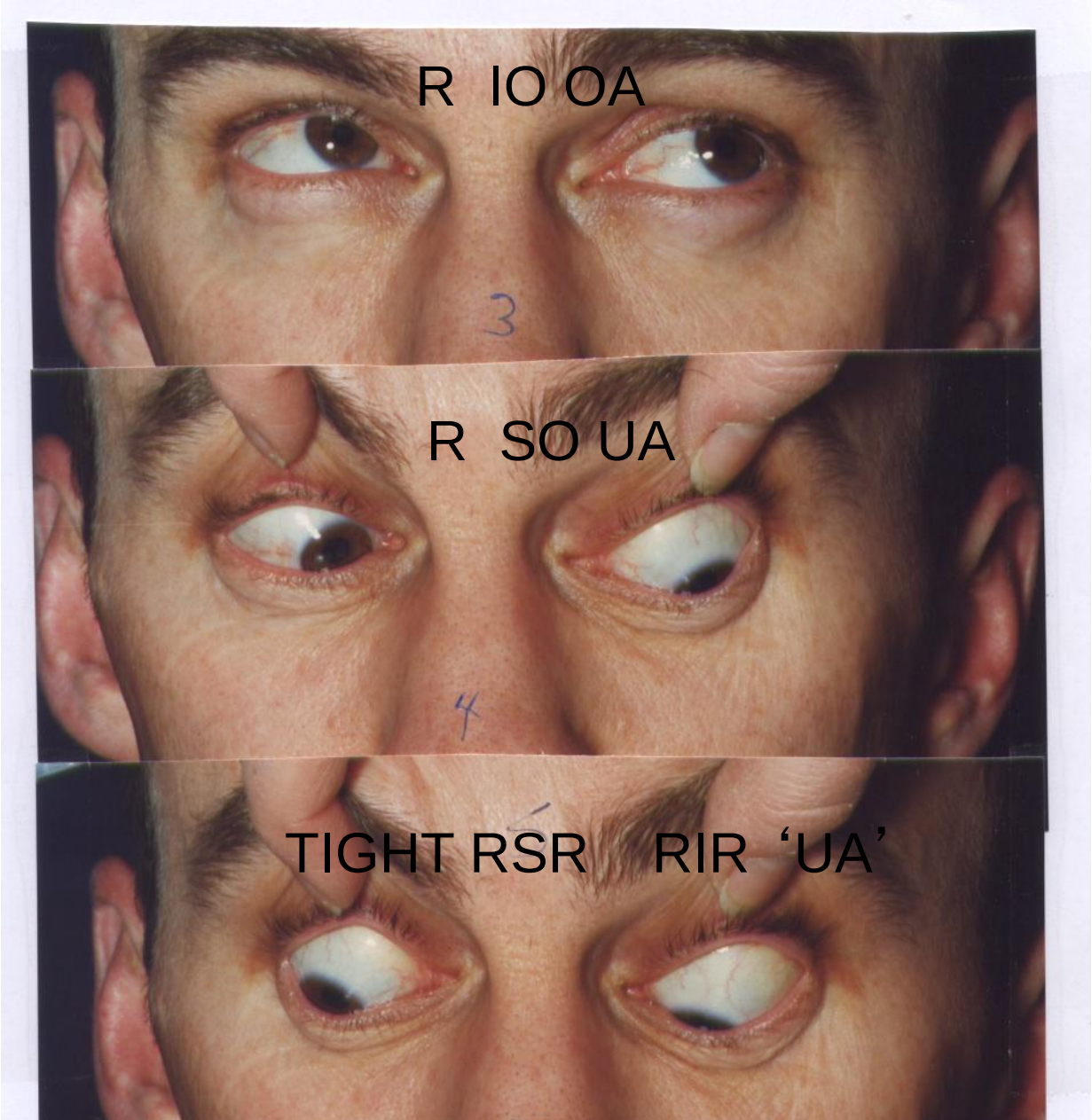
ABNORMAL OBLIQUE ANATOMY / FUNCTION

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 ± 2-3 Δ.

Any imperfection will interfere with motor fusion, and predispose to tropia; if hyperopic, ET

ABNORMAL OBLIQUE ANATOMY / FUNCTION



MECHANICAL FACTORS THAT DECREASE THE QUALITY OF FUSION 1 ABNORMAL OBLIQUE ANATOMY / FUNCTION

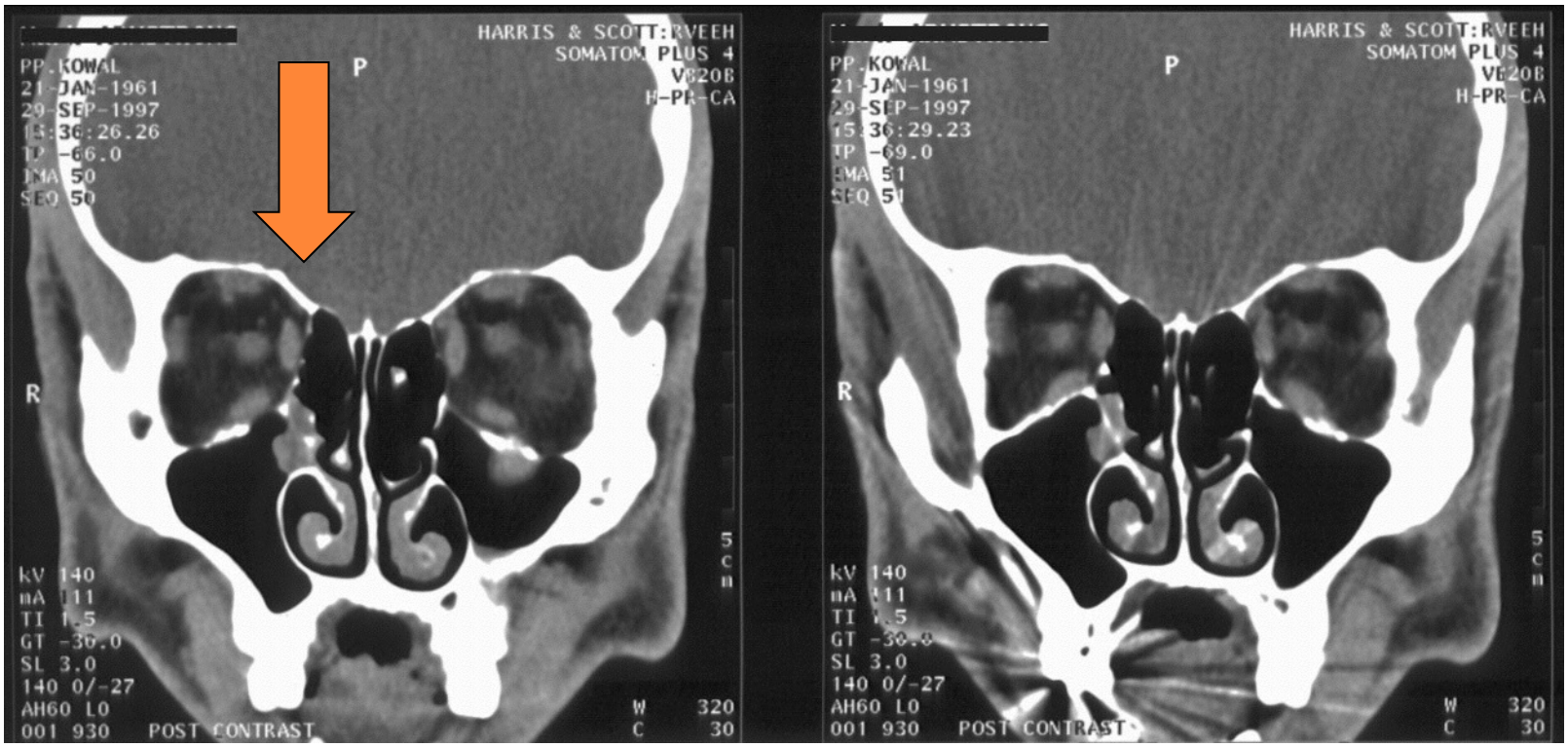
1. Atrophic superior oblique

It never developed or

Damaged by falling off change table / bike …

MECHANICAL FACTORS THAT DECREASE THE QUALITY OF FUSION 1

SUPERIOR OBLIQUE ATROPHY



LSO OK RSO ?absent

MECHANICAL FACTORS THAT DECREASE THE QUALITY OF FUSION - SUBTLE ABNORMALITIES IN ORBITAL ANATOMY 2

ABNORMAL OBLIQUE ANATOMY / FUNCTION – NON PARETIC

FINK: 20% of cadavers: > 30˚ difference b/w course of SO & IO

Trans Am Ophthalmol Soc. 1954; 52: 305–350. PMCID: P

The Role of Developmental Anomalies in Vertical Muscle Defects

Walter H. Fink

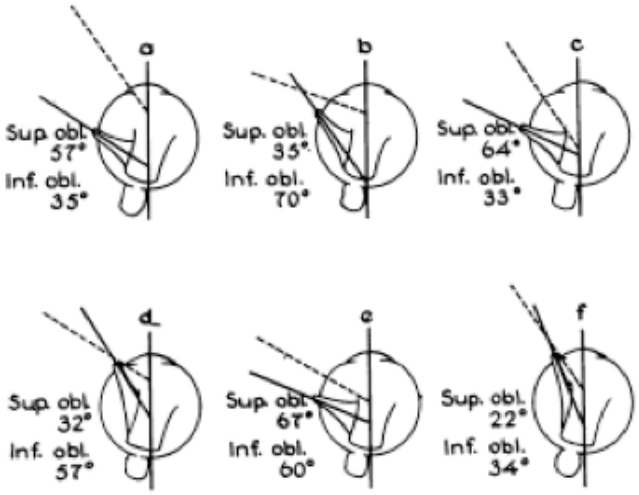


FIGURE 5. DRAWINGS OF SPECIMENS IN WHICH THERE ARE PRONOUNCED VARIATIONS OF THE OBLIQUE MUSCLE PLANES OF ACTION Continuous line indicates the superior oblique plane of action. Broken line indicates the inferior oblique plane of action.

