The Institute of Optometry is unique in being an independent self-financing charity dedicated to the promotion of clinical excellence, research, and education in optometry.

Roberson (1989)

Binocular vision anomalies: preliminary investigation & treatment

The relations of the 41st Congresso Nazionale dell’Albo degli Ottici Optometristi

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PLAN

INTRODUCTION

INVESTIGATION OF INCOMITANCY

INVESTIGATION OF HETEROPHORIA

INVESTIGATION OF HETEROTROPIA

TREATMENT

CONCLUSIONS

Full handout of slides from www.bruce-evans.co.uk

DISCLOSURE

Paid lectures & KOL/product feedback programmes:
- Lecture content always my own
- Author of Pickwell’s Binocular Vision Anomalies, editions 3-5
- I.O.O. Sales Ltd markets IFS orthoptic exercises, which the speaker designed, and for which he receives a small royalty
- Community optometric practice in Brentwood, Essex

OVERVIEW: CAVEAT

- Always look for pathology:
- Neuro-optometric checks
- Pupils, discs, fields, strabismus, incomitancy, accommodation
- Check these things regularly
- Don’t forget refraction
- Change management if not improving significantly
- Refer if still not improving
- Appropriate re-exam intervals (frequent)
Why do we get spectacle non-tolerance? (Evans, 2012)

- 95% limits of repeatability of subjective refraction are circa ± 0.50D to 0.75D
  [MacKenzie (2008); Shah et al. (2009)]
- in spectacle non-tols the final Rx is within ±0.50D of the not tolerated one in 84% of cases  [Freeman & Evans (2010)]
- a significant number of wearers notice errors in distance vision, as small as +0.25D in sphere and cylinder  [Miller et al. (1997)]
- So, some non-tols are inevitable

Demographics of prescription non-tols (Freeman & Evans, 2010)

- 3091 eye exams in 6/12
  - 62 non-tols; 59 included
- Most common in 50-59y
- 88% of non-tols presbyopes
- Male = female
- None were neophytes (not significantly different to control group)
- All could be resolved with an adjustment of 1.00D
  - 84% with 0.50D adjustment

Reasons for non-tol examinations (Freeman & Evans, 2010)

<table>
<thead>
<tr>
<th>Reason</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prescription related</td>
<td>61%</td>
</tr>
<tr>
<td>Dispensing related</td>
<td>22%</td>
</tr>
<tr>
<td>Pathology</td>
<td>8.5%</td>
</tr>
<tr>
<td>Data entry error</td>
<td>6.8%</td>
</tr>
<tr>
<td>Binocular vision</td>
<td>1.7%</td>
</tr>
</tbody>
</table>

Conclusions on spectacle non-tolerance

- Over 80% of non-tols are presbyopes
- Don’t over-plus or under-minus
- The accuracy of refraction (±0.75) is worse than the mean adjustment needed to correct a non-tol (±0.50)
  - So discourage patients from separating prescribing and supply
- Consider non-tols as an opportunity by excelling at dealing with these challenging patients

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CAUSES OF PARESES

- Diabetes
- Hypertension
- Stroke
- Aneurysms
- Temporal arteritis
- Tumours
- Multiple sclerosis
- Myasthenia gravis
- Migraine
- Trauma
- Thyrotoxicosis
- Toxic
- Iatrogenic
- Idiopathic

Underlined = more likely in elderly
Motility test

- Use reliable pen torch
- Check nose not occluding
- Really, three tests, so do three times:
  1) Observe corneal reflexes
  2) Cover test in peripheral gaze
  3) Ask about diplopia
- Beware of reports of diplopia
  - May break down (in view of target, distance, fus. res.)
  - May be confused
  - Know the muscle actions (RADSIN)

Common incomitancies seen in optometric practice

- Superior oblique palsy
- Duane’s syndrome
- Lateral rectus palsy
- Brown’s syndrome

- Become familiar with what these look like:
  - CD in Pickwell’s Binocular Vision Anomalies, 5th edition

SO palsy

- Usually:
  - Hyper-deviation of affected eye, worse in down-gaze
  - Under-action of affected eye when looking down and in
  - More likely to have symptoms with reading than with distance
- But, may have secondary sequelae
- Avoid fitting multifocal spectacles or monovision

Duane’s syndrome

- Retraction of the globe on attempted adduction
- Co-contraction of medial and lateral recti
- Not all cases exhibit retraction
- Limitation of abduction and/or adduction in one or both eyes
- Can look like a lateral or medial rectus palsy
- May also be elevation or depression of affected eye
- Convergence is very often abnormal, even when adduction appears to be intact

