Myopia Management
Myopia Management  
Roundtable 15 June 2018

Introduction

1. On 15 June 2018, the College of Optometrists held a roundtable meeting to bring together clinicians, researchers and lead organisations across eye health, to consider the current evidence on childhood and adult myopia control/management. The aim was to reach a consensus about what the current evidence supported with regard to practice in this area.

2. This event coincided with the publication of a dedicated *Ophthalmic & Physiological Optics* (OPO) feature issue on the topic of myopia.

3. Participants included researchers, policy leads and clinicians from across the sector. A full list of participants can be found at Annex A.

4. This report reflects the discussions held on the day and brings together possible next steps based on the views and ideas of the participants and the points on which consensus was reached.

The programme

5. Before the event, we asked the participants what they considered the most significant opportunities and challenges arising from the evidence – or lack of evidence – for myopia control and prevention. From this exercise, we identified two main themes and questions for each theme.

6. We structured the programme around these themes. Participants were split into five groups and each group was asked to answer the questions listed in paragraph 8 below. Following feedback from each group, a general discussion took place to identify areas where a consensus could be reached or not. The programme can be found at Annex B.

The event

Setting the scene

7. Professor Ed Mallen, President of the College of Optometrists, opened the event and set the scene, summarising the key evidence. Two other speakers then joined him: Dr Nicola Logan, Director of Research, Ophthalmic Research Group, Aston University, and Chris Hammond, Frost Professor of Ophthalmology, King’s College London and Consultant Ophthalmologist, Guys and St Thomas’ NHS Foundation Trust. All three speakers presented information about the evidence relating to interventions to prevent myopia onset, or to slow or limit myopia progression, and the gaps in the current evidence. The presentations can be found at Annex C.
Roundtable discussions

8. The groups used the following questions to focus their discussions:

A. Do we have enough evidence/the right evidence?
   A.1. To support widespread use of myopia control/management interventions?
   A.2. To develop evidence-based guidance for the profession?
   A.3. To determine which interventions work for which people?

B. What should eye health professionals (EHPs) be doing now with respect to myopia control/management?
   B.1. Is it safe/ethical for the EHPs who are engaged in offering myopia control/management interventions to continue to do so?
   B.2. Is it safe/ethical for those EHPs who currently are not offering myopia control/management interventions to continue not to mention these as options?
   B.3. What information should EHPs be using to guide decision making in this area?
   B.4. Should myopia control/management practice require a higher qualification, or is it within core competence?

9. As noted earlier, the event was designed to lead to a consensus statement. This report captures the discussion on the day and sets out what those who attended the event from the eye health and optical sectors agreed and disagreed about.

A. Do we have enough evidence/the right evidence?

Key points from the discussion were:

A.1. To support widespread use of myopia control/management interventions?

- Participants agreed that there was evidence, based on average data, showing that progression of myopia could be slowed. However, participants also agreed that there was not enough evidence to support a recommendation of intervention in all, or the majority of myopic children. They considered this evidence was too variable, the long-term risks of myopia control/management interventions were not known, and there were not enough European studies. For example – because myopia prevalence varies with ethnicity, we do not know if the current evidence base relating to slowing progression would be fully relevant to children with European ancestry.
- Participants suggested that the evidence relating to the efficacy of interventions was stronger in studies involving younger children.
- Research also shows that myopia progression naturally slows with age.
- Although participants agreed that myopia control measures were not routinely offered in the UK, there was agreement that the evidence available supported the idea that practitioners should be able to inform the patients and their parents about the benefits and risks of the treatments available, even if they did not provide these treatments. Therefore, practitioners needed to be well informed about and familiar with the current evidence. Furthermore, practitioners should be able to discuss the benefits and risks of the treatments available in a balanced way.
- We will have more evidence once the studies that are currently recruiting patients are completed and have reported, for example the International Myopia Institute’s report to be published by the end of 2018, and the Cochrane Eyes and Vision Group update of their systematic review on myopia control interventions expected in early 2019.
A.2. To develop evidence-based guidance for the profession?

- Participants agreed that there was a need to develop guidance based on the current evidence to facilitate honest and clear conversations between practitioners and patients/parents about the current evidence relating to myopia management/control interventions.
- Participants considered that the evidence was not strong enough for practitioners to routinely recommend a treatment, and that, for example, it was not of a standard that would lead NICE to produce guidance recommending a particular treatment.
- Participants agreed that the eye care sector should produce guidance based on the available evidence on:
  - What eye care professionals should tell patients and their parents about the available treatments; for whom they might be suitable; how effective they might be and the probability of them being effective, and the likely short-term and long-term risks and benefits.
  - Specific points about what eye care professionals already offering myopia control/management interventions should do.
- Participants agreed that the guidance should indicate that evidence was building in relation to the efficacy of different treatment modalities, but was limited in terms of which treatments were most efficacious. They also acknowledged that there was almost no evidence about long-term results and risks, and lack of evidence about the effect on myopia progression following cessation of treatment. The degree of efficacy and strength of evidence for the different treatments should be set out, together with the evidence relating to possible risks. The guidance would change as the available data changed.
- Literature and website-based information could be included for practitioners who wanted to learn more.

