

Myopia management & contact lenses for children

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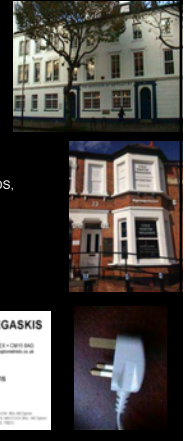
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DISCLOSURE

- I have received funding from the following bodies for lectures, key opinion leader/product feedback, and research:
 - Alcon, American Academy of Optometry (UK), Association of Optometrists, Birmingham Focus on Blindness, Black & Lizards, Central (LOC) Fund, Cerium Visual Technologies, College of Optometrists, Coopervision, ESRC, General Optical Council, Hadassah College, Hoya, Institute of Optometry, Iris Fund for Prevention of Blindness, Johnson & Johnson, Leightons, MRC, NIOS, Norville, Optos, Paul Hamlyn Trust, Perceptive, Scrivens, Specsavers, Thomas Pocklington Trust.
- Lecture content always my own
- I am not a myopia researcher, but a clinician with an interest in helping my myopic patients



PLAN

introduction

theory

evidence

other approaches

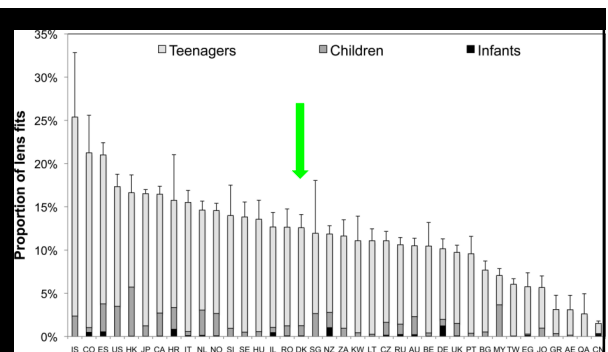
tips for success

conclusions

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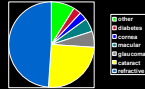
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International survey of 100,000 fits for 2005-2009...UK data

- Teenagers (13-17): ~8%
 - Children (6-12): ~2%
- Efron, Morgan, Woods (2011)

Visual problems

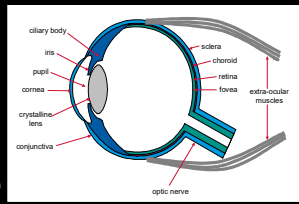


- What is the commonest cause of visual impairment?



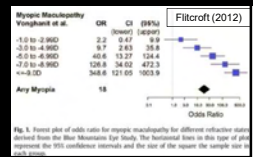
Pie chart figures approximate, based on data on WHO website

- Myopia is the most common vision disorder and the leading cause of visual impairment worldwide (Tkatchenko et al., 2015)
- 19% of UK school children have a visual problem requiring attention (Thomson, 2002)



Why does myopia matter?

- Common and increasing prevalence
 - 93% of Taiwanese medical students are myopic (Lin et al., 1996)
 - Prevalence of myopia in USA has increased in last 30 years from 25% to 42% (Vitale et al, 2009)
 - 50-53% of UK university students are myopic (Logan et al., 2005)
 - Prevalence of myopia in UK has more than doubled in last 50y (McCullough et al., 2016)
- Significant health impact
 - High myopia (≤ -6) increases risk of retinal detachment, myopic macular degeneration, glaucoma, & other conditions
 - "no evidence of a safe threshold level of myopia for any of the known ocular diseases linked to myopia" (Flitcroft, 2012)
 - In the Copenhagen study myopia-related diseases were the most common cause of impaired vision (Holden et al., 2014)