MECHANICAL FACTORS THAT DECREASE THE QUALITY OF FUSION - SUBTLE ABNORMALITIES IN ORBITAL ANATOMY 2
ABNORMAL OBLIQUE ANATOMY / FUNCTION

Unicoronal synostosis [premature fusion of a coronal suture] : ~ **slightly misshapen forehead**.

Apparent IO OA ~50%

Manifest strabismus in primary >**50%**

ET with vertical 61% of all strabismus

BAGOLINI:
isolated posteroplaced trochlea is a cause of idiopathic oblique dysfunction

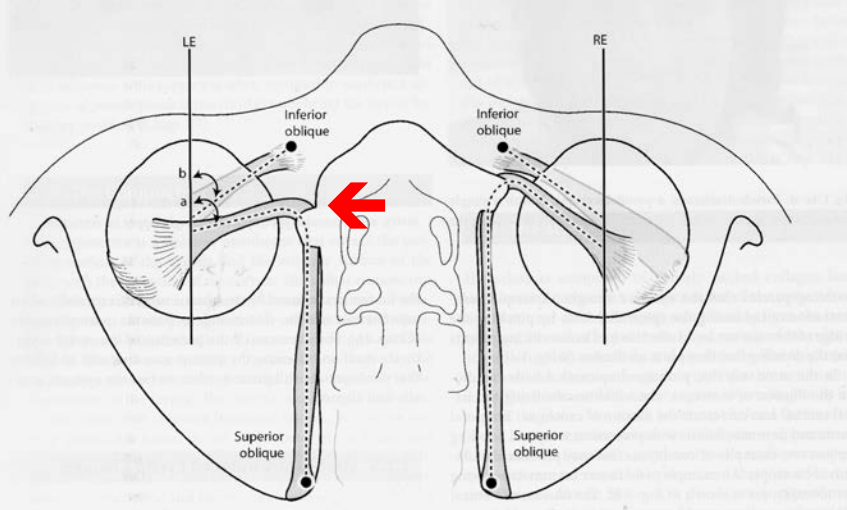


Fig. 1.3. Failure of the trochlea to advance anterior to the equator in a patient with unilateral coronal synostosis may result in reduction of d
pressing action on the globe with contraction of the superior oblique muscle

AAPOS SNEC 2013

MECHANICAL FACTORS THAT DECREASE THE QUALITY OF FUSION - SUBTLE ABNORMALITIES IN ORBITAL ANATOMY 3

- Orbital pulley heterotopy

Changes muscle actions

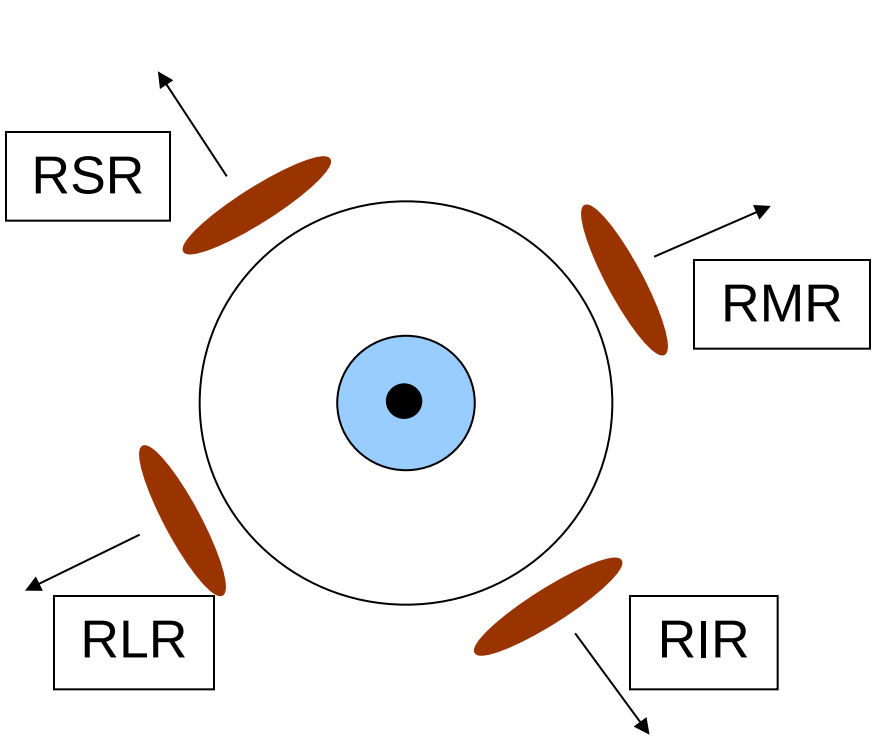
- Intorted / extorted orbit

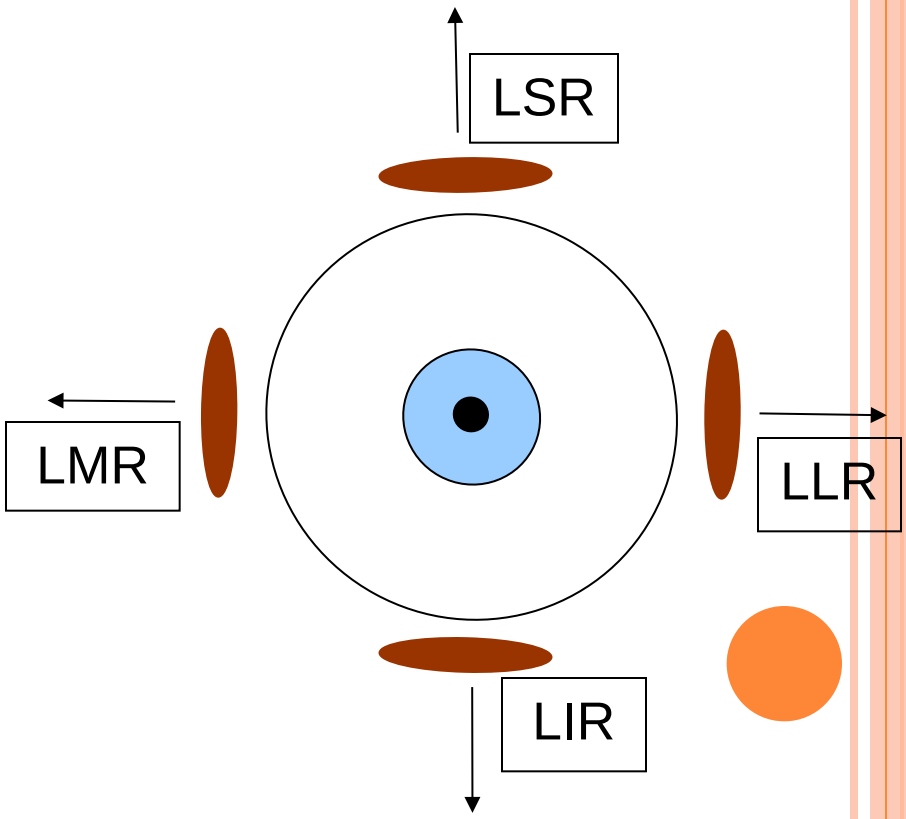
More prone to alphabet patterns

…some overlap

EXTORTED ORBIT

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





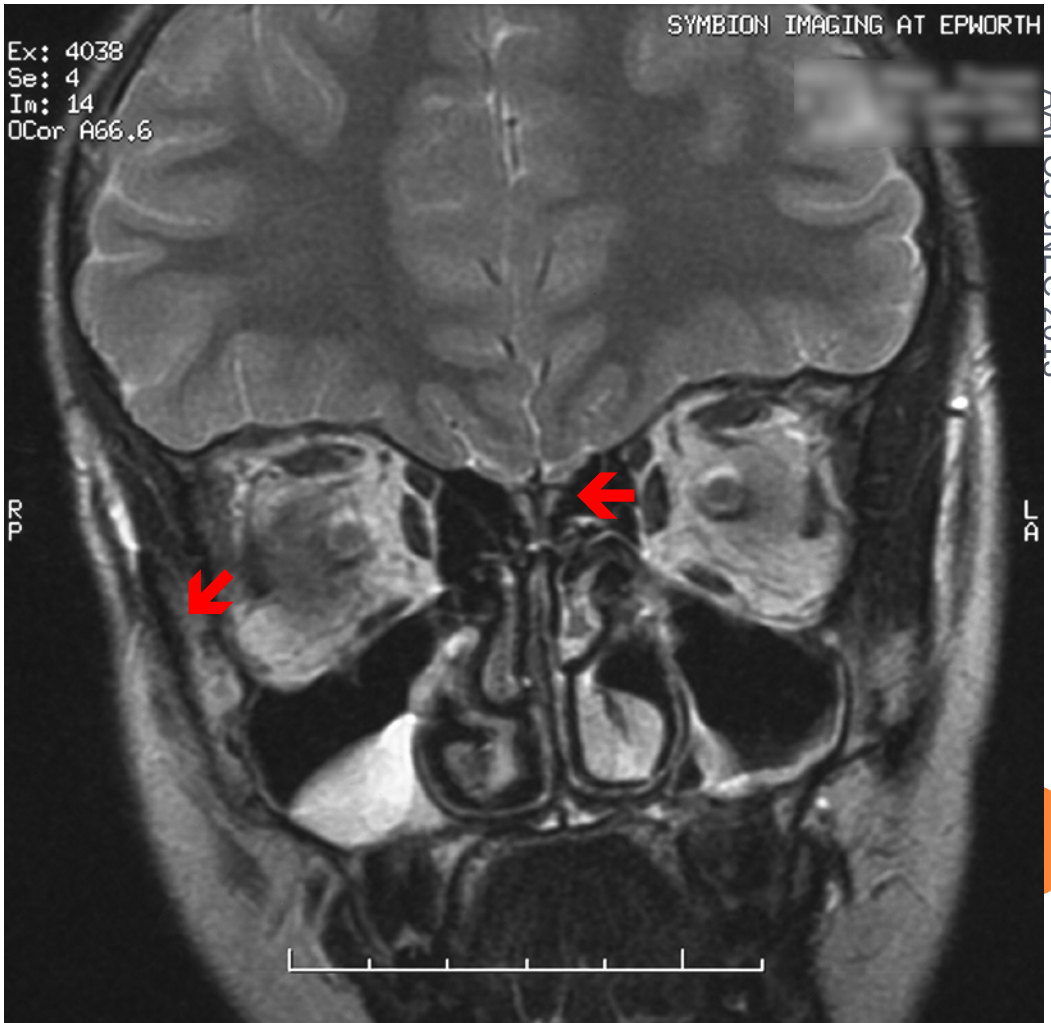
MECHANICAL FACTORS THAT DECREASE THE QUALITY OF FUSION -
SUBTLE ABNORMALITIES IN ORBITAL ANATOMY 3
ORBITAL PULLEY HETEROTOPY