A.3. To determine which interventions work for which people?

- Because a lot of data are based on averages and not on individuals, there is insufficient evidence to determine conclusively which interventions work for which people. Longer-term longitudinal data for individuals was noted as a particular gap. Also, there are no studies comparing one treatment with another, and the current evidence is primarily based on children of Chinese ethnicity in highly myopiagenic environments such as Singapore and Hong Kong.
- Low dose atropine for myopia control is currently not licensed in the UK, but there are a number of UK trials using it at various concentrations (0.01% or 0.02%) that have been done, are underway, or about to start.
- There is evidence showing that there are contact lens (CL) designs that could be used to slow progression of myopia, however their efficacy is variable and has been found to be around 40-60% across a number of studies.
- The participants agreed that the change from a standard CL to a myopia control CL was unlikely to introduce additional risk. On this basis, it was felt that contact lenses could be used for myopia control, but if this was done, the benefits, uncertainties about efficacy and possible risks should be clearly set out before proceeding. Although a recent evidence review (Bullimore et al) suggested that children were generally low risk contact lens users compared to young adults and adults, it was agreed that there might be increased risks of corneal infections among children, as well as among teenagers and young adults using contact lenses compared to those not using contact lenses. There was general agreement that there was unlikely to be a difference in relative risk between CLs specifically designed for myopia management and other CLs. It was noted that all clinical trials would provide some data on adverse effects of myopia control.
contact lenses. However, clinical trials are small by their nature, and underpowered to look for rare but potentially serious adverse events. Sharing data in this area would be important in the future.

- There was discussion about how to measure the success of any of the myopia management interventions/treatments: while refractive error is the obvious outcome for atropine and soft CL therapies, axial length monitoring would be needed to assess whether progression is being influenced by orthokeratology (ortho-k). To compare interventions in meaningful ways, it would be preferable if all myopia control programmes used axial length to measure progression.
- The Group agreed that it was also difficult to define “success”. This was because progression was likely to vary according to age and other factors, and therefore when to decide a treatment has failed and to change/stop that treatment was difficult at present.
- The cost of the equipment to measure axial length is currently high. It was suggested that regional centres for this could provide a possible solution and support practitioners who could not afford the equipment to measure axial length.

**Consensus summary**

- There is a need for myopia management interventions and evidence exists showing that myopia progression and rate of axial length growth could be slowed by approximately 50%, for at least 1-2 years, using the most effective intervention strategies currently available.
- However, there is not, currently, sufficient evidence, other than encouraging children to spend time outdoors, to support the widespread roll out of myopia control procedures for all myopic patients, or those at risk of developing myopia. Continuing research is welcomed to underpin any change in routine clinical practice.
- There is not enough evidence to determine which interventions work for which people.
- Practitioners should be able to inform the patients/parents about the current state of knowledge and the benefits and risks of the treatments available, and the risks if no intervention is chosen.
- There is a need to develop evidence-based guidance to facilitate honest and clear conversation between the practitioners and the patients/parents.
- The guidance should indicate that the evidence is not clear at the moment and the degree of efficacy and strength of evidence for the different treatments should be set out.
- Low dose atropine is currently not licensed in the UK for myopia control.

*After-event note: NICE Guidance on prescribing states that “Prescribing medicines outside the recommendations of their marketing authorisation alters (and probably increases) the prescriber’s professional responsibility and potential liability. The prescriber should be able to justify and feel competent in using such medicines, and also inform the patient or the patient’s carer that the prescribed medicine is unlicensed.”*

- The change from standard CLs to myopia control CLs is unlikely to introduce additional risk.
- There might be increased risks of corneal infections among children, teenagers and young adults moving from spectacle use only to using CLs.
- At present, there is no evidence that myopia control treatments are effective in preventing myopia from developing (i.e. prophylaxis). However, encouraging children to spend time outdoors has a strong evidence basis for reducing the onset of myopia.

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B. What should eye health professionals (EHPs) be doing now with respect to myopia control/management?