Brown’s syndrome

- Mechanical restriction of the superior oblique
- Looks like inferior oblique (IO) palsy
- But IO palsy is much rarer & has:
  - Secondary sequelae
  - Incycledeviation in primary position
  - Positive Parks three step test

Incomitancies: conclusions

- Some incomitancies are difficult to detect
  - 2/3 of diplopic hypertropic pxs OK on motility
  - Tamhankar et al (2011)
- If symptoms are suspicious, do cover testing in peripheral gaze
- Testing for cyclo-deviations detects SO palsies
- Refer new or changing incomitancies
- In some long-standing cases, prescribing the prism required in the primary position may help
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SYMPTOMS OF DECOMP. PHORIA

1. Blurred vision
2. Diplopia
3. Distorted vision
4. Difficulty with stereopsis
5. Monocular comfort
6. Difficulty changing focus
7. Headache
8. Aching eyes
9. Sore eyes
10. General irritation

KEY SIGNS OF DECOMP. PHORIA

- Symptoms
- Poor cover test recovery
- Aligning prism
- Low fusional reserve opposing phoria
  - Sheard’s criterion
  - Particularly useful for exophorias
- For esophorias, size and imbalanced fusional reserves are relevant
- For hyperphorias, size matters

KEY SIGNS OF DECOMP. PHORIA

- Symptoms
- Poor cover test recovery
- Aligning prism (FD test)
- Low fusional reserve opposing phoria
  - Sheard’s criterion
  - Particularly useful for exophorias
- For esophorias, size and imbalanced fusional reserves are relevant
- For hyperphorias, size matters
ALIGNING PRISM: Mallett Unit
• aligning prisms/spheres to eliminate FD
• good foveal and peripheral fusion lock
• question set is important
  • ask if a line ever moves
  • Karania & Evans (2006)

KEY SIGNS OF DECOMP. PHORIA
• Poor cover test recovery
• Aligning prism
• Low fusional reserve opposing phoria
  • Sheard’s criterion
  • Particularly useful for exophorias
• For esophorias, size and imbalanced fusional reserves are relevant
• For hyperphorias, size matters

Optometric correlates of dyslexia:
Meares-Irlen Syndrome/Visual Stress (MISViS)
PREVALENCE: 30% of people with dyslexia
AETIOLOGY: cortical hyperexcitability causing pattern glare from text
SYMPTOMS: asthenopia, headaches, perceptual distortions
SIGNS: coloured overlays alleviate symptoms and improve rate of reading
TREATMENT: Precision Tinted lenses

Differential diagnosis:
Binocular vision anomaly or MISViS

<table>
<thead>
<tr>
<th>Sign</th>
<th>Binocular vision anomaly</th>
<th>Meares-Irlen Syndrome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypothalamus</td>
<td>Single gaze and binocular metacity</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Low fusional reserve</td>
<td>Present</td>
<td>May be present</td>
</tr>
<tr>
<td>Signs affected by occlusion</td>
<td>Yes</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Pattern glare</td>
<td>Unlikely</td>
<td>Present</td>
</tr>
<tr>
<td>Phosphate</td>
<td>Yes, but not colour specific</td>
<td>Yes, colour specific</td>
</tr>
<tr>
<td>Symptoms alleviated by coloured lenses</td>
<td>Unlikely</td>
<td>Yes</td>
</tr>
</tbody>
</table>

In the CITT RCT of VT for CI (2008) ONLY 56% of those receiving optimal VT were asymptomatic at the end of 12 weeks of treatment (CITT, 2008).

Allen, Evans, Wilkins (2010) Vision & Reading Difficultes
Strabismus: the bottom line for the busy optometrist

**SUMMARY:** DIAGNOSIS

<table>
<thead>
<tr>
<th>Type of strabismus</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exotropia (deviation towards the nose)</td>
<td>No</td>
</tr>
<tr>
<td>Esotropia (deviation towards the eye)</td>
<td>No</td>
</tr>
<tr>
<td>Hypotropia (deviation downwards)</td>
<td>No</td>
</tr>
<tr>
<td>Hypertropia (deviation upwards)</td>
<td>No</td>
</tr>
</tbody>
</table>

**DIAGNOSIS**

- Exotropia: deviation towards the nose
- Esotropia: deviation towards the eye
- Hypotropia: deviation downwards
- Hypertropia: deviation upwards

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**MICROTROPIA:**

**SUGGESTED DIAGNOSTIC CRITERIA**

- **Near:**
  - Angle < 10A
  - Amblyopia: > 1 line, unless alternating microtropia (see)
  - Bitemporal fixation
  - MABY

