Myopia management: the new frontier for optometry

Bruce Evans
BSc (Hons) PhD FCOptom FAAO FCOptom FBCAO DipCLP DipOrth
Director of Research Institute of Optometry
Visiting Professor City, University London
Visiting Professor London South Bank University
Private practice Brentwood, Essex

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Lecture content always my own
I am not a myopia researcher, but a clinician with an interest in helping my myopic patients.

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)
  - 50-60% 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 (Hafned et al., 2014)
- 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)

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 80% (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)

PLAN

theory
evidence

other approaches
tips for success

conclusions

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” (Moster 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)

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)
- Accommodative biofeedback ineffective (Koslowe, 1991)
- Biofeedback training ineffective (Angi et al., 1996)
- Perceptual learning no effect on myopia but improves VA (Surje & McKinnon, 2007)
- Over-correction has no effect on myopia progression
- Under-correction (0.75) makes myopia worse
- Monovision (2D under-correction) slows progression, but rebound effect
- Under-correction (0.50D) makes myopia worse
- Under-correction worsens myopia
- Un-correction slows myopia
- Single vision spectacles

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Slowing of myopia progression with multifocal spectacles

Larger near segment gives greater treatment effect

(Bullmore, 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)

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

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

How to reduce peripheral hyperopic defocus?

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

**Myopia control with multifocal CL: practical tips**

- e.g., Biofinity multifocal centre-distance BE

**Prescribe:**
- Add that eliminates eso-fixation disparity at near
  - (Alver, 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)
Myopia control – other ideas

- Genes – non-modifiable
- Environment
  - Time outdoors reduces risk of developing myopia (Xiong et al., 2017)
  - Have more summers (Donovan et al., 2012)
  - Sports (probably because outdoors. Sute Thilmeyer et al., 2017)
  - 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

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

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

Miller (1990)

**PLAN**

- Introduction
- Theory
- Evidence
- Other approaches
- Tips for success
- Conclusions

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**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
  - No studies of possible rebound (Sankaridurg, 2017)
  - 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

**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

Sankaridurg (2017, Clinical Experimental Optometry)