Key points from the discussion were:

B.1. Is it safe/ethical for the EHPs who are engaged in offering myopia control/management interventions to continue to do so?

- Participants agreed that for practitioners already undertaking myopia control/management, interventions would be relatively low risk if they followed guidance to be developed by the sector, which included a minimum equipment requirement.
- Guidance should include information about risk factors that would indicate which children were more likely to end up highly myopic, and therefore most appropriate for intervention.
- All myopia control interventions are treatments and need to be supported by informed consent that involves clear provision of information and accurate record keeping of the conversations leading to the consent being given.
- There was considerable support for the idea that all myopia management interventions should be used in conjunction with axial length measurements, although consensus was not reached on this.
- Myopia control ophthalmic spectacle lenses are available only in countries outside the UK at present, although they are believed to be coming to the UK.
- If practitioners are going to recommend interventions, they need to take responsibility for ensuring that they maintain their awareness and understanding of the evidence about myopia management, and for being well informed about and dealing confidently with consent. Participants suggested that the College of Optometrists could take the lead in providing guidance about these issues.
- At this stage, it is difficult to know whether the effect of the available myopia control interventions makes it worth intervening. In public health terms, reducing the overall number of people living with higher levels of myopia may be beneficial, but is not clear at present whether the benefits to the individuals outweigh the costs and risks to them. Any significant public health or individual benefits derived from intervening now to try to control myopia in children would only show in 40 – 60 years’ time.
- Practitioners have a duty to fully inform themselves about all aspects of the available options for managing myopia.
- Where practitioners offer treatment, they must discuss the option of no treatment and should document and record that discussion. Discussions should include the mechanism they would use to measure outcomes, and make clear that it would be difficult to predict whether, and to what extent, an individual would benefit from any intervention, and that it is impossible to show what might have happened without any intervention.
- Some form of audit to gather population-based data would be useful, as would the sharing of best practice among those currently undertaking this work. This should be included in the Guidance.
B.2. Is it safe/ethical for those EHPs who currently are not offering myopia control/management interventions to continue not to mention these as options?

- Participants agreed that it was safe for practitioners not to be doing myopia management at present.
- There were discussions about whether practitioners had an ethical obligation to act. Participants agreed that, as myopia management was not routinely offered in the UK, there was no obligation to offer it. However, the participants felt that the evidence was adequate to suggest that clinicians should be able to inform patients/parents about the current evidence and to explain whether/why they did/did not offer myopia management. This was felt to be important even without NICE-level guidance.
- As previously noted, practitioners should be able to discuss the benefits and risks of the treatments available with patients and their parents, even if they did not provide these treatments, but there should be no obligation on a practitioner to advise on a specific intervention, as efficacy and safety were not yet adequately established by the evidence.
- It was also important to consider any harm that could be caused by any intervention. Eye health professionals must discuss the risks and benefits in a clear, balanced way that is consistent with the evidence available.
- A comprehensive discussion about risks and benefits protects the professional as well as the patient.

B.3. What information should EHPs be using to guide decision making in this area?

- Participants agreed that explicit consent from patients/parents was needed and should be recorded. However, there was variation in opinions about whether it needed to be written or oral consent.

After-event note: Guidance on consent has been published by the General Optical Council\(^2\), the General Medical Council\(^3\) and the College of Optometrists\(^4\). Although myopia control/management interventions are not mentioned, their features mean they fall in the category of treatments that need explicit consent.

- Myopic parents, rapid progression, age of the child are the biggest indicators for myopia prevalence.
- An assessment of the patients/parents’ anxiety about not receiving treatment against the risk of treating should be made.
- Practices should have an adverse event reporting scheme to track safety issues and build the evidence base data set for future use.

B.4. Should myopia control/management practice require a higher qualification, or is it within core competencies?

- Participants agreed that myopia management did not merit a higher qualification. They considered it as an extension of core competence for optometrists rather than a specialty area. Continuing Professional Development (CPD) would be more appropriate than a higher qualification, but some measure of competence would be needed.

Consensus summary
- It is safe and ethical for the EHPs offering myopia control/management interventions to continue to do so, if they follow guidance to be developed by the sector, which would include requirements in terms of giving patients/parents information and obtaining consent, and practices’ processes and practitioners’ responsibilities.
- Those practising myopia control/management should ensure they maintain their awareness and understanding of the evidence relating to myopia management. They should also have the necessary knowledge, skills and equipment, but CPD would be more appropriate than a higher qualification.
- Practitioners must discuss the option of no treatment along with the associated risks and should document and record the discussion.
- It is safe for EHPs not to do myopia management at present but advisory to keep up to date with the latest research.
- There is no obligation to advise patients/parents on particular myopia management interventions.
- Explicit consent from patients/parents is needed and should be recorded.