Realistic goals of myopia control

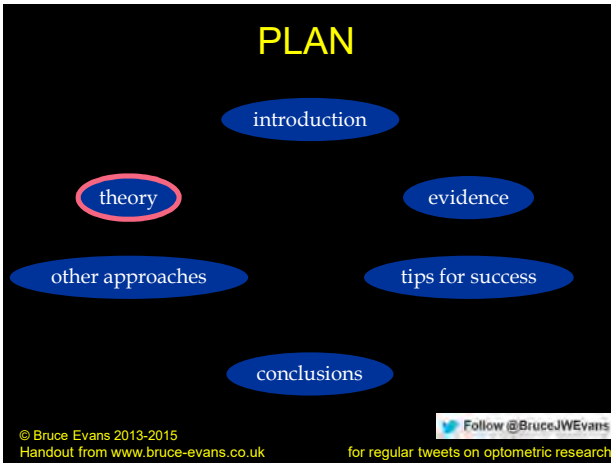
- 33%
 - Person destined to be -4.00 would be -2.50
 - Person destined to be -6.00 would be -4.00
 - Person destined to be -8.00 would be -5.25
- Reducing the rate of myopia progression by 50% would lead to reduction in frequency of high myopia of over 90% (Brennan, 2012)
- For person destined to be -6.00 (Flitcroft, 2012)
 - No control: -6.00: RD risk 16x MMD risk 40x
 - 50% control: -3.25: RD risk 10x MMD risk 10x
 - 75% control: -1.25: RD risk 2x MMD risk 2x
- Average...means no guarantee!



Evaluating studies

- 1a. Systematic review of homogenous RCTs
- 1b. Individual RCT with good CI
- 2a. Systematic review of homogenous cohort studies
- 2b. Individual cohort study
- 3a. Systematic review of case control studies
- 3b. Individual case control study
4. Case series
5. Expert opinion

EBP is "the conscientious, explicit and judicious use of current best evidence in making decisions about the care of the individual patient. It means integrating individual clinical expertise with the best available external clinical evidence from systematic research." (Sackett, 1996)

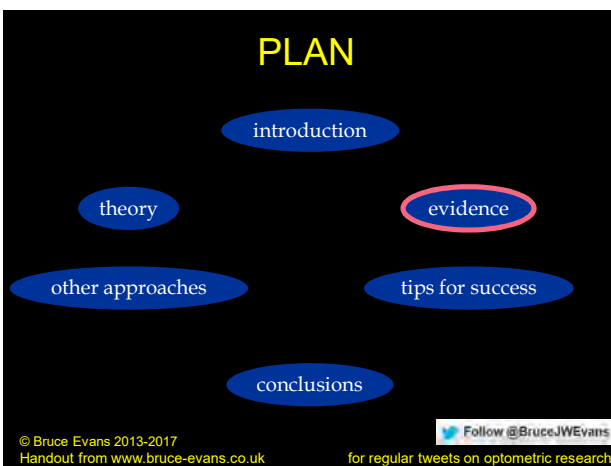


Does near vision lead to myopia?

- Kepler (1611): "he who is from childhood occupied with study or fine work, speedily becomes accustomed to the vision of near objects, and with the advance of years this increases, so that remote objects are more and more imperfectly seen" (Rosenfield & Gilmartin, 1988)
- "accommodation appears to have a very minor role, if any, in the induction of myopia" (Holden et al., 2014)
- Near activities not a predictor for myopia (CLEERE study; Zadnik et al., 2015)
- Independent of spending less time outdoors, participants who became likely myopic in later childhood spent more time reading (ALSPAC study; Shah et al., 2017)

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Myopia control: vision therapy

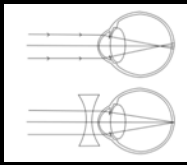
- Vision training for myopia control by behavioral optometrists is ineffective (Woods, 1945)
- "Flashes of clear vision" may account from perceived benefit from Bates method (Marg, 1952)
- Accomotracc biofeedback ineffective (Koslowe, 1991)
- Biofeedback training ineffective (Angi et al., 1996)
- Perceptual learning no effect on myopia but improves VA (Durrie & McMinn, 2007)