RLR lower than RMR

R gaze: RLR will pull RE to R & **down**

LMR will adduct on the horizon: LE will then be higher than RE: **Resembles LIOOA**

Will be no fundus torsion: LIO surgery not expected to be effective



FACTORS THAT DECREASE QUALITY OF FUSION

Mechanical

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

Neurological /sensory:

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

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 pressure to misalign them

- ⇓ sensory fusion

stereopsis

- Abnormal binocular columns

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

Stroke @ 32 weeks gestation.

Causes one/ more of:

Cong ET **PVL: 30+ times greater risk of IOS**

Congenital nystagmus [both types]

Optic n hypoplasia

Reading problems

Reduced acuity for cortical reasons [CVI]

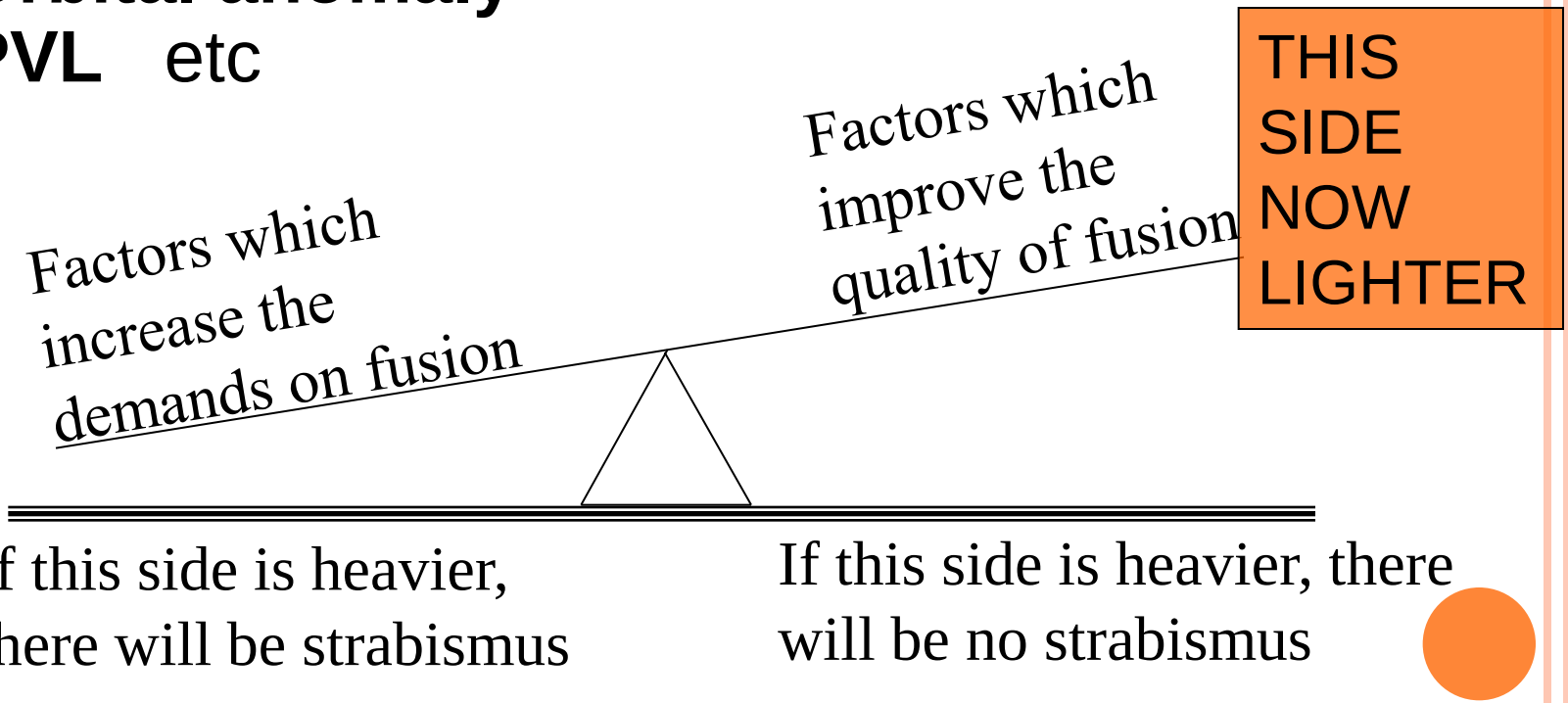
& …..

Non-mechanical Factors which decrease the quality of fusion 3

- **Amblyopia**
  - e.g. anisometropic amblyopia, amblyopia from congenital cataract, strabismic amblyopia
- **Decreased vision from organic causes**
  - Retinal disease - any visual pathway disease
- **Head injury**

IMPAIRED SENSORIMOTOR FUSION:
ET happens more readily [with lower or no +]

- **Chromosomal defect / devptl delay**
  Amblyopia
  Orbital anomaly
  PVL etc



TYPES OF STRABISMUS

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

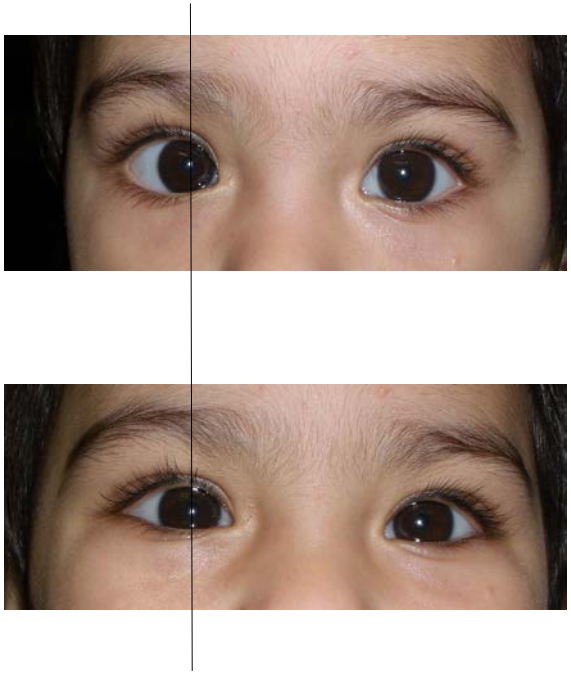
PSEUDO-ET:
BEWARE OF DISMISSING AN ? ET (NOT PRESENT DURING YOUR TESTING) AS A PSEUDO-ET

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

R pseudo ET

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

- MUST include cycloplegic retinoscopy for latent hyperopia



Pseudo-ET

Determine if 6^ 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***

PSEUDO STRABISMUS: IS IT?

This is not Chandigarh, but isn't it a beautiful photo?

- 51 children
- Av age, 1.5 ± 0.8 y; range, 3-36 mo
- Refractive accommodative ET developed in **16%** of the children @ mean age of 2.8 ± 1 y.
- **ET developed in 54% of children with pseudoesotropia who were > + 1.5 D c.f. 3% of those ≤ + 1.50 D (P=0.0001).**

- Family history of strabismus (P= 0.193) and age @ presentation with pseudoesotropia (P =0.571) were not predisposing factors.