Conclusion
10. From the discussions, we have identified the following key themes of consensus:
- There is a need for myopia management interventions and evidence exists showing that myopia progression and rate of axial length growth could potentially be slowed by around 50% at least in the short-term.
- There is not, currently, sufficient evidence to support the widespread roll out of myopia control procedures for all myopic patients, or those at risk of developing myopia. Further research is required to underpin any change in routine clinical practice. There is not enough evidence to determine which interventions work for which people.
- There is enough evidence to produce guidance on how to answer questions from patients and parents and on key points relating to myopia control/management practice.
- It is relatively low risk to offer myopia control/management interventions with a clear explanation of the benefits, risks and potential for success.
- It is ethical to offer, as well as not to offer, myopia control/management interventions.
- Explicit informed consent from the patients/parents is needed.
- Myopia control/management interventions do not require a higher qualification but some measure of competence would be desirable.
- Myopia control/management is an area that will be continually reviewed and updated for eye health professionals.
Next steps

11. The College of Optometrists is now considering the next steps to develop guidance on:
   - What eye care professionals should tell patients and their parents about what treatments are available, for whom they are suitable, how effective they might be and the probability of them being effective, and what the short-term and long-term risks and benefits were likely to be.
   - Specific points for eye care professionals who are already offering myopia control/management interventions.

12. A leaflet providing the patients and their parents with information on myopia management to be made available to practitioners will be also developed.

13. How detailed the final information produced will be will depend upon areas of agreement and disagreement. We will need the strong engagement of all participants to reach this consensus.

14. We would like to thank the speakers, the facilitators and the participants for their contribution to what is an important topic.
## Roundtable participants

<table>
<thead>
<tr>
<th>Name</th>
<th>Organisation</th>
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<tbody>
<tr>
<td>Andrew Price</td>
<td>Association of British Dispensing Opticians</td>
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<td>Anna Horwood</td>
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<td>Vision UK</td>
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<td>Matt Broom</td>
<td>Vision UK</td>
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<td>Matthew Cufflin</td>
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There is a separate list of those who signed up to the consensus statement at the end of the consensus statement.
Roundtable on Myopia Control

BMA House, Prince’s Room, Tavistock Square, London WC1H 9JP

15 June 2018 from 12.30pm to 4.30pm

12.30 Registration and Lunch

1.15 Welcome and Introduction – Setting the scene
   Professor Ed Mallen

1.35 Interventions to slow myopia progression
   Dr Nicola Logan
   Professor Chris Hammond

1.55 Gaps in the evidence
   Professor Ed Mallen
   Professor Chris Hammond
   Dr Nicola Logan

2.15 Q&A

2.30 Coffee break

2.45 Roundtable discussions explained
   Mr Mike Bowen

2.50 Roundtable Discussion
   Facilitated by Professor Ed Mallen
   Professor Chris Hammond
   Dr Nicola Logan
   Professor Kathryn Saunders
   Mr Mike Bowen

3.35 Plenary session
   Ms Jo Mullin

4.20 Wrap-up and next steps
   Professor Ed Mallen

4.30 END
Roundtable on Myopia Control

Setting the scene

Edward Mallen PhD MCOptom
President, The College of Optometrists
Professor of Physiological Optics, Head of Optometry and Vision Science, University of Bradford

Overview of the event

12.30 Registration and Lunch

1.15 Welcome and Introduction – Setting the scene, Professor Ed Mallen

1.35 Interventions to slow myopia progression, Dr Nicola Logan, Professor Chris Hammond

1.55 Gaps in the evidence, Professor Ed Mallen, Professor Chris Hammond, Dr Nicola Logan

2.15 Q&A

2.30 Coffee break

2.45 Roundtable discussions explained, Mr Mike Bowen

2.50 Roundtable Discussion, Facilitated by Professor Ed Mallen, Professor Chris Hammond, Dr Nicola Logan, Professor Kathryn Saunders, Mr Mike Bowen

3.35 Plenary session, Ms Jo Mullin

4.20 Wrap-up and next steps, Professor Ed Mallen

4.30 END
The aims for today

• Arrive at a consensus on the current best practise for myopia control
  – Including a broad definition of the type of myopes we are trying to help

• Set foundations for a guidance document to help practitioners in the management of myopia progression

• Formulate methods to monitor research findings, and build these into the guidance

• Consider how clinical work can contribute to the evidence base in myopia management/control

Some initial thoughts

• Determining success in myopia control
  – What are we aiming for?