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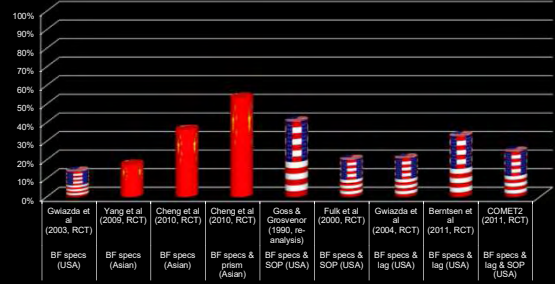
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Single vision spectacles

- Over-correction has no effect on myopia progression (Goss, 1984)
- Under-correction (0.75) makes myopia worse (Chung et al., 2002)
- Monovision (2D under-correction) slows progression, but rebound effect (Phillips, 2005)
- Under-correction (0.50D) makes myopia worse (Adler & Millodot, 2006)
- Under-correction worsens myopia (Vasudevan et al., 2014)



Slowing of myopia progression with multifocal spectacles



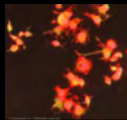
Larger near segment gives greater treatment effect

(Bullimore, 2014; Sankaridurg & Holden, 2014)

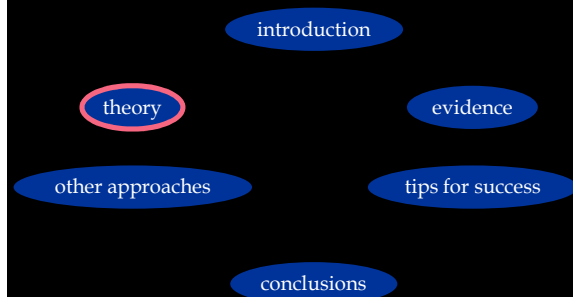
Anti-muscarinic drugs

- Meta-analysis of atropine controlled trials shows 0.5% atropine slows, 1% stops MP (Song et al., 2011)
 - Major side effects photophobia, glare, allergic blepharitis
 - "prolonged use clinically inadvisable" (Phillips, 2013)
- Atropine slows MP by 73% (Wu et al., 2011; China)
 - Started with 0.05%, increased to 0.1% if progressed over 0.5D in 6/12
- 0.01% atropine **minimal side effects** & almost as effective (Chia et al., 2012)
- "non-accommodative mechanism" (McBrien, 2000)
- Putative action on receptors in sclera
 - 7MX may reduce progression by 66% (Holden et al., 2014)

Muscarinic Acetylcholine Receptor 2 antibody
www.abcam.com



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Refractive error: conventional view

Hypermetropia (long-sighted)
- image shell focused behind retina

Emmetropia (normal vision)
- image shell focused on retina

Myopia (short-sighted)
- image shell focused in front of retina

Myopia: the new view

Patient about to become myopic
- image shell focused on retina at fovea
- image focused behind retina in periphery
- *relative peripheral hyperopic defocus* - RPHD

Reviews: Charman & Radhakrishnan (2010); Earl Smith (2011); Filtcroft (2012)

The eye grows so the peripheral image is in focus causing myopia at the fovea

Spectacles or contact lenses correct the focus at the fovea, but not the RPHD so myopia progresses

BUT: see Atchison et al. (2015)
Relative peripheral hyperopia does not predict development and progression of myopia in children

How to reduce peripheral hyperopic defocus?