- *Development of refractive accommodative esotropia in children initially diagnosed with pseudoesotropia*
- *Mohan & Sharma, J AAPOS 2012;16:266-268 Chandigarh*

DEVELOPING AN ESOTROPIA…

THE UNCORRECTED HYPEROPE

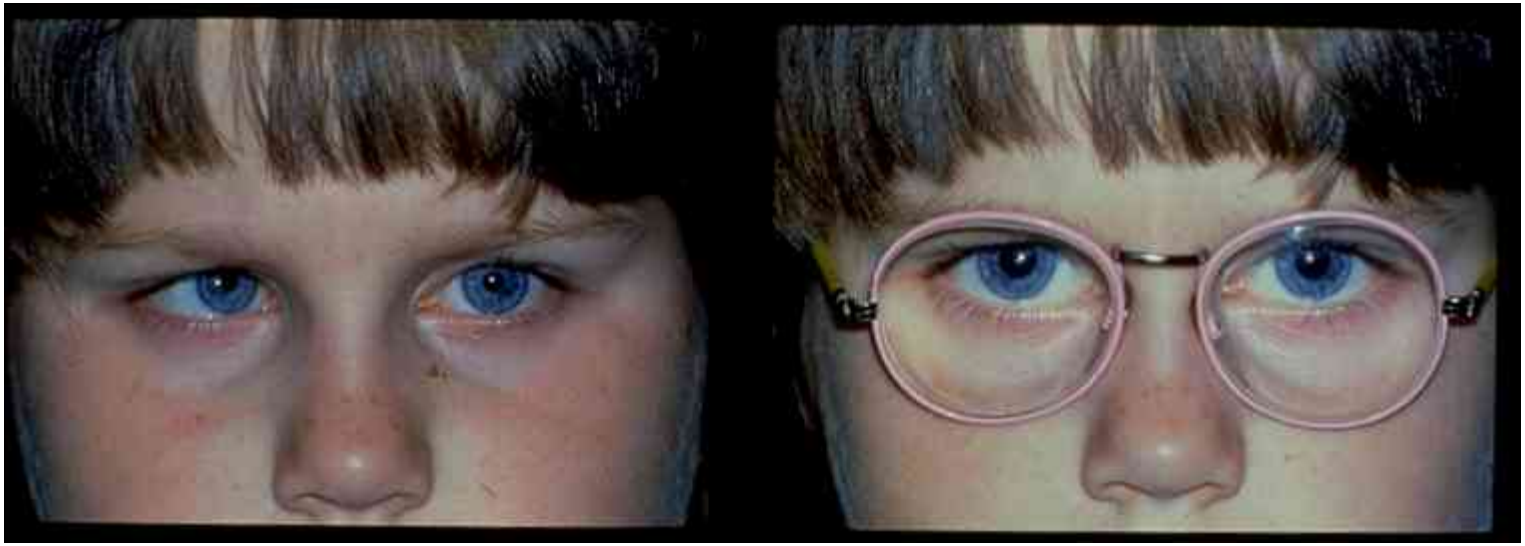
Prolonged accommodation → tendency to prolonged inappropriate convergence and **increased tone in medial recti** [vergence tonus]

Developing an esotropia…2

- 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

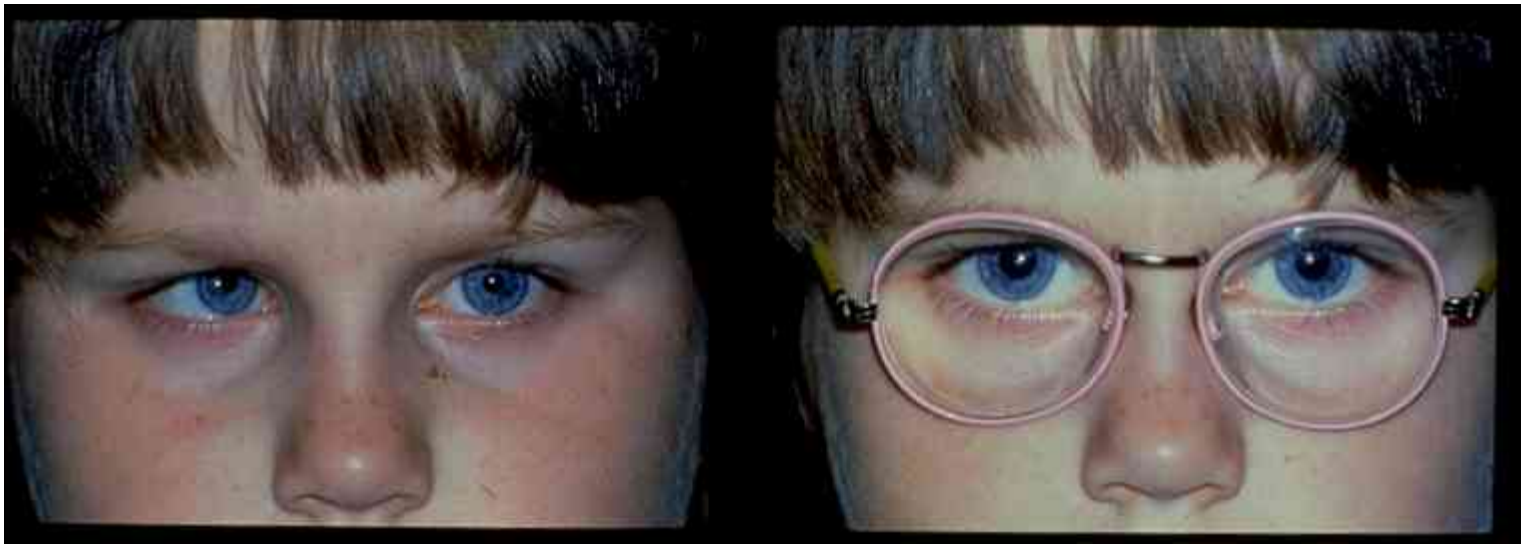
- **SEMINAL SLIDE**

‘OPTOMETRIC’ ESOTROPIA



- e.g. +4 : Abnormal [& appropriate!] degree of accommodation is required to see clearly
- Abnormal amount of accommodative convergence is generated
- Glasses required to make the child normal
- If you wait too long before you fully compensate with +, you will get structural changes in the MR and glasses alone will be insufficient to straighten the eyes

‘OPTOMETRIC’ ESOTROPIA



- Exactly the same can happen with low + and abnormal accommodative - convergence relationship = **convergence excess.**
- If you wait too long before you fully compensate with +, you will get structural changes in the MR and glasses alone will be insufficient to straighten the eyes

Accommodative esotropia

- Usually 2-5 yrs old

Second small peak in middle age

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

Esotropia ET

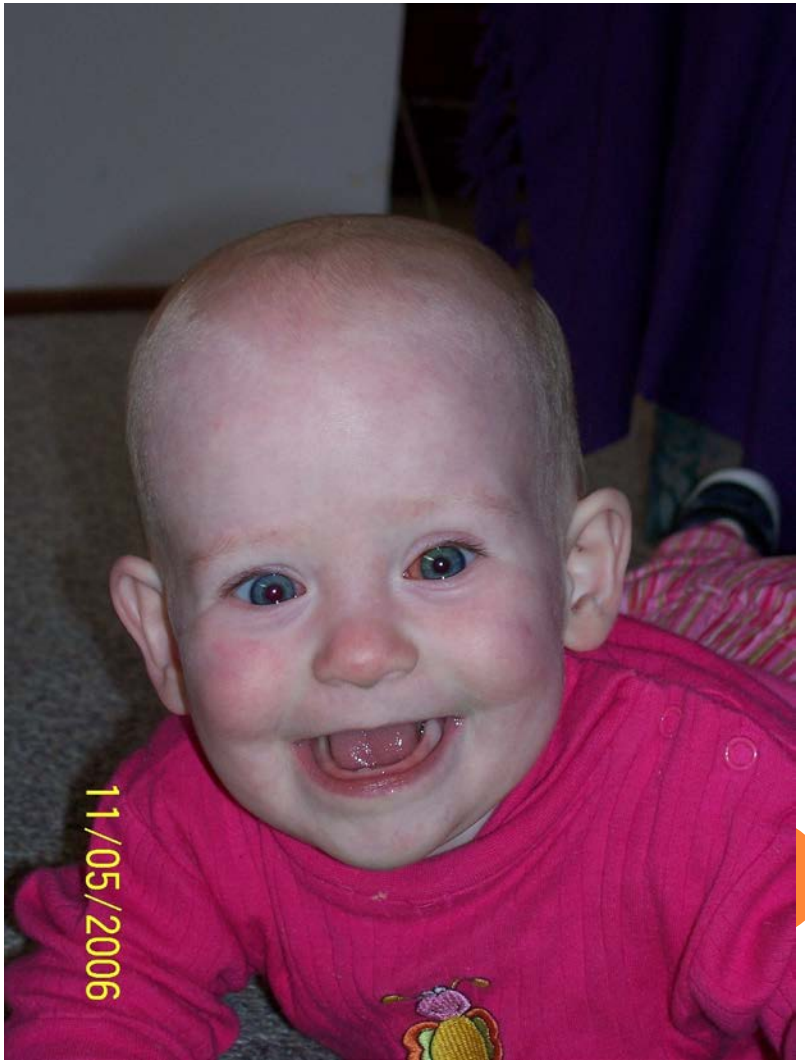
- **ET: core problem is [or becomes] a tight medial rectus, often driven by accom convergence**

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

TYPES OF STRABISMUS

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

CONGENITAL ESOTROPIA
= IOS INFANTILE ONSET STRABISMUS, USU ET



ASSOCIATIONS OF CONGENITAL ET

- Down's 30%
- Bad neonatal course

IVH / HC >>50%

- PVL ?%

PRINCIPLES OF TREATMENT OF ANY ET

- 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 amblyopic eye*
- 2. Rx any amblyopia
- 3. Consider realignment for any residual ET after best amblyopia result and + has been re-checked

+ IN ET

- Always give full +
- Then check that you have given full +
- Then check again

Over 8-10 yo: a new Q

- **Does this child still need full + to stay this good?**
- If BIFR > 6, consider cutting by 0.5 DS every 4-6 months

BENEFITS OF REALIGNMENT OF ET

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

THINKING OF SURGERY….

The child has symptoms or signs that surgery can be expected to improve & after a discussion about:

- Benefits
- Risks
- Hassle / Costs
- Alternative treatments

….I proceed, with the parents' blessings

Parents' expectations have to = mine 1

- Realignment fixes part - a large necessary part, but only a part - of the problem
- Often, the only reliable outcome is improved appearance

Parents' expectations have to = mine 2

- ET: improved alignment: improved field
- Perfect alignment necessary for 3D
- Glasses may still be needed
- Amblyopia Rx may still be needed and may be more effective if the eyes are straight[er]

These parents need LOTS of time

- Parental expectations will never be met: one surgery perfect cure - perfect alignment, appearance, 3D
- Child has had unconventional ineffective treatment for some years : need total recalibration of ‘religion’
- Albinism: +ve angle Kappa common: when aligned, look XT

Mentioning disaster outcomes: Tailor to parent

- Most: surgery is 99+% safe – do you want to talk about the rare problems?