• The “so what?!?” of myopia: why it is a big deal

• Current work on myopia control
  • Where are we up to?
  • Treatment efficacy
  • Patient safety

• Measuring/monitoring refractive and biometric change

• How can clinicians contribute to data?

• How can our data contribute to the evidence base?
Determining success – what are the challenges?

• Measuring refractive outcome
  • Rate of change in refraction similar to repeatability of measurement
  • Is the treatment working??

• What are we going to accept as ‘success’?
  • For example: -3 D instead of -6 D?
  • Halve the annual rate of progression?
  • Lessen the lifetime risk of retinal detachment by 50%?
  • Reduce the risk of maculopathy?

• When should we stop ‘treatment’ and revert to conventional correction?
  • Never? Lifetime cost issue?
  • Rebound effect if we stop treatment?
  • Balance between ‘good’ vision and myopia correction?

Defining ‘success’ in myopia control; what should we be aiming for?

• Achieving the greatest amount of myopic control?
  • Is emmetropia the ideal refractive state?

• Can everyone benefit from myopia control procedures?
  • Is identifying suitable patients a primary outcome in itself?

• Be sure that other visual development mechanisms are not disrupted by myopia control techniques
  • Plus, other related issues (e.g. educational development) not impeded
  • No adverse health effects
    • e.g. in relation to long-term pharmacological interventions
### Is there a problem?

<table>
<thead>
<tr>
<th>Age group</th>
<th>1971-2</th>
<th>1999-2004</th>
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<tbody>
<tr>
<td>12-17</td>
<td>24.0% myopic</td>
<td>33.9% myopic</td>
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<tr>
<td>18-24</td>
<td>27.7</td>
<td>38.1</td>
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<tr>
<td>25-34</td>
<td>24.2</td>
<td>44.0</td>
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<tr>
<td>35-44</td>
<td>24.5</td>
<td>44.9</td>
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<tr>
<td>45-54</td>
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<td>44.8</td>
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<tr>
<td>TOTAL</td>
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<td>41.6</td>
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Studies show increased prevalence of myopia


- Myopia prevalence in three major ethnic groups in Singapore

### Myopia: is it such a big deal?

The large, vulnerable myopic eye: **glaucoma risk**

- Myopes 60% more likely to have POAG than emmetropes (Wong et al. 2003).
- Prevalence of POAG in myopes more than twice that in emmetropes (Suzuki et al. 2006).

#### Blue Mountains Eye Study (Mitchell et al. 1999)

- 3654 participants (49-97 years old).
- No myopia: 1.5% prevalence; Low myopia (1-3D): 4.2% prevalence; Moderate-high myopia (>3D): 4.4% prevalence.
- Odds ratio for myopia: 2.3 (low) and 3.3 (moderate-high).
Myopia: is it such a big deal?

Myopia as a Risk Factor for Open-Angle Glaucoma: A Systematic Review and Meta-Analysis

Odds ratio for low myopia (1-3D) = 1.77

Odds ratio for moderate-high myopia (>-3D) = 2.46


Myopia: is it such a big deal?

Rotterdam Study; N = 6597 participants

Impact of refractive error on visual impairment (VI)
• Prevalence of VI at age 85:
  • 9.5% in emmetropes
  • 15.3% in hypermetropes
  • 33.7% in myopes – of which, 38.9% was myopic macular degeneration

Odds ratios for VI:
• For myopes between 6 D and 10 D: 3.4x
• For myopes greater than 10 D: 22.0x

Challenge: patient selection

Need to define which patients we are seeking to help

Practical considerations in relation to the use and compliance with an intervention
- Contact lenses
- Pharmacological agents

Age of patient compatible with likely compliance and likely therapeutic benefit of the intervention

Parental understanding of the commitment required
- Includes time for follow-up appointments and costs of intervention

Challenge: measuring refractive and biometric change

- Traditional refraction, auto-refraction
- Advances in biometry over last decade

Normal growth of an emmetropic eye
- ~0.16 mm / year, age 6-9 yrs
- ~0.02 mm / year, age 11-14 yrs


PCI-based biometry offers 0.01 mm resolution
Repeatability ~0.04 mm (equivalent to ~0.10 DS)

Santodomingo-Rubido et al. (2002)
Buckhurst et al. (2009)
Measuring refractive and biometric change

• Relationship between ocular biometry and refractive error clearly established

\[ N = 70 \]
\[ R^2 = 0.65 \]
\[ c = 23.63 \text{ mm} \]

Axial length shows negative slope against refraction

1/3 mm ~ 1 D shift

Mallen (2002)