- RPHD eliminated by orthokeratology (OK) (Ticak & Walline, 2013)
- Large pupil diameters facilitate OK myopia control (Chen et al., 2012)
- Centre-distance multifocal SCL creates peripheral myopic defocus during DV and to lesser extent during NV (Bertsen & Kramer, 2013)
- Proclear [Biofinity] CD design creates RPMD (Wagner et al., 2014; Kang et al., 2013)

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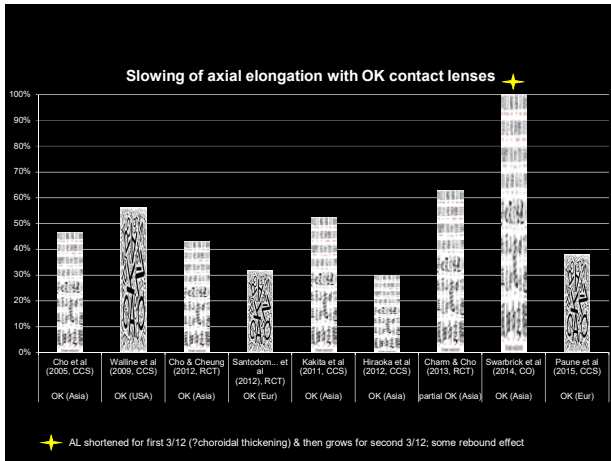
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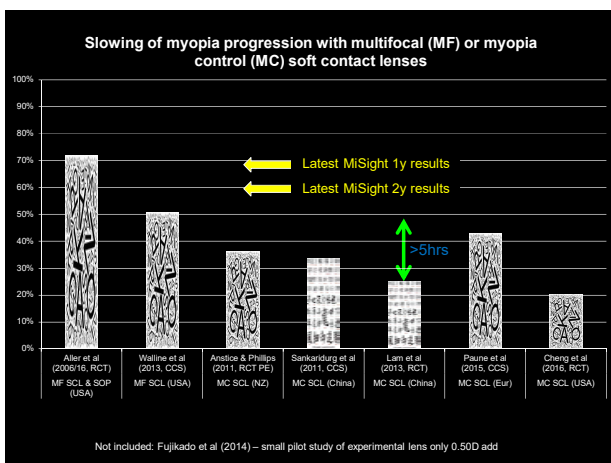
Safety of overnight orthokeratology (OOK)

- For soft contact lenses, overnight wear increases risk of microbial keratitis (MK) by 10x
- Several cases of (MK) reported, mainly in Asian countries thought to be associated with poor hygiene
 - Watt & Swarbrick (2007)
 - Tap water, old contact lens cases, suction holders
- Prevalence of complications from OOK has not been established
 - Van Meter et al. (2008)
- Risk of OOK similar to other overnight wear of contact lenses
 - Bullimore et al. (2013)

Safety of Overnight Orthokeratology for Myopia

A Report by the American Academy of Ophthalmology

Woodward S, Van Meter MD, David C, Moshir, PhD, MPH, Lishank S, Jacobs, MD, Stephen C, Kaufman MD, PhD, William T, Bushara MD, Ira J, Lieb MD



Comparison of methods (Turnbull, Munro, Phillips, 2016)

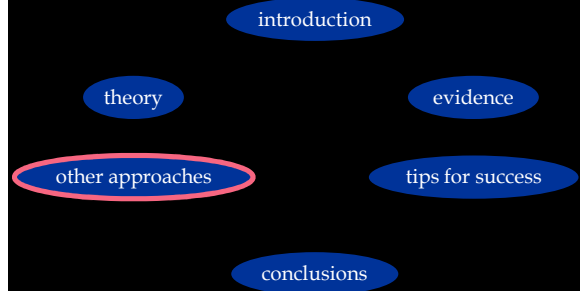
- 110 patients: 4-43y, mean 12y, 62% female
- Options: OrthoK, dual focus soft lenses (DFCL), 0.01% atropine, "no preferential recommendations"
- Px choice: 56 OrthoK, 32 dual focus SCL, 22 advice only, 3 chose 0.01% atropine
- No difference in efficacy between OrthoK & DFCL
- VA during treatment NS different in 3 main groups
- OrthoK pxs seen 7 times ±4, DFCL 4.7±2; hours in clinic 8.6 of 4.3
- One adverse event (?central ulcer) in an OrthoK px, 5 OrthoK with lens adherence