Some:

- Anesthetic disaster 1/100,000
- Blind [usually infection] 1/10,000 – I have never seen it in Melbourne
- Pedestrian/ passenger 1/20,000 pa

- ***New discussion: developmental problems after general anesthesia in young children - several references on my website***

Preparation for the hospital experience

- My website:
- 1. Ella's Eye Surgery Experience
- 2. Amy’s adventure.
- **3.** Gabriel's Eye Surgery Adventures *
- 4. Briannah’s Book
- 5. Kara’s adventure *
- 6. Noah’s adventure

- * not my patient: all others are

Hospital Experience

View Kara's visit to the Eye and Ear:

TECHNIQUES FOR REALIGNMENT OF ET

SURGERY

BIMEDIAL RECESSION or

RECESS / RESECT ONE EYE

Conv Xs: BMR

Amblyopia: R-R

<35Δ same results

Other:

Botox

Prism

SURGERY

AIM: perfect early alignment

- Expectation: 80- 90%
- IF operating for ET /XT, **improve the ‘other’ factors that have compromised fusion** esp. anomalous oblique anatomy /function

SURGERY

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 pateint’

TECHNIQUES FOR REALIGNMENT OF ET : 2

MEDIAL RECTUS BOTOX

- 50+% success for 10 –20Δ ET
- 15% temporary ptosis
- 1% permanent acquired vertical

Small number of Drs get GREAT results

- LK 20 p.a. [= 20% of country]

CONGENITAL ET / IOS

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

Alignment **has** to be mechanically perfect.

- Expectation of alignment : 80- 90%
- The repositioned muscles may not grow in perfect mechanical balance with growth in the eye & orbit; recurrent tropia more common
- No cortical ‘glue’ = no motor fusion to help maintain the mechanical alignment in some

ACQUIRED ET:

- 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, and keep the deviation as a phoria.

**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

SEMINAL SLIDE
ESOTROPIA & EXOTROPIA ET & XT

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

EXOTROPIA XT SEMINAL SLIDE

- Core problem is usually **subtle anomaly in orbital anatomy**, not a tight LR

- A common 2° problem:

hemiretinal suppression that 'allows' XT without diplopia

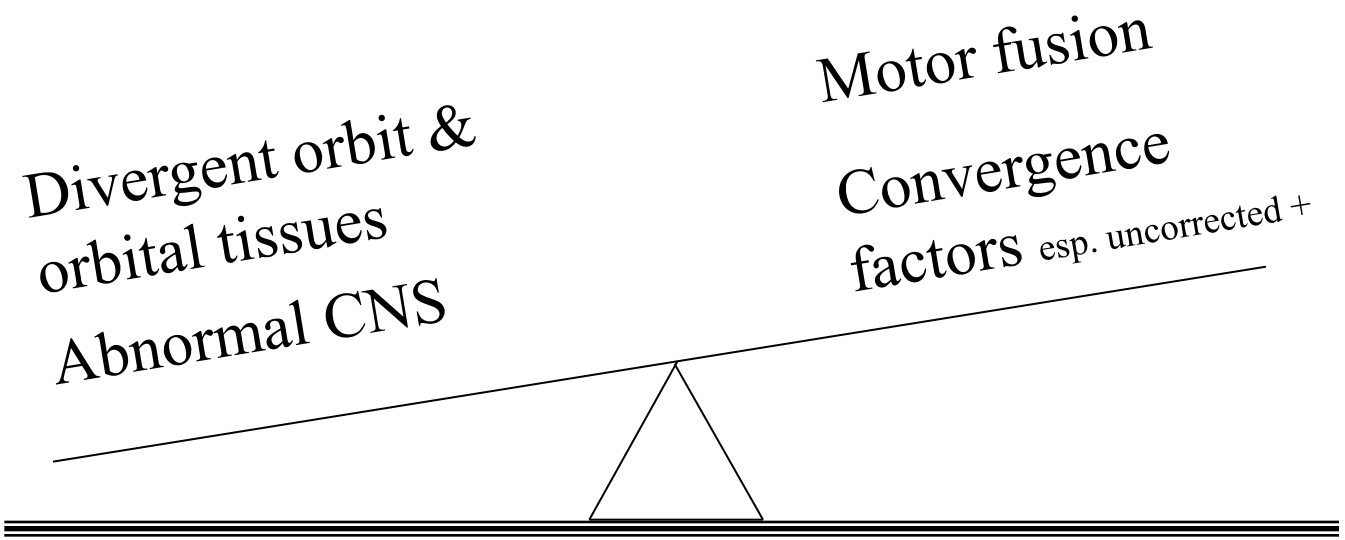
Fixing the LR length & tension tries to compensate for the XT and improve the alignment & mechanics, but:

- 1. does not return the mechanics of this abnormal orbit to normal - this 'allows' some recurrence of XT

- 2. may not alter the suppression pattern even when straight - this 'allows' recurrent XT

EXOTROPIA - BASICS

- Abnormal mechanical balance of orbital tissues & other factors vs. motor fusion & other factors



TYPES OF XT: INTERMITTENT XT, D > N

- Usu 2-7 yo *
- Little / no amblyopia Because often straight
- Motor fusion is typically better for N, so XT worse for D
- Hemiretinal suppression that 'allows' XT without diplopia

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

INTERMITTENT XT : MAYO CLINIC STUDY

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

Basics of treatment of XT

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

Paradoxical effect

- Treat any amblyopia

BASICS OF TREATMENT OF XT
LOOSE GUIDELINES

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

BASICS OF TREATMENT : **MINUS LENS TREATMENT**…TO PROMOTE ACCOMM CONVERGENCE

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

Typically -1.5 over the cyclo to start

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

Usually NOT a long term solution

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

Useful temporising measure to age 7-8

Who gets XT surgery?

Better outcome if :

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

BASICS OF TREATMENT : XT SURGERY

>50% early ET [5-10Δ desirable]

<10% persistent ET ⇒ **risk of amblyopia / troublesome diplopia** depending on age

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

BASICS OF TREATMENT : XT SURGERY OUTCOMES

12 mo results:

10% have needed 2nd surgery

80% excellent

10 yr results:

30% have needed 2nd surgery

OTHER TYPES OF EXODEVIATION

- SENSORY – surgery when it looks bad. Sometimes needs multiple surgeries in a lifetime

- **CONVERGENCE INSUFFICIENCY – very difficult issues with selection bias**
- Mild/ moderate / severe
- CITT trial: did not control for ADHD
- LK: never see pts for whom pencil push-ups are useful

TYPES OF STRABISMUS

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

RED FLAGS IN STRABISMUS

- 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^
- A recently symptomatic vertical of any size
- Recent onset nystagmus / oscillopsia
- Recent / variable ptosis

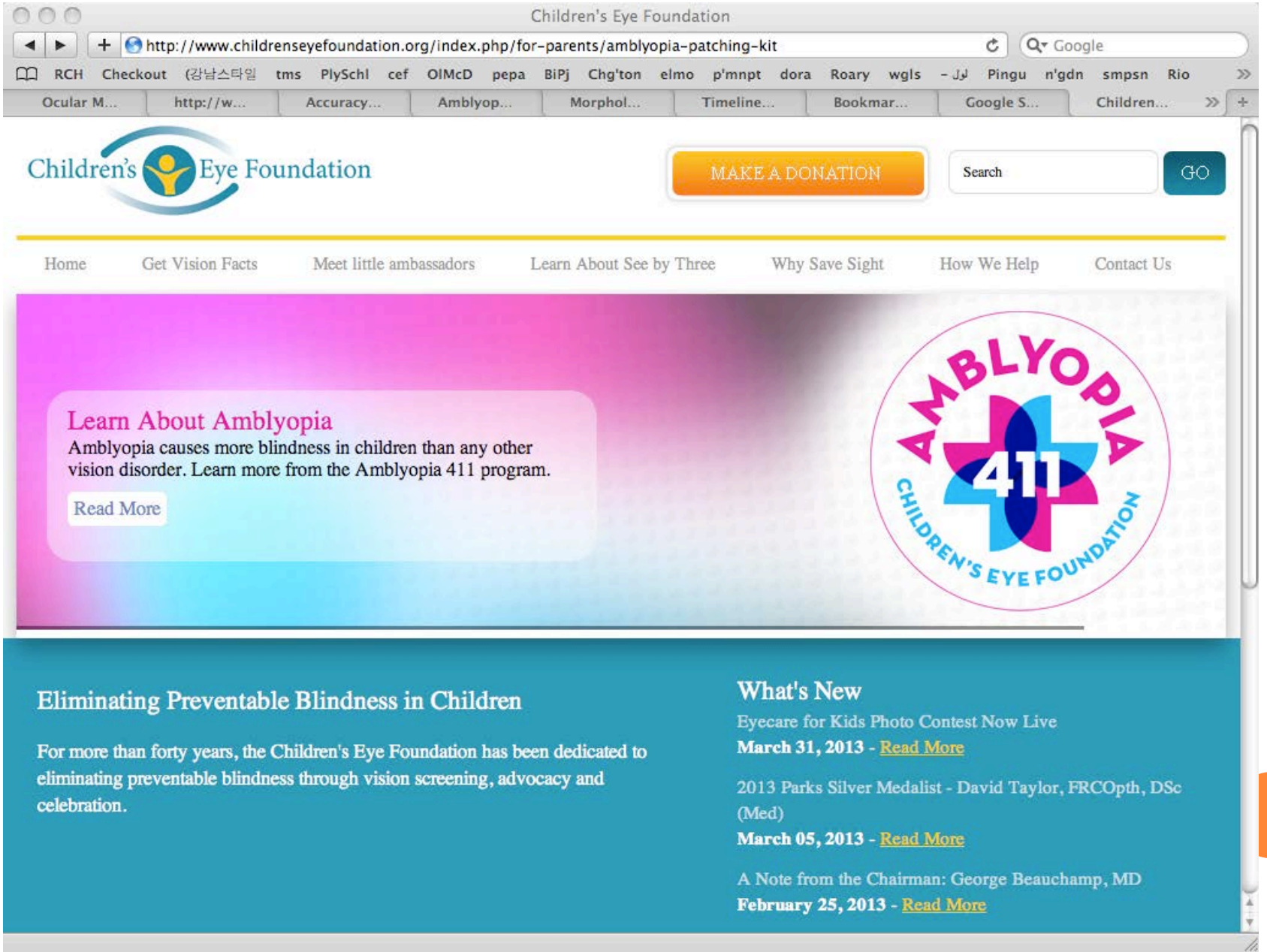
SEMINAL
SOME NOTES ON THERAPEUTIC PRISMS

- **Do not use prisms unless you have a diagnosis or are about to get one**
- ‘Esodeviation’ is not an acceptable diagnosis: could be due to thyroid eye disease, presbyopia, 6th nerve palsy, underplussed, ….