Measuring refractive and biometric change

• Refraction has significant test-retest variability, and myopia progression rate varies hugely
  • Difficult to define when a ‘slowing’ of myopia progression has occurred

• Accurate and repeatable axial biometry is essential in the evaluation of myopia control techniques
  • Important for lab-based and clinical research

• What about when these techniques are used routinely on patients?
  – Monitoring rebound effects following cessation of therapy (e.g. interventions involving atropine)

Should all practitioners involved in myopia control methods have a Lenstar or IOLMaster (or other biometer)?
Challenge: selection of the intervention

Studies show myopia control efficacy for a number of intervention strategies

Selection of the most appropriate myopia control strategy for a particular patient is, currently, not clear

Determining clinical parameters for a change in strategy is also not clear
  • Refinement of a strategy (e.g. changing the near addition)
  • Changing to a different strategy
  • Combining multiple strategies

Challenge: cessation of the intervention

Determining the point at which to cease myopia control intervention

Monitoring myopia progression following cessation of treatment
  • ‘rebound’ effect?

Criteria for recommencement of myopia control intervention
How can clinicians contribute to data?

• We have a huge network of clinicians
  • Potential to collect a large data set
    • Data is power!

• Considerations:
  • Common methods for measuring refraction
  • Autorefractometry under cycloplegia ideal?
    • Eliminates bias

• Need accurate biometry
  • Axial length elongation rate
  • Important if retinal contour is a marker for likely success of treatment, or for initial choice of intervention/refinement of intervention

How can clinicians contribute to data?

• Publication of outcomes
  • Need more to build a collection of evidence

• Establish best practice and prescribing guidelines
  • Input from professional bodies and academia

• Myopia Consortium UK
  • Network of academics and clinical researchers

Huge potential for practice-based research

Powerful vehicle for multi-disciplinary research
What would constitute ‘success’ in myopia control?

• Reliable method to identify suitable candidates for myopia control
  • This method can be used widely in standard clinical settings

• Reliable method of monitoring refractive and biometric change

• No adverse reaction or reduction in visual function

• Wide uptake of the method(s) across the professions

Research evidence underpinning clinical interventions, and data from the clinical setting feeding back into the knowledge base

We now move on to discuss the evidence for interventions which slow myopia progression, and the gaps in the evidence
Gaps in the evidence

What is the most effective time to start a myopia control intervention
Gaps in the evidence

Should an intervention be applied constantly, or can effective myopia control be achieved with an intermittent or phased approach

Gaps in the evidence

What are the key indicators that show that an intervention can be stopped (or perhaps tapered?)

Following cessation of an intervention, are there pre-cursor signs or symptoms (or other markers) that may predict a re-triggering of myopic growth?
Gaps in the evidence

For interventions that use a near addition, is there a power of addition that provides the most effective myopia control?

Is the power of addition dependent on the visual ‘diet’ of the patient (e.g. working distance, etc)?

Gaps in the evidence

In orthokeratology, can the shape of the peripheral (off-axis/parafoveal) retinal image shell be refined to maximise the level of myopia control?
Gaps in the evidence

Can combined interventions provide more effective myopia control?

Is the ‘dose’ of each intervention required to give maximum control ‘person dependent’?

Does the most effective dose combination change over time?

Gaps in the evidence

Does the type of intervention giving maximum myopia control for an individual stay constant, or does it change over time?

For example, might atropine be most effective initially, then a multifocal contact lens become most effective as the child ages?
Gaps in the evidence

Are we absolutely certain that long term atropine use (even at very low dose levels) is safe?

Gaps in the evidence

Do we know enough about the modern visual diet and its potential role in myopia development?

Could the balance between outdoor activity, near work, use of screens/electronic displays be used to control myopia?
Gaps in the evidence

Do we know enough about the role of spectacle correction in myopia progression?

Specifically (and related to the Lin et al paper) can the peripheral relative hypermetropia resulting from a spectacle lens push myopia to progress at a faster rate?

Do we need to consider oblique astigmatism too?

Gaps in the evidence

Is there any consequence of a less than optimal retinal image (for example in a dual focus optical arrangement) on visual development?
Interventions to prevent myopia progression

Dr Nicola Logan
Professor Chris Hammond

Roundtable on Myopia Control
15th June 2018
The College of Optometrists

What influences progression?

Myopia Progression fastest in...

- The earlier the onset
  - Myopia before age 9 = -6D by adulthood
- Children with myopic parents
  - Most significant risk factor of all
- Children who have high IQ, school achievement, read lots, less time outdoors..

.... i.e. risk factors for progression are probably the same as for developing myopia
Can we slow progression?