Myopia control with multifocal CL: practical tips

- e.g., Biofinity multifocal centre-distance BE
- Prescribe:
 - Add that eliminates eso-fixation disparity at near (Aller, 2014)
 - If no esophoria, maximum add giving acceptable DV
 - Myopia control requires lens centration (Kang et al., 2013)
- Wear for schoolwork
 - Daily wear
 - Can wear all waking hours if desired & safe – more treatment effect
 - Remove when swimming
 - Don't shower in CL
 - E-seg glasses for backup
- Monitor every 6/12
 - CL check and eye exam
 - "natural" stimulus so rebound effects unlikely (Holden et al., 2014)



PLAN



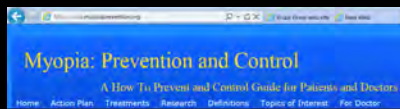
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Myopia control – other ideas

- Genes – non-modifiable
- Environment
 - Time outdoors reduces risk of developing myopia (Bullimore, 2014)
 - Have more summers (Donovan et al., 2012)
 - Sports (Parssinen et al., 2014; c.f., Jones-Jordan et al., 2012)
 - Avoid excessive near vision work
 - Diet – revert to natural diet by avoiding sugar, salt, fruit juices, dairy products & cereal grains such as wheat, rice and corn



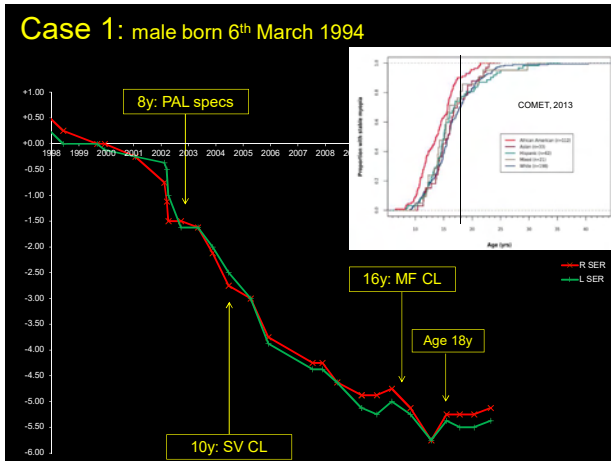
Case 1: male born 6th March 1994, 2 myopic parents (8280)

Aug 2002: R-0.75DS L-0.25DS N 4Δ SOP

Oct 2002: PAL spectacles

May 2004: SV CL (Focus dailies)

June 2010: MF CL (Proclear CD +1.50 add)



Case 2: 10y old female, monitoring early myopia⁽¹⁸³⁷⁹⁾

Symptoms: D blur, occasional episodes N blur; Dad myope

V: R 6/15+ L 6/19

Ret: R-0.25/-0.50x155 L-0.50/-0.50x175

Sub: R-0.25/-0.50x155 6/7.5 L-0.50/-0.50x175 6/9

Cover test (s): D orthophoria N 3Δ esophoria G1

NPC & AA: to nose R 16D L15D

Ocular health: Pupils, motility, ophthalmoscopy, fields, ret reflex: all normal

Grade	Description
1	rapid and smooth
2	slightly slow/jerky
3	definitely slow/jerky but not breaking down
4	slow/jerky and breaks down with repeat covering, or only recovers after a blink
5	breaks down readily after 1-3 covers

Case 2: 10y old female – further tests

Accomm. lag: not done (would do now!)