Overview Part 2

- Old and New approaches to amblyopia – causes and treatment

THIS WILL BE DIFFICULT FOR YOU AND PARENTS YOU NEED THEM ON SIDE TO HELP TREAT THEIR CHILD EFFECTIVELY



AMBLYOPIA

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

<u>Small list of associated / causative factors:</u>

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

Why treat amblyopia?

Better spare tyre

More accurate presurgical strabismus measurements

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

AMBLYOPIA ACRONYMS

PEDIG [USA]:

- Large numbers of clinics / patients
- Simulates community treatment

MOTAS [UK]:

- Few clinics
- High tech electronic patch

WHEN TO TREAT AMBLYOPIA?
SUCCESS RATES @ DIFFERENT AGES

3-7 y	75-85%
7-17 y	25 - 50%
Adult	≤10%

AMBLYOPIA TREATMENTS
*WELL STUDIED

Monocular occlusion

- ** Opaque patch popularised by Erasmus Darwin

Asymmetric binocular input

- ** Glasses / CLs
- **Atropine – near penalisation. Late 19th century.
- * Bangerter filters
- * Optical penalisation
- Hess Tetris Ipod [LK: investigator]

PEDIG: Glasses alone

- **6/12 to 6/75**
- 27% cured
- Another 50% ≥ 2 lines better
- Took up to 7 mo

MOTAS
GLASSES ALONE

- 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.

6/12 - 6/24 OCCLUSION & ATROPINE

- 2h/ d = 6h/d
- Weekend A = daily A

- 10%: change in strabismus - better or worse

6/30 -6/120

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

SEMINAL SLIDE

MOTAS …SEVERAL STUDIES

1 line gain:

- needs ~ 120h occlusion

2 line gain:

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

DOSE-RESPONSE OF OPAQUE PATCH @ DIFFERENT AGES

< 4 years old:

- low doses (<3 h/d) are effective, 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 has little effect; need >3h/d

Conclusions of Amblyopia Recurrence Study

- ¼ 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 ≥ 6h of patching stopped – **recurrence risk is lower if patching is reduced to 2h/d before cessation – "weaning" is beneficial**

WHEN IT DOESN'T WORK FOR YOUR PATIENT: IS IT THE PARENTS?

- Parents avoid parading an obviously defective child & will not patch in public
- Parents do not want to inflict discomfort on their child

Recruting parents to treat their children

HAVE TO TREAT THE **FAMILY**

Types of parents ……

- 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).

- 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

- Alignment can result in better response to amblyopia therapy…or no need for amblyopia therapy in 20%?

TIMING OF AMBLYOPIA THERAPY RELATIVE TO STRABISMUS SURGERY

LAM GC, **REPKA MX**, **GUYTON DL** OPHTHALMOLOGY. 1993 DEC

- 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

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

NEW/ UPCOMING BINOCULAR TREATMENTS

- Handheld device based games - BRAVO study, etc
- Video goggles based treatment
- Electronic shutter glasses - AmblyZ
- Pharmacotherapy - Levodopa, Citicholine
- Perceptual learning vision therapy - NeuroVision/ RevitalVision
- Combined perceptual training and Transcranial Random Noise Stimulation (tRNS

CLINICAL AND EXPERIMENTAL
OPTOMETRY

RESEARCH PAPER

The iPod binocular home-based treatment for amblyopia in adults: efficacy and compliance

Clin Exp Optom 2014; 97: 389–398

DOI:10.1111/cxo.12192

Robert F Hess* DSc
Raiju Jacob Babu† OD
Simon Clavagnier* PhD
Joanna Black§ OD
William Bobier† PhD
Benjamin Thompson§ PhD

* McGill Vision Research, Department of Ophthalmology, McGill University, Montreal, Quebec, Canada
† Department of Optometry and Vision Science, University of Waterloo, Waterloo, Ontario, Canada and § Department of Optometry and Vision Science, University of Auckland, Auckland, New Zealand

Background: Occlusion therapy for amblyopia is predicated on the idea that amblyopia is primarily a disorder of monocular vision; however, there is growing evidence that patients with amblyopia have a structurally intact binocular visual system that is rendered functionally monocular due to suppression. Furthermore, we have found that a dichoptic treatment intervention designed to directly target suppression can result in clinically significant improvement in both binocular and monocular visual function in adult patients with amblyopia. The fact that monocular improvement occurs in the absence of any fellow eye occlusion suggests that amblyopia is, in part, due to chronic suppression. Previously the treatment has been administered as a psychophysical task and more recently as a video game that can be played on video goggles or an iPod device equipped with a lenticular screen.
The aim of this case-series study of 14 amblyopes (six strabismics, six anisometropes and two mixed) ages 13 to 50 years was to investigate: 1. whether the portable video game treatment is suitable for at-home use and 2. whether an anaglyphic version of the iPod-based video

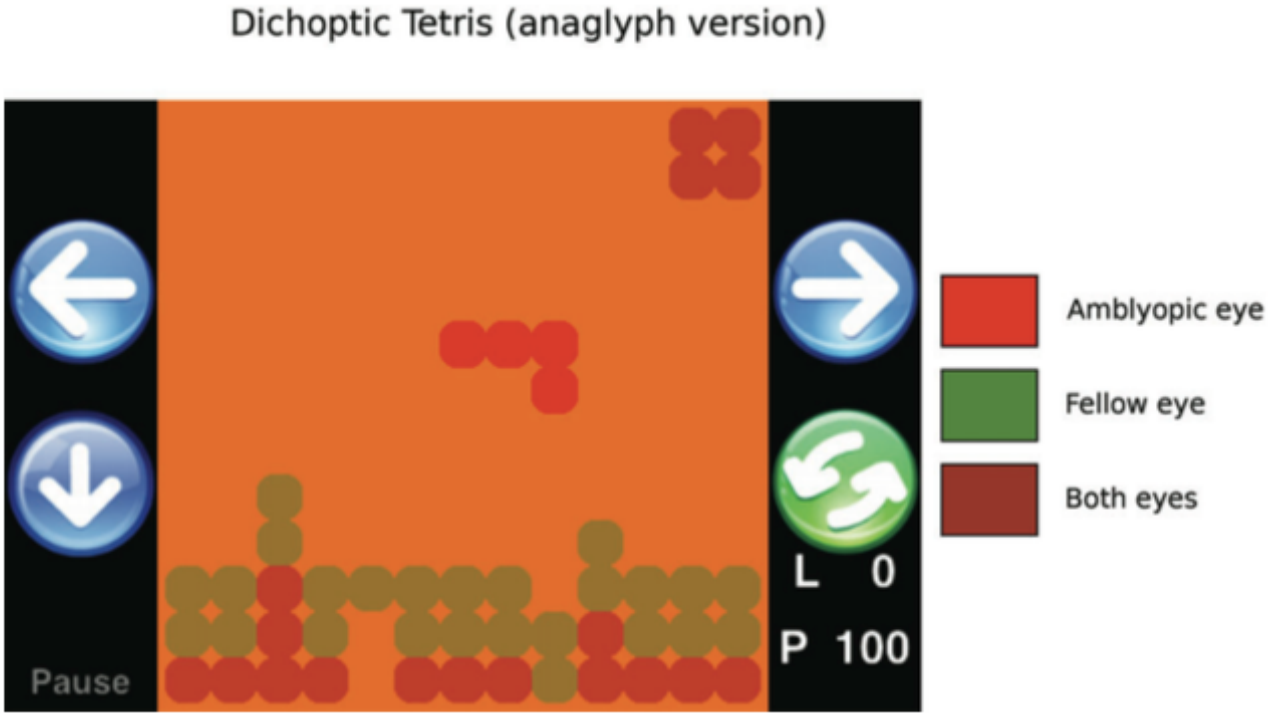


Figure 1. The anaglyphic version of the iPod-based Tetris game. The high-contrast red blocks were seen by the amblyopic eye. These were the falling blocks. The low-contrast green blocks were seen by the fellow fixing eye (FFE). These were the superficial ground plane blocks relevant to the task. Some ground plane blocks were seen by both eyes (brown/orange). Over time and successful play, the contrast offset between the eyes was reduced (the fixing eye contrast was increased by 10 per cent of its starting value every 24 hours). We identified two phases of fusional recovery (Figures 7A and B); phase 1 where the contrast is automatically incrementing in the fixing eye with successful game play and phase 2 where the contrast in the FFE has reached an asymptote (usually 100 per cent), which is the same as that of the fellow amblyopic eye.

