Can changes in refraction and axial length in the first six months of DIMS spectacle lens wear predict future progression in UK children?

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Purpose

To evaluate whether axial elongation (AE) and myopia progression (MP) in the first 6 months of wearing DIMS spectacle lenses can predict future myopic progression. Data presented are from a 3-year observational trial of DIMS spectacle lens wear among UK children.[1]

Methods

Participant characteristics:

- 102 children aged 10.2±2.2 years (54% female)
- 45% <10 years, 55% 10-15 years
- 65% White, 18% Indian Asian, 7% Chinese, 10% Other

Initial refractive status under cycloplegia:

Spherical equivalent refraction (SER): -0.50 to -8.50D;
Anisometropia: ≤1.50D; Astigmatism: ≤2.50D

- All children were prescribed DIMS spectacle lenses
- Average daily wearing time 13±1.5 hours (range 7.6 - 16.0 hours)

Measurements made at baseline and at 6-monthly intervals for a period of 18 months were:

- Cycloplegic Autorefraction (SER): Grand Seiko/Shin Nippon, 30 mins post instillation of 0.5% proxymetacaine HCl, 1.0% cyclopentolate HCl.
- Axial Length (AL): Zeiss IOLMaster 500/700

Statistical analysis:

- Pearson's correlations evaluated single baseline variables with AE and MP between 6 and 18 months **(Table 2).**
- Change in AE and MP in initial 6 months of DIMS spectacle lens wear compared with change in AE and MP between 6 and 18 months **(Table 2).**
- Single variables that met statistical significance (*p*<0.05) were evaluated in multiple regression models **(Tables 3 & 4)**.
- Rate of AE was classified as 'fast' (>mean annual AE for untreated myopes[2]) or 'slow' (<=mean annual AE for untreated myopes[2]) for both the first 6 months of treatment (annual AE by age/1.71 factor derived from Fig. 1A) and between 6 and 18 months of treatment (annual AE by age).

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Results

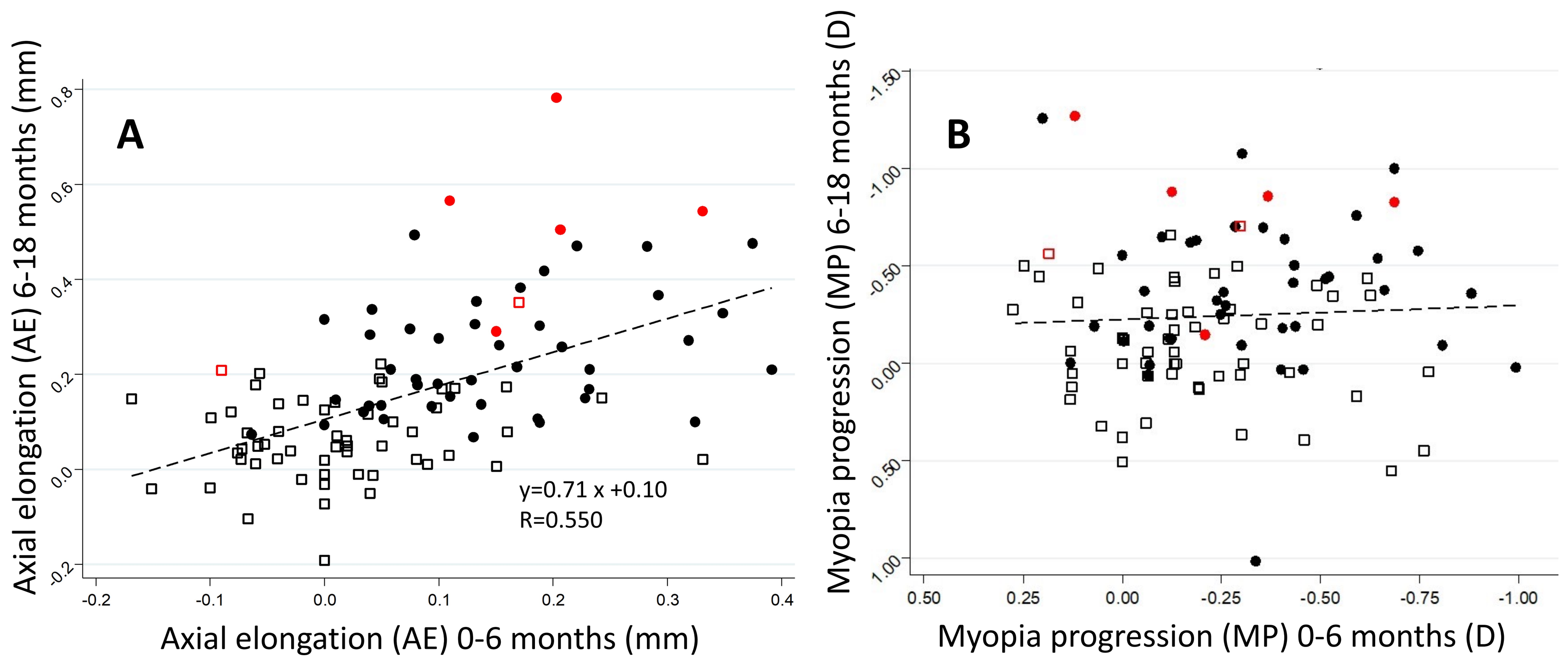
Table 1. describes the mean changes ±SD (range) in AE and MP over the first 6 months and the following year of DIMS wear (between 6 and 18 months). Only right eye data are presented (AE and MP R=L, all p<0.0001).