- **Far:**
  - Angle < 10A
  - Amblyopia: > 1 SOQ
  - Microtropia with disparity angle of am stereo = angle of anisometry
  - Monocular abnormalities: apparent phoria movement no coronet test
  - Motor fusion: pseudocycloidal reserve can be measured
  - Response of 1 SOQ or more uncommon
  - Every microtropic test shows positive response
  - Longen's test: inconclusive: decommissioned with Arnnall criterion

TREATMENT OF AMBLYOPIA (a)

- Flow chart based on review of recent RCTs in Evans et al. (2011; OPO)
- Many cases of amblyopia can be cured by refractive correction alone;
- 20% don’t need occlusion (Gibson, 1955; Pickwell, 1984; Stewart et al., 2004; West & Williams, 2011)
- Contact lenses are likely to be best (Evans, 2006)
- Many cases never require full-time occlusion
  - If 6/9 to 6/25, 2h occ. ≡ 6h
  - If ≤ 6/30, 6h > 2h
- Avoid full time occlusion for orthotropic anisometropia
- Timings approximate
  - See patients frequently during the treatment of amblyopia, to begin with every 4-6 weeks

MOTOR DEVIATION:
REFRACTIVE CORRECTION: OVERVIEW

- Mandatory in accommodative esotropia
- Also possible to treat exo-deviations with negative lenses & convergence excess with multifocals
- limited by 4 factors
  - angle of deviation
  - refractive error
  - accommodation
  - AC/A ratio

MOTOR DEVIATION:
REFRACTIVE CORRECTION: MYTHS

- negative adds might cause myopia
  - overminus lenses do not induce clinically significant myopic changes (Rutstein et al., 1989; Paula et al., 2009)
- patient likely to adapt to the over-correction
  - if abnormal BV, tend not to adapt (North & Henson, 1985)
- bifocals might reduce children’s ability to accommodate
  - smooth muscle; 14D-3D=11D
  - BF don’t reduce amplitude of accommodation (Fresina et al., 2010)
- accommodative (hyperopic) esotropia will not need glasses in later life
  - after 10 yrs, 97% still need Rx (Rutstein & Marsh-Tootle, 1998)

MOTOR DEVIATION:
REFRACTIVE CORRECTION: SPECIFICS

- determine sphere that
  - eliminates strabismus (no diplopia)
  - eliminates FD on Mallett Unit
- Can check (2 mins) don’t adapt (North & Henson, 1985)
- prescribe, try to reduce approx. every 3-6/12
- negative adds and bifocals/varifocals can work well

MOTOR DEVIATION:
REFRACTIVE CORRECTION: CASE STUDY: D1542

- 11/5/96, female, age 8y, 1 headache a fortnight
  - wearing full cyclo plus (c. +2.00, R=L)
  - cover test: D: 8 Δ
    - SOP N: 10 Δ
    - RSOT
  - with +2.00 add: N ortho

MOTOR DEVIATION:
PRISMATIC CORRECTION: OVERVIEW

- preferred treatment in small/moderate vertical deviations
- may also help in small/moderate horizontal deviations if not amenable to refractive modification or exercises
- limited by angle of deviation / cosmesis of prism

There I was, asleep in this little cave here, when suddenly I was attacked by this hideous thing with five heads!
MOTOR DEVIATION: PRISMATIC CORRECTION: MYTH

- patient might “eat up prisms”
- prism adaptation usually abnormal in orthoptic anomalies (North & Henson, 1981)
- exceptions can occur
  - e.g., myopes with decompensated esophoria

MOTOR DEVIATION: PRISMATIC CORRECTION: CASE STUDY: F6123

- 8/4/97, male, age 6y, ? dyslexia
- symptoms: words move, sore and tired eyes
- motility full, +0.50DS BE, cover test ortho., D=N, NPC=nose
- Dissoc. tests: D: 3Δ SOP, 2Δ L/R N: 3Δ XOP, 3Δ L/R
- Align. prism: D: LE supp. N: 1Δ down, 1Δ up R
- Rx: plano, 1Δ up R
- 5/7/97
  - symptoms: with Rx no eyes hurting, D & N clearer
  - no slip with glasses, other findings as above

MOTOR DEVIATION: FUSIONAL RESERVE EXERCISES: OVERVIEW

- preferred treatment in small/moderate horizontal deviations, if px co-operative
  - Work well in those aged 11-19y, even if strabismic (Pickwell & Jenkins, 1982)
- in exo-deviations improve ability to converge
- in eso-deviations improve ability to diverge
- try to assess progress using a method different to the treatment technique
- there is some supporting evidence from RCTs
  - Ciuffreda & Tannen (1995)