How fast do myopes progress?
“control” SVL arms in RCTs

Studies
- Cheng 2010 (2 yrs)
- Yang 2009 (2 yrs)
- Hasebe 2008 (18 mos)
- Walline 2008 (3 yrs)
- Katz 2003 (2 yrs)
- Gwiazda 2003 (3 yrs)
- Edwards 2002 (2 yrs)
- Leung 1999 (2 yrs)
- Shih 2001 (18 mos)
- Sankaridurg 2010 (1 yr)

Summary

Annual Myopia Progression Rate for SVL Groups (D/year)

Deng L et al, ARVO 2012
Principles of treatments

- **Close work theory**
  - Accommodation must be bad
  - Accommodation lag in myopes

- **Animal models**
  - Muscarinic antagonists (eg atropine) work in animal models

- **Peripheral retina**
  - Monkey ablation experiments
  - Myopes prolate cf oblate eyes
  - “built up” environment causes hyperopic defocus

- **Light**
  - Outdoor activity protective
  - Animal studies

Principles of treatments

- **Close work theory**  UNDERCORRECT/BIFOCALS/PALS
  - Accommodation must be bad
  - Accommodation lag in myopes

- **Animal models**
  - Muscarinic antagonists (eg atropine) work in animal models

- **Peripheral retina**
  - Monkey ablation experiments
  - Myopes prolate cf oblate eyes
  - “built up” environment causes hyperopic defocus

- **Light**
  - Outdoor activity protective
  - Animal studies
Undercorrect or fully correct?

- 94 Malaysian myopes 9-14 years
- randomised to full or undercorrection (+0.75D, to 6/12)
- Stopped 2 years cf 3: faster progression in undercorrected


Progressive add lenses

- Hong Kong Progressive Lens Myopia Control Study
  - 138 PAL, 160 SVL for 2 years (ages 7-10)
  - Progression -1.26 SVL, -1.12 PAL
- Correction of Myopia Evaluation Trial (COMET)
  - 469 USA myopes (ages 6-11)
  - Progression -1.48 SVL, -1.28 PAL

Edwards MH et al. IOVS 2002; 43: 2852-8
Gwiazda J et al. IOVS 2003;44:1492-500
Overall Myopia Progression:
All PALs, Bifocals, Multifocal specs

Summary

Difference in Myopia Progression between Treatment and Control Groups at Study Completion (D)

Principles of treatments

- **Close work theory**  **BIFOCALS/PALS**
  - Accommodation must be bad
  - Accommodation lag in myopes
- **Animal models**  **ATROPINE**
  - Muscarinic antagonists (eg atropine) work in animal models
- **Peripheral retina**
  - Monkey ablation experiments
  - Myopes prolate cf oblate eyes
  - “built up” environment causes hyperopic defocus
- **Light**
  - Outdoor activity protective
  - Animal studies
Atropine 0.01% Studies in European children

- **CHAMP Study**
  - NI/Scotland/Birmingham/Cambridge
  - Recruitment starting imminently

- **MOSAIC Study**
  - Dublin
  - Recruitment recently started

- **PEDIG Study**
  - USA
  - Recruitment starts imminently

- **Australia ATOM Study**
  - 39 children recruited to date (April 2018)
Atropine 0.5% in Europe

- Rotterdam study
- 77 kids, age 10.3 +3.2, mean -6.6D
  - 53 European origin
- 60 (78%) still using Rx after a year
  - 11/17 discontinued within a month
  - Older children more likely to discontinue
- 1D progression year before, 0.1 D at one year
  - 0.5D in those who stopped Rx
  - Younger kids (<9 did worse- 0.5D), older did better
- Recommend start 0.5%, wean when stable

Polling JR. Eye 2017: 30: 998-1004

Principles of treatments

- Close work theory BIFOCALS/PALS
  - Accommodation must be bad
  - Accommodation lag in myopes
- Animal models ATROPINE/PIRENZEPINE
  - Muscarinic antagonists (eg atropine) work in animal models
- Peripheral retina OPTICAL INTERVENTIONS
  - Monkey ablation experiments
  - Myopes prolate cf oblate eyes
  - “built up” environment causes hyperopic defocus
- Light
  - Outdoor activity protective
  - Animal studies
Optical interventions: role of peripheral retina in myopia development

- Creates hyperopic blur in peripherally
- Acts as stimulus for axial growth

Standard SV lens

Optical interventions: role of peripheral retina in myopia development

- No peripheral stimulus for growth – inhibits myopia

Modified lens
Orthokeratology

Effective in prevention of myopia progression (Cho et al., 2005; Walline et al., 2009; Kakita et al., 2011; Cho and Cheung, 2012; Hiraoka et al., 2012; Santodomingo-Rubido et al., 2012; Chen et al., 2013)