Table 1.	Axial Elongation (AE) (mm)	Myopia Progression (MP) (D)
Baseline to 6-months	0.08±0.12 (0.39 to -0.17)	-0.24 ± 0.27 (-0.99 to +0.28)
6- to 18-months	0.16 ±0.16 (0.78 to -0.19)	-0.24 ± 0.40 (-1.53 to +1.02)

Table 2.	Pearson's R/ AE 6-18 months	*p*	Pearson's R/ MP 6-18 months	*p*
Baseline age (years)	-0.662	<0.0001*	0.475	<0.0001*
Baseline SER (D)	0.136	0.17	-0.031	0.76
Baseline AL (mm)	-0.259	0.009*	0.086	0.39
6-month AE	0.550	<0.0001*	-0.572	<0.0001*
6-month MP	-0.169	0.09	0.043	0.67

Table 3.	Multiple regression/ AE 6-18 months	*p*
	Model 1 R^2=0.48	
Baseline age (yrs)	-0.036	<0.0001*
6-mth AE (mm)	0.317	0.008
Baseline AL (mm)	-0.008	0.56
	Model 2 R^2=0.48	
Baseline age (yrs)	-0.037	<0.0001*
6-mth AE (mm)	0.311	0.009

Table 4.	Multiple regression/ MP 6-18 months	*p*
	Model 1 R^2=0.36	
Baseline age (yrs)	0.038	0.04*
6-mth AE (mm)	-1.474	<0.0001*
	Model 2 R^2=0.41	
Baseline age (yrs)	0.033	0.07
6-mth AE (mm)	-1.91	<0.0001*
6-mth MP (D)	-0.378	0.004*



Figures 1 A & B. Axial elongation (AE) and myopia progression (MP) in first 6 months of treatment plotted against AE and MP between 6-18 months of treatment, respectively. Circles = children <10 years at baseline; open squares= children 10-15 years at baseline. Black= 'slow' eye growth, red='fast' eye growth[2]. Dashed black line= line of best fit.

References

1.McCullough, S, Barr, H, Fulton, J, Logan, N, Nagra, M, Pardhan, S, Richardson, P, Saunders, K, Whayeb, Y, Williamson, P, Vlasak, N; 2-Year Multi-Site Observational Study of MiYOSMART myopia control spectacle lenses in UK children: 1-year results. Invest. Ophthalmol. Vis. Sci. 2023;64(8):4945.
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Results (continued)

Predicting Future Axial Elongation from Initial 6-Month Change

		Classification Axial Elongation 0-6 months of Treatment		
		Fast	Slow	Total
Classification Axial Elongation 6-18 months of Treatment	Fast	2	5	7
	Slow	9	86	95
	Total	11	91	102

Fast/Slow classification of AE over 0-6 months was not significantly associated with classification of AE in the following 12 months (X^2=2.47, *p*=0.116). Only 2/11 participants classed as demonstrating 'fast' AE in the first 6 months showed 'fast' AE in the following year. However, 86% (88/102) sustained the same classification of AE rate across the first 18 months of DIMS spectacle wear.

Conclusions

- Baseline age and AE after 6 months of DIMS spectacle wear
  - were significant predictors of AE and MP in the following year
  - accounted for 48% and 36% of the variance in AE and MP, respectively.
- MP in the first 6 months of DIMS spectacle wear was only predictive of future success when considered in parallel with axial length change. Other studies have reported similar variability in prediction models using refractive measurements in isolation.[3]
- Baseline AL and SER were not helpful covariates within the prediction models.
- Classifying children as 'fast' or 'slow' in terms of AE over 6-months showed modest predictive accuracy for future AE.

Clinical Relevance

- **Age** at treatment initiation and **axial elongation within the first 6 months** of lens wear are indicative of progression in the next year. Extended monitoring (e.g. for 12-months) may be a more sensitive means to identify children with persistent 'fast' eye growth who could potentially benefit from additional myopia management interventions.
- The **level of myopia** and **magnitude of axial length** at treatment initiation **are not helpful predictors** of future progression with DIMS spectacle wear. Longer eyes or those with high myopia did not exhibit faster progression.
- **Axial measures are more sensitive** for predicting future progression than refractive error measures in isolation.