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
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
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
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

- 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 Mojon³

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 al⁶ 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 al⁷ 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 al⁸ 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 al⁹ showed that strabismus surgery reduced the psychosocial difficulties reported before surgery and improved the quality of psychosocial functioning. Beauchamp et al¹⁰ 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?

**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
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
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 = Peri Ventricular Leuko Malacia, damage to the posterior-most fibers of the optic radiations, the binocular inputs to striate cortex).

PVL: >30 fold greater risk of IOS
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.

Factors which increase the demands on, or lessen the quality of horizontal fusion:

If this side is heavier, there will be strabismus.

Factors that optimise the quality of horizontal fusion:

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 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
MATERNAI SMOKING DURING PREGNANCY [ISRAEL; 2012]

Maternal smoking during pregnancy (PPD)

Child's refraction

Non (n=817) 0.2 (n=51) 0.5 (n=50) 0.75 (n=29) 1 (n=27)

P<0.0001
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].
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

Factors which increase the demands on, or lessen the quality of horizontal fusion

Factors that optimise the quality of horizontal fusion

If this side is heavier, there will be no strabismus
LONG 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
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; if hyperopic, ET
MECHANICAL FACTORS THAT DECREASE THE QUALITY OF FUSION

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
FINK: 20% of cadavers: > 30° difference b/w course of SO & IO
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
MECHANICAL FACTORS THAT DECREASE THE QUALITY OF FUSION - SUBTLE ABNORMALITIES IN ORBITAL ANATOMY

- 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
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
Poor Sensorimotor Fusion

- $\downarrow$ motor fusion
  oculomotor ‘shock absorber’ / ‘glue’ that tries to keep eyes straight despite pressure to misalign them
- $\downarrow$ 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

Factors which increase the demands on fusion

Factors which improve the quality of fusion

If this side is heavier, there will be strabismus

If this side is heavier, there will be no strabismus
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?

- 51 children
- Avg 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

This is not Chandigarh, but isn’t it a beautiful photo?
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
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
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].
2. + *for amblyopic eye is to optimise vision in the amblyopic eye*
3. + *for fixing eye is optimise alignment of amblyopic eye*
4. Rx any amblyopia
5. 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
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
<35° 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
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

MEDIAL RECTUS BOTOX

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

Small number of Drs get GREAT results
- LK 20 p.a. [= 20% of country]
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
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

If this side is heavier, there will be exotropia
If this side is heavier, there will be no exotropia
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 ACCOMMODATION 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 ⇒ >10% have persistent ET ⇒ 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 [5-10\(\Delta\) 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
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

Children’s Eye Foundation

Learn About Amblyopia
Amblyopia causes more blindness in children than any other vision disorder. Learn more from the Amblyopia 411 program.
Read More

Eliminating Preventable Blindness in Children

For more than forty years, the Children’s Eye Foundation has been dedicated to eliminating preventable blindness through vision screening, advocacy and celebration.

What’s New

Eyecare for Kids Photo Contest Now Live
March 31, 2013 - Read More

2013 Parks Silver Medalist - David Taylor, FRCOpt, DSc (Med)
March 05, 2013 - Read More

A Note from the Chairman: George Beauchamp, MD
February 25, 2013 - Read More
AMBLYOPIA

- Normal ocular 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 which amblyopia is superimposed
WHY TREAT AMBLYOPIA?

Better spare tyre

More accurate presurgical strabismus measurements

Better sensory fusion: ↑ stereo ⇒ 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

<table>
<thead>
<tr>
<th>Age</th>
<th>Success Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-7 y</td>
<td>75-85%</td>
</tr>
<tr>
<td>7-17 y</td>
<td>25-50%</td>
</tr>
<tr>
<td>Adult</td>
<td>≤10%</td>
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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
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’?

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
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…
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)
RESEARCH PAPER

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


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Raiju Jacob Babu† OD
Simon Clavagnier‡ PhD
Joanna Black§ OD
William Bobier† PhD
Benjamin Thompson§ PhD

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† Department of Optometry and Vision Science, University of Waterloo, Waterloo, Ontario, Canada
‡ 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
A binocular iPad treatment for amblyopic children

Conclusions Binocular iPad treatment rapidly improved visual acuity, and visual acuity was stable for at least 3 months following the cessation of treatment.
Binocular iPad Treatment of Amblyopia for Lasting Improvement of Visual Acuity

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, 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).
Binocular dichoptic video content treatment for amblyopia – pilot study

Chaim Stolovitch MD, Gad Dotan MD, Noa Delman MD, Daphna Mezaz MD

Pediatric Ophthalmology Unit, Department of ophthalmology, Tel Aviv Medical Center and Dana Children’s Hospital, Tel Aviv University, Tel Aviv, Israel

AMBLYOPIA
- Different image perception due to refractive/strabismus leads to suppression of one eye
- Prevaling Treatment - fellow eye Occlusion by patch / Atropine penalization
- Only 60% of kids achieve normal vision with occlusion therapy (PFEDG, MOTK)
- ~35% reach peak VA improvement and regress
- Occlusion’s challenge - child & parent compliance
- Recent studies, evaluated a surrogate treatment to patching, suggesting efficacy of binocular treatment by playing dichoptic contrast presentation of customized video games such as Tetris (Dr. Eileen Birch) and Pac-Man (Dr. Teng-Ling Ooi)

METHODS
- VA and Stereo-vision baselines established (M&S Tech, Random Dot
- Stimuli device was a video goggles connected to a PC storing 150 standard animated TV shows
- Daily 60 min, at home for 12 weeks 6 days a week
- NO other therapy
- NO Occluding
- Progress evaluated every 4 weeks

STUDY OBJECTIVES
To evaluate the feasibility of a novel Binocular Amblyopia Treatment.
- Streaming Video which provides visual Stimuli device were video googles
- SAME picture presented differently to each eye
- Cyclic Real-Time changing of the presentation
- Same regimen to all subjects

Technique Audio Visual Stimuli Regimen
Cyclic Real-Time changing of the dichoptic presentation parameters:
- Brightness
- Contrast
- Sound levels
- Overlay images
- Sound cues

RESULTS

CONCLUSIONS
- A potential alternate treatment to occlusion
- Content’s variety & familiarity contributed to compliance
- Efficacy observed in strabismic kids
- Previously treated kids BCVA further improved
- Effect typically sustained after treatment ceased
- No adverse effects reported
ELECTRONIC SHUTTER GLASSES - AMBLYZ

**Technology:**
- Active Shutter Glasses

**Lens Type:**
- LCD

**Battery Life:**
- over 100 hours

**Battery Type:**
- Rechargeable Lithium-ion Polymer cell

**Frame Weight:**
- 35 g (without prescription lenses)

**Frame Colour:**
- Sand/White / Orange

**Lens Height:**
- 31.4 mm
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 BenEzra5

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.

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<th>Product Number</th>
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<tr>
<td>400210</td>
<td>Left Eye Occlusion</td>
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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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INDIANA. PRESENTED AAPOS, APRIL 2015
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!