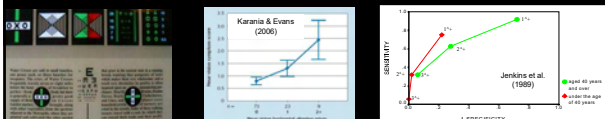
Cycloplegic: done in 2009 showing early myopia

Maddox wing: 3Δ eso with subjective

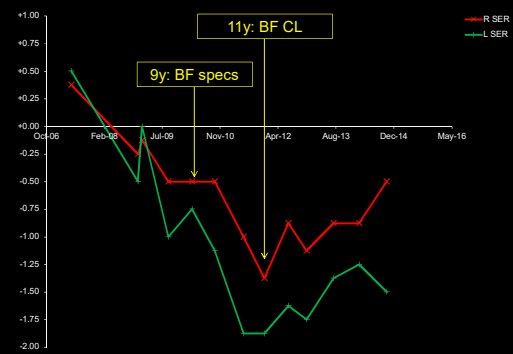
Mallett unit s: 1Δ base out L aligning prism; or +0.50D aligning sphere

AC/A ratio: 3.5 Δ/D

(Sub): R-0.25/-0.50x155 6/7.5 L-0.50/-0.50x175 6/9

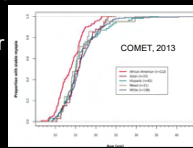


Case 2: 10y old myope – what happened?

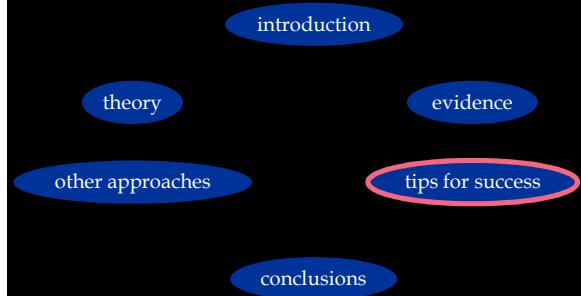


Caveats

- Need more RCTs
 - But myopia control effective "on balance of probabilities" and need to start young
- Persistence of treatment effect
 - Unclear whether the treatment effect is sustained
 - May be rebound effect when stop intervention
 - Perhaps unlikely with optical interventions & can keep in MF CL until myopia likely to be stable
- Check for DV blur –max add for good DV
- Axial length changes correlated with myopia changes ($r^2 = 65\%$)
- Followers of a theory tend to ignore other theories
 - If myopia wasn't multifactorial, then we would have solved it by now!

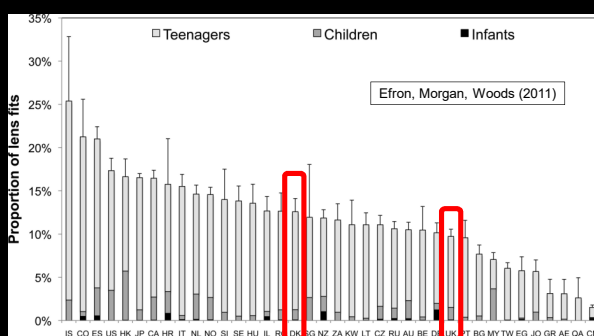


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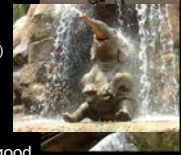
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Why aren't we doing better?

Perceived barriers to fitting CL to kids

- Eyecare practitioners!
- Perceived cost
 - Yet, only about £1 a day
- Some people still think CL will hurt
- Some parents think that the child won't be able to learn handling
- Fear of microbial keratitis
 - Our job is to allow informed choice
 - Parents accept risks if give children benefits
 - MK occurs 1-2 in 5,000 PA; risk minimised by good hygiene and prompt action
 - With myopia control: risk of sight loss from MK outweighed by reduced risk of myopia-related pathologies
 - Only fit to motivated cases who can be hygienic



Some key research on CL for children

- Soni et al. (1995): age 11-13y
 - ◆ 3 successful attempts in training
 - ◆ Exam helps
- CLIP study (Walline et al., 2007a,b; Jones et al., 2009)
 - ◆ 84 children (8-12) of 85 teens (13-17)
 - ◆ "No serious adverse events were reported during the 3 month study"; biomicroscopy of children similar to teens
 - ◆ Children do as well as teens
 - ◆ Similar chair time, slightly more tuition for children
 - ◆ Improved quality of life
- ACHIEVE study (Walline et al., 2009)
 - ◆ RCT of children (8-11), CL v. Specs, 3y
 - ◆ Physical appearance, athletic competence, social acceptance all significantly better with CL
 - ◆ 91% of CL group wore CL to 3 year check



