



ORIGINAL ARTICLE

Refraction during incipient presbyopia: The Aston Longitudinal Assessment of Presbyopia (ALAP) study

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KEYWORDS

Presbyopia;
Myopia;
Refractive error

Abstract

Purpose: To investigate non-cycloplegic changