Interventions to retard myopia progression in children: an evidence-based update

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Authors' objectives
To evaluate the efficacy of interventions such as eye drops, bifocal lenses, or contact lenses in retarding the progression of myopia in myopic children.

Searching
MEDLINE, EMBASE and the Cochrane Library were searched between 1968 and 2000 for articles in any language, using the following keywords: 'myopia', 'short-sightedness', 'near-sightedness' or 'myopia control', combined with 'progression of myopia' or 'myopia prophylaxis' or 'myopia prevention'. The publication type was limited to 'clinical trials'. The bibliographies of existing reviews and retrieved articles were also reviewed for additional articles not identified from the database searches. Several drug companies involved in clinical trials for myopia control were contacted for information on unpublished RCTs. The proceedings of recent major international conferences on myopia research, such as the International Conference on Myopia and the Association for Research in Vision and Ophthalmology, were also examined.

Study selection
Study designs of evaluations included in the review
Randomised controlled trials (RCTs) were eligible for inclusion in the review.

Specific interventions included in the review
Studies evaluating cycloplegic eye drops, pressure-lowering eye drops, bifocal spectacle lenses, or contact lenses for the retardation of myopia progression longer than one year, were eligible for inclusion. Short-term interventions (less than 1 year) were excluded, as were interventions using behavioural vision training, ocular exercises, orthokeratology, prismatic lenses, multifocal convex lenses and hydrogel lenses. There were 7 comparisons of atropine eye drops (3 against tropicamide, 1 against cyclopentolate, and 3 against lenses), and 2 comparisons of timolol eye drops (against bifocals and single vision spectacles). There were also 7 comparisons of bifocals with various additions, one of multifocal lens alone and in conjunction with 0.5% atropine, and one of contact lenses against single vision spectacles.

Participants included in the review
The participants were children with myopia. Studies with adults were excluded. No further details of the participants' characteristics were provided.

Outcomes assessed in the review
The primary outcome assessed was the mean progression rate of myopia (diopters, D, per year) and its standard deviation. This was measured as the change in spherical equivalent cycloplegic refractive error and, secondarily, as a dichotomous variable (fast progression: yes/no). Fast progression was defined as at least 0.25 D/year or at least 0.5 D/year.

How were decisions on the relevance of primary studies made?
Three independent investigators reviewed all the articles to identify studies meeting the inclusion criteria. The investigators met to resolve any differences in the interpretation of the articles.

Assessment of study quality
Studies were assessed for validity using the recently revised Scottish Intercollegiate Guidelines Network Methodology checklist for RCTs (see Other Publications of Related Interest). The criteria appeared to include the method of randomisation, the similarity of the groups at baseline, and blinding. The authors did not state who performed the validity assessment. [A:The assessment was performed by 2 reviewers: SSM and EC]
Data extraction
The authors do not state how the data were extracted for the review, or how many of the reviewers performed the data extraction.[A: The data was extracted by three reviewers using a standard case report form]

Information on study design, conduct, outcomes and analysis was documented on a data extraction form. This included details of the following: study design; masking; method of randomisation; unit of randomisation; description of the intervention and control groups; characteristics of the study population; similarity of the two groups at baseline; equality of treatment for the two groups; length of follow-up; frequency of follow-up; rate of loss to follow-up in each group; whether an intention to treat analysis was conducted; eyes analysed (left, right, worse, average of two eyes); outcome measures, e.g. the change in refraction; and adverse effects.

Methods of synthesis
How were the studies combined?
No statistical pooling was undertaken. The studies were combined narratively by the intervention, and were rated according to the 'strength of evidence' defined by the American Academy of Ophthalmology's glaucoma panel. Level 1 indicated that the data provided strong evidence in support of the recommendation, and that the study design was relevant, performed in a population of interest and conducted in a manner that ensured production of accurate and reliable data, using appropriate statistical methods. Level II indicated that the data provided substantial evidence in support of the recommendation, but that the evidence lacked some qualities. Level III indicated a consensus of expert opinion in the absence of evidence that met the requirement of levels I and II.

How were differences between studies investigated?
No statistical pooling was undertaken, and no formal test for heterogeneity was carried out.

Results of the review
Ten RCTs (n=1,612) were included in the review. There were 5 three-arm parallel studies, one four-arm parallel study, one matched pair (twin) study, and 3 two-arm parallel studies.

Three RCTs demonstrated that 0.5% atropine eye drops may lower the rate of progression of myopia, although little is known of the long-term side-effects. No significant effect was found for either tropicamide or timolol eye drops.

A trial of soft contact lenses showed no significant effects.

Five of the 6 RCTs on bifocal spectacle lenses with various additions failed to show significant retardation; the sixth trial had positive, although barely significant results (p=0.047).

The findings of the individual included studies were reported in the review.

Authors' conclusions
The latest evidence from RCTs does not provide sufficient information to support interventions to prevent the progression of myopia. Long-term, large scale double-masked RCTs, which include cycloplegic refraction, are needed before any clinical practice interventions can be recommended to prevent high myopia in myopic children.

CRD commentary
The review question and the study selection criteria were clear. The literature search was reasonably comprehensive, with efforts made to identify additional and unpublished relevant studies through manual searches of reference lists and conference proceedings, and by contact with several drug companies involved in trials for myopia control. Information was provided on how the literature was selected, although the authors did not state how the validation process was carried out, who performed the data extraction or how it was performed. While the studies were heterogeneous as a group, the reviewers could have pooled the data statistically according to the intervention, e.g. with the studies of atropine eye drops, or of bifocal lenses.
The findings were clearly presented under appropriate headings. The authors’ conclusions seem appropriate given the findings reported in the review.

**Implications of the review for practice and research**
Practice: The authors do not recommend the routine use of atropine, bifocal lenses or soft contact lenses to retard myopia progression in children.

Research: Long-term, large scale double-masked RCTs, which include cycloplegic refraction, are needed before any clinical practice interventions can be recommended to prevent high myopia in myopic children.

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