BRAVO: BINOCULAR TREATMENT FOR AMBLYOPIA USING VIDEOGAME

OBJECTIVE:

To assess the effectiveness of a novel video-game based (Tetris) treatment for amblyopia, delivered by iPod Touch which directly targets binocular function

- Placebo-controlled, Double-blind, Randomised clinical trial (randomised to receive home-based 6 week treatment of active or placebo game

- **Study Centres**:
- University of Auckland Optometry
- University of Waterloo Optometry
- McGill University, Ophthalmology
- **Centre for Eye Research Australia, RVEEH, Melbourne**
- Optometry, Hong Kong Polytechnic University

Eye (2014) 28, 1246–1253

www.nature.com/eye

LABORATOR

A binocular iPad treatment for amblyopic children

SL Li[1], RM Jost[1], SE Morale[1], DR Stager[2], L Dao[3], D Stager[3] and EE Birch[1,4]

Conclusions **Binocular iPad treatment rapidly improved visual acuity, and visual acuity was stable for at least 3 months following the cessation of treatment.**

RESEARCH LETTER

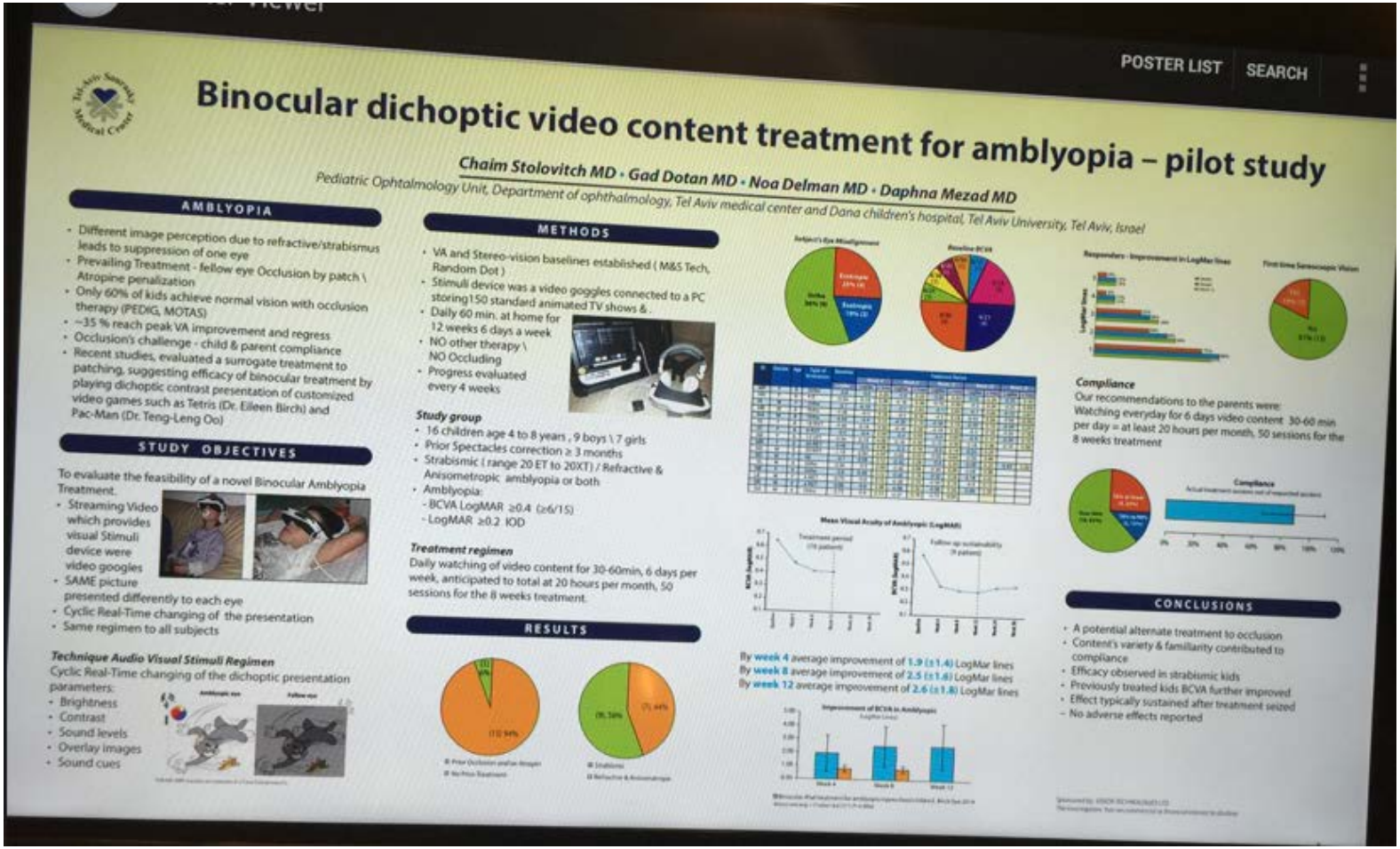
Binocular iPad Treatment of Amblyopia for Lasting Improvement of Visual Acuity

Simone L. Li, PhD
Reed M. Jost, MS
Sarah E. Morale, BS
Angie De La Cruz, BS
Lori Dao, MD
David Stager Jr, MD
Eileen E. Birch, PhD

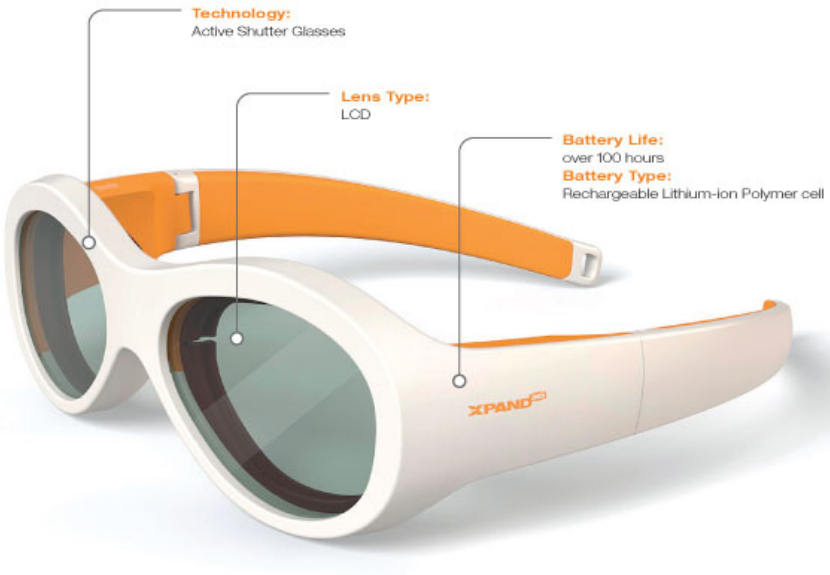
Discussion | To our knowledge, this study provides the first evidence that BCVA improvements obtained with binocular iPad game play are retained for at least 12 months after the treatment ends. Along with our previous study,[4] this demonstrates that home-based binocular iPad games may be an effective treatment for amblyopia. Compared with the traditional patching treatment, which usually takes months to years, the binocular iPad game play appears to improve visual acuity rapidly (in only weeks).

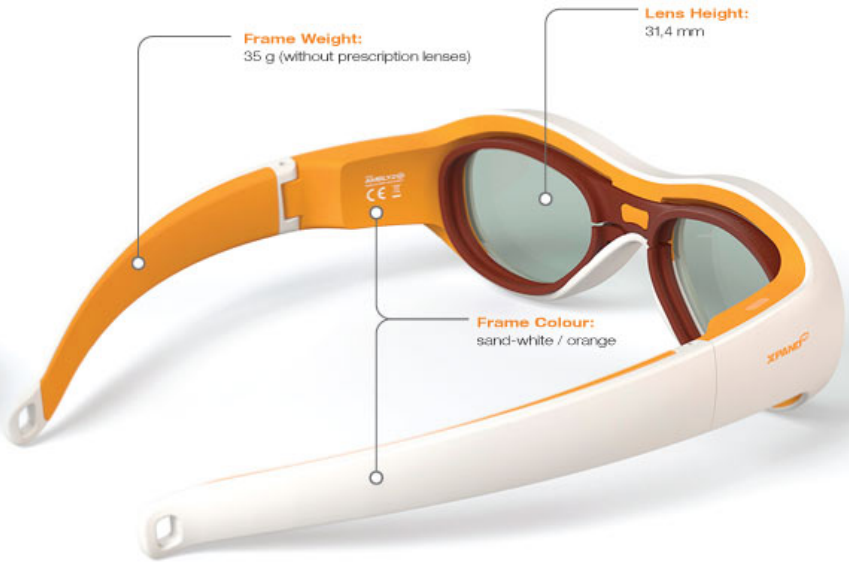
JAMA Ophthalmology Published online January 22, 2015

VERY SMART VIDEO



ELECTRONIC SHUTTER GLASSES - AMBLYZ





AMBLYZ

- Worn like normal prescription glasses all day
- Need to be charged every night

Treating Amblyopia with Liquid Crystal Glasses: A Pilot Study

Abraham Spierer,[1,2] Judith Raz,[2,3] Omry BenEzra,[4] Rafi Herzog,[4] Evelyne Cohen,[5] Ilana Karshai,[5] and David BenEzra[5]

Methods. In this noncomparative, prospective, interventional case series, 28 children (age range, 4–7.8 years) with monocular amblyopia participated, of which 24 completed the study. In the LCG, the occluding and nonoccluding phases of the flicker were electronically set in all patients at a fixed rate. The rate was set so that accumulated occlusion was 5 hours during 8 hours' weartime. Occlusion was applied only to the good eye. All 24 children were followed up regularly for 9 months. Best corrected VA for distance and near, fixation patterns, and binocular function were measured. VA for distance was measured with the Snellen chart and for near with the Rossano/Weiss chart.