Top tips for fitting & tuition

- Address fear of the unknown
 - ◆ Soft lenses are mostly water
 - ◆ Let the child handle lenses
- Fitting
 - ◆ Don't put fitting lens directly on cornea
 - ◆ Avoid pain
 - ◆ If RGP, use anaesthetic at first insertion
- Tuition
 - ◆ Aim tuition & literature at child & parent
 - ◆ Be positive, realistic, encouraging
 - ◆ If your personality is at all impatient/stern, then delegate!
- At aftercare, right time to be stern!
 1. Quiz
 2. Have the children show you what they do
 3. Use parents to ensure compliance at home



The quiz

1. When do you wear your lenses?
2. What do you do in the mornings?
3. What do you do in the evenings?
4. What are the danger signs?
5. What do you do if you have a danger sign?
6. What do you do if the danger sign does not get better over the next few hours?
7. How often do you replace your lenses?

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c.f., adults: Miller's pyramid

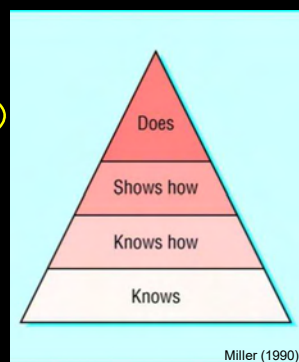
Potential for better compliance than adults

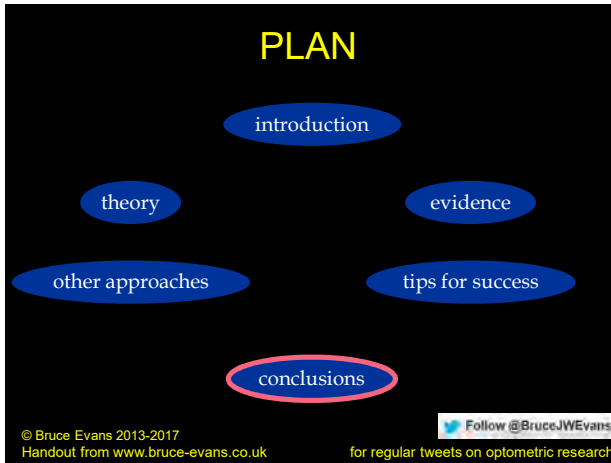
parents

observation at aftercare

tuition

the quiz





Conclusions: myopia control in European children

- If NV esophoria or high accommodative lag, recommend multifocals
 - MF glasses (E-seg) likely to reduce progression rate by 30-40%
 - MF CL may reduce progression by up to 70%
 - Aim to eliminate esophoria; typical add +2.00, CD
- If not esophoric and normal lag, effect reduced
 - MF glasses likely to reduce progression by only 15%
 - MF CL success unclear, perhaps 36-60% if perform like dual focus
- OK slows myopia progression by 32-63%
- Also encourage kids to go outdoors

Used in research studies

Conclusions on when to discuss CL

- Young people have greater need than adults
- Children benefit just as much as teenagers
- When to first mention?
 - When first refractive correction
 - When issuing an Rx
- How to discuss?
 - "This can be corrected with glasses or CL"
 - CL require motivation and hygiene, but have a high success rate at this age
 - Modern CL are comfy and child-friendly
 - Specialist CL can slow myopia progression

The corrector becomes a treat!

OK, stranger...
What's the circumference of the Earth? Who wrote "The Odyssey" and "The Iliad"? What's the average rainfall of the Amazon Basin?

Part, you fool! You can't shoot first and ask questions later!

HOTEL

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