MOTOR DEVIATION: FUSIONAL RESERVE EXERCISES: EVIDENCE IN THE LAST 10 YEARS - RCTs

- In-office VT better than placebo or home pencil push-ups (Scheiman et al., 2005; CITT, 2008)
  - [15min a day + 60min weekly > 15min a day]
- Systematic review supports VT for CI; lack of evidence for other disorders (Castro Martinez et al., 2009)
- Treatment for 12+ weeks may be optimal (Scheiman et al., 2010)
  - But did not control for treatment dose
- Systematic review suggests in-office VT better than at home (Scheiman et al., 2011)
  - But don't seem to have controlled for treatment dose

CONVERGENCE INSUFFICIENCY: OVERVIEW

- an exophoria/tropia at a close viewing distance
- exercises to extend the binocular range into the monocular range
- often need brief top-up (maintaining) exercises
- RCTs support training of positive fusional reserves

CONVERGENCE INSUFFICIENCY: SPECIFICS

- Treatments in order of increasing complexity:
  - simple push up (bead on string if very remote)
  - jump convergence
  - push up with physiological diplopia
  - jump convergence with physiological diplopia
  - free-space stereograms
- RCT shows intensive programme of exercises better than home push-up (Scheiman et al., 2005)
  - (15min a day + 60min weekly) > 15min a day
BEAD-ON-STRING EXERCISES
- Patient holds card, C, close to nose
- Bead, B, is on string tied to card
- Patient fixes bead, sees card in crossed physiological diplopia
- String appears as X
  - In suppression, part of X is missing
- This approach does **not** exercise relative accommodation or relative convergence

FUSIONAL RESERVE EXERCISES:
- HTS
  - Wide range of vision therapy
  - For fusional reserves, amblyopia & much more (if wanted)
- In-office
- At-home
- Orthoweb
  - Patient "visits" web site to do exercises
  - http://www.academy.org.uk
  - Designed by Andrew Field

Conclusions about orthoptic exercises
- Decompensated exophoria and convergence insufficiency are readily treatable in optometric practice
  - Treatment does not need to take up a lot of "chair time"
  - Treatment improves fMRI measures (Alvarez et al., 2010)
- Treatment with orthoptic exercises is appropriate for optometric practice
  - Strabismus can also be treated with exercises (Pickwell & Jenkins, 1982)
  - Treating strabismus with exercises seems less common now (Piano & O’Connor, 2011) than Pickwell might have wished...

A sceptical view of Behavioral Optometry
- Non-standardised
- "no randomised controlled trials" (Jennings, 2000)
- "a large majority of behavioral management therapies are not evidence-based" (Barrett, 2008)
  - Validated
    - VT for convergence insufficiency
    - Yoked prisms in neurological patients
    - Visual rehabilitation after brain disease/injury

Controversy: training saccades in dyslexia
- Saccades are not unique to reading
- Abnormal saccades when reading more likely to be a consequence than a cause of dyslexia
- The DEM is not an eye movement test:
  - DEM test has no correlation with objective eye movements measures (Ayton et al, 2009)
  - Abnormal DEM ratio is an effect not a cause of reading difficulties (Medland et al., 2010)
  - the DEM is not a measure of saccadic eye movements (Webber et al., 2011)
- Attention deficit disorder (ADD) is an important confounding variable
3-D displays are popular but unnatural

- Vergence changes but accommodation does not
- Loss of spatial resolution (but may help) OR
- Loss of temporal resolution
- Unusual degrees of stereopsis
- Possible mismatch between various depth cues

Howarth (2011)

How many people will not perceive 3-D content?

- Strabismus 2.5-4%
- Uncorrected anisometropia 0.5-1.5%
- Monovision 0.4%
- Stereoblind <0.1%
- Poor or distorted vision in one eye very rare in young
- Total 3.5-8%

How many people may have discomfort with 3-D?

- Under-corrected refractive error 11-30%
- Decompensated heterophoria possibly, 1-10%

*more common in older people
Could be reduced with better eyecare

CONCLUSIONS

- Always be on the lookout for pathology
- refer if no significant improvement
- BUT pathology is very rare
- It is possible to treat amblyopia in optometric practice
- patients will need good instructions & regular checks
- Many comitant ocular motor anomalies are treatable
- plus for eso and minus for exo are under-used treatments
- Vision therapy for convergence insufficiency is evidence-based, but there is a need for more research for other forms of vision therapy

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