Results. Mean VA for distance at the end of the study (after 9 months) was 0.59 (SD, 0.16) compared with 0.27 (SD, 0.09) at the beginning ($P < 0.001$). Most of the children (92%) complied well with the treatment. (Good compliance was defined as wearing the LCG for at least 8 hours per day.) Stereopsis at the end of treatment was good (better than 60 sec arc) in 21% of the children compared with 8% at the beginning. No serious adverse events were recorded.

Conclusions. The use of LCG in patients with amblyopia yielded an improvement in near and distance VA and in stereopsis. Treatment was well accepted by children and parents.

Amblyz™ glasses have been developed to provide convenient, practical, and aesthetic eye patching. Amblyz™ glasses's frame was designed with special thoughts to what it's like to be a child:

- Children with vision problems usually need correction glasses. Amblyz™ glasses incorporate the prescription lens frame so children just wear glasses – like they would if they only needed correction glasses;
- The glasses feature kid-friendly, unisex designs;
- The inner lining is made of soft rubber to ensure perfect fit and comfort for all-day wear;
- The frame is comprised from light weight and durable high grade plastics.

Includes Amblyz™ device, Custom frame for prescription optical glasses, nosepiece, USB charging cable, microfiber pouch and user manual.

Please choose which eye will be occluded. Good-Lite will have the glasses set before they are shipped.

Product Number	Type	Price	Qty.
400200	Right Eye Occlusion	**$450.00**	0
400210	Left Eye Occlusion	**$450.00**	0

Add to Cart

Amblyz™ Electronic Occluding Glasses

For a limited time, the price of Amblyz has been dropped!

Amblyz™ glasses represent a totally new approach in eye occlusion. The electronic device, shaped like glasses, is easy to use, comfortable, suited for children from 3 – 10 years of age. Using electronically controlled intermittent occlusion embedded within the device, Amblyz™ glasses provide eye occlusion without the discomfort and the stigma associated with an eye patch.

Amblyz™ glasses have been developed to provide convenient, practical, and aesthetic eye patching. Amblyz™ glasses's frame was designed with special thoughts to what it's like to be a child:

- Children with vision problems usually need correction glasses. Amblyz™ glasses incorporate the prescription lens frame so children just wear glasses – like they would if they only needed correction glasses;
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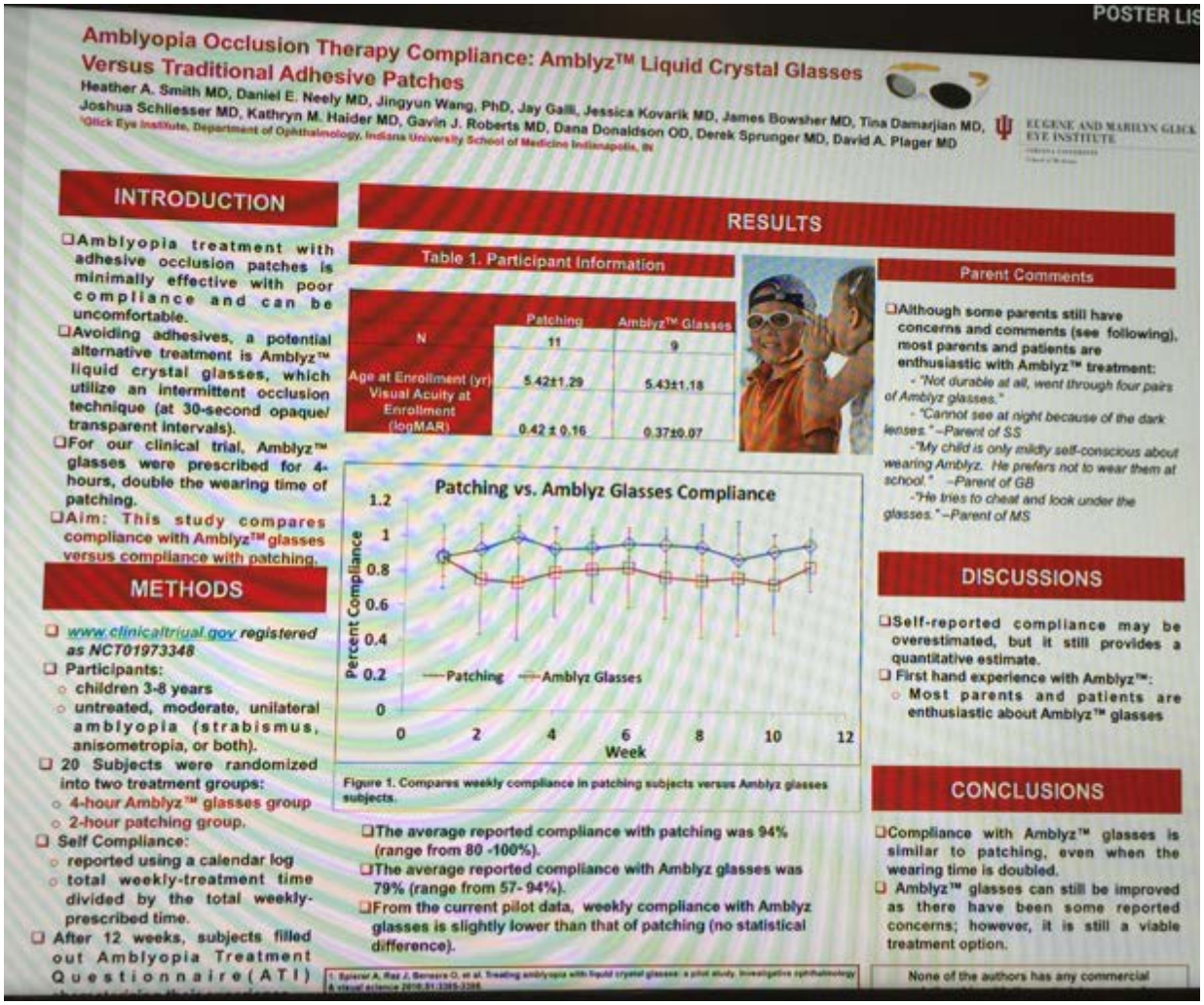
Product Number	Type	Price	Qty.
400200	Right Eye Occlusion	**$275.00**	0
400210	Left Eye Occlusion	**$275.00**	0

INDIANA.
PRESENTED AAPOS, APRIL 2015



POSTER LIS

Amblyopia Occlusion Therapy Compliance: Amblyz™ Liquid Crystal Glasses Versus Traditional Adhesive Patches

Heather A. Smith MD, Daniel E. Neely MD, Jingyun Wang, PhD, Jay Galli, Jessica Kovarik MD, James Bowsher MD, Tina Damarjian MD, Joshua Schliesser MD, Kathryn M. Haider MD, Gavin J. Roberts MD, Dana Donaldson OD, Derek Sprunger MD, David A. Plager MD
Glick Eye Institute, Department of Ophthalmology, Indiana University School of Medicine Indianapolis, IN
EUGENE AND MARILYN GLICK EYE INSTITUTE

INTRODUCTION

- Amblyopia treatment with adhesive occlusion patches is minimally effective with poor compliance and can be uncomfortable.
- Avoiding adhesives, a potential alternative treatment is Amblyz™ liquid crystal glasses, which utilize an intermittent occlusion technique (at 30-second opaque/ transparent intervals).
- For our clinical trial, Amblyz™ glasses were prescribed for 4-hours, double the wearing time of patching.
- Aim: This study compares compliance with Amblyz™ glasses versus compliance with patching.

METHODS

- www.clinicaltrial.gov registered as NCT01973348
- Participants:
  - children 3-8 years
  - untreated, moderate, unilateral amblyopia (strabismus, anisometropia, or both).
- 20 Subjects were randomized into two treatment groups:
  - 4-hour Amblyz™ glasses group
  - 2-hour patching group.
- Self Compliance:
  - reported using a calendar log
  - total weekly-treatment time divided by the total weekly-prescribed time.
- After 12 weeks, subjects filled out Amblyopia Treatment Questionnaire (ATI)

RESULTS

Table 1. Participant Information

	Patching	Amblyz™ Glasses
N	11	9
Age at Enrollment (yr)	5.42±1.29	5.43±1.18
Visual Acuity at Enrollment (logMAR)	0.42 ± 0.16	0.37±0.07

Figure 1. Compares weekly compliance in patching subjects versus Amblyz glasses subjects.

- The average reported compliance with patching was 94% (range from 80 -100%).
- The average reported compliance with Amblyz glasses was 79% (range from 57- 94%).
- From the current pilot data, weekly compliance with Amblyz glasses is slightly lower than that of patching (no statistical difference).

Parent Comments

- Although some parents still have concerns and comments (see following), most parents and patients are enthusiastic with Amblyz™ treatment:
  - *"Not durable at all, went through four pairs of Amblyz glasses."*
  - *"Cannot see at night because of the dark lenses."–Parent of SS*
  - *"My child is only mildly self-conscious about wearing Amblyz. He prefers not to wear them at school." –Parent of GB*
  - *"He tries to cheat and look under the glasses."–Parent of MS*

DISCUSSIONS

- Self-reported compliance may be overestimated, but it still provides a quantitative estimate.
- First hand experience with Amblyz™:
  - Most parents and patients are enthusiastic about Amblyz™ glasses

CONCLUSIONS

- Compliance with Amblyz™ glasses is similar to patching, even when the wearing time is doubled.
- Amblyz™ glasses can still be improved as there have been some reported concerns; however, it is still a viable treatment option.

1. Spiezia A, Raz J, Benaiah O, et al. Treating amblyopia with liquid crystal glasses: a pilot study. Investigative Ophthalmology & Visual Science 2016;57:3265-3268.

None of the authors has any commercial

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

1. Improve /equalize acuity
2. Straighten the eyes

- Optically
  - Botox
- Surgically


That's all Folks!
SUPERB wallpapers