Orthokeratology: Cho & Cheung IOVS 2012

- 2 year randomised clinical trial
- 102 children: 6-10 years
- -0.50 to -4.00D myopia
- Ortho-k slowed axial progression by 43%

![Graph showing axial length progression over time with Ortho-k and Control groups](image-url)

<table>
<thead>
<tr>
<th>Duration of study</th>
<th>6-monthly Increase Ortho-k</th>
<th>6-monthly Increase Control</th>
<th>p-value*</th>
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<tbody>
<tr>
<td>First</td>
<td>0.09±0.10</td>
<td>0.20±0.11</td>
<td>&lt;0.001</td>
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<tr>
<td>Second</td>
<td>0.11±0.09</td>
<td>0.16±0.09</td>
<td>0.004</td>
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<tr>
<td>Third</td>
<td>0.10±0.08</td>
<td>0.14±0.09</td>
<td>0.043</td>
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<tr>
<td>Fourth</td>
<td>0.06±0.08</td>
<td>0.13±0.08</td>
<td>0.001</td>
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</tbody>
</table>

![Graph showing change in axial length over time with Orthokeratology and Control groups.]

**Soft contact lenses:**
**Multifocal/dual focus/EDOF Contact Lenses**

- **Dual focus:**
  - CD, +2 add

![Contact lens images and diagrams showing extended depth of focus.]

Partnership with Brien Holden Vision Institute
MiSight® (CooperVision)

- Four optical zones
  - Two correction zones (refractive correction)
  - Two treatment zones (2.00D myopic defocus)

MiSight: Change in Refractive Error (Diopters)

- 3 year multicentre study
- 8-12 year olds
- N=144
- Based on wearing CL10 hours per day 6 days a week
- NCT01729208

Chamberlain et al. BCLA meeting June 2017
Principles of treatments

- **Close work theory** BIFOCALS/PALS/DENMARK(!)
  - Accommodation must be bad
  - Accommodation lag in myopes

- **Animal models** ATROPINE/PIRENZEPINE
  - Muscarinic antagonists (eg atropine) work in animal models

- **Peripheral retina** VFCL/ORTHO-K
  - Monkey ablation experiments
  - Myopes prolate cf oblate eyes
  - “built up” environment causes hyperopic defocus

- **Light** GOAL STUDY/CLASSROOM
  - Outdoor activity protective
  - Animal studies
Outdoor light?

- **GOAL study**
  - RCT 40 min/day extra outdoor lesson after school
  - Myopic progression 0.17D difference (1.42 vs 1.59D)
- **Finnish Longitudinal Study**
  - 23 year longitudinal myopia progression
  - Outdoor activity (sport/leisure) protective
    - >3hr outdoor activity -5 c.f. -5.5D progression
- **Anyang Childhood Eye Study**
  - 1079 myopic kids: no effect of outdoor activity

He et al. JAMA 2015: 314: 1142
Li S-M et al. IOVS 2015: 56: 4734

Glass Classroom...

https://doi.org/10.1371/journal.pone.0181772
Conclusions: slowing myopia

• **Atropine probably most effective**
  – Only full strength available in UK
    • PAL and photochromic, NB rebound
  – Atropine 0.01%
    • Trials in European children underway
    • Available soon?

• **Contact lenses**
  – Orthokeratology
    • But expensive/risk of corneal infection
  – Bifocal/multifocal soft CLs
    • Of some effect: commercial pressures
Safety

Open access paper

- Similar rates of corneal infiltrative events and microbial keratitis compared to adults
- May be a lower risk in children aged 8-12 years (likely due to compliance)

Safety

Incidence of Adverse Events

- Retrospective study
- ≤ 16 years
- OrthoK vs SCL
- 10 year lens wear

<table>
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<tr>
<td>Total</td>
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<td>103</td>
</tr>
</tbody>
</table>

Hiraoka et al OPO 2018
Unknows re Atropine

- Effectiveness of dilute atropine in European kids
  - Spanish study 0.14D cf 0.65D
- Other strengths?
  - 0.05% well tolerated in Hong Kong, better 0.01%?
- Who responds best?
- No head to head comparisons
- Combinations of treatments eg with CLs
- Long-term efficacy, how long to continue
- Best dosing regimen
- What to do when atropine fails?
  - >1.5D 2-year progression in 9% of kids in Chia 0.01% group


Gaps in knowledge

- Prediction for myopia
- Progression rate
- Individual response
- Greater efficacy

- Main gap is not knowing exact mechanism for development of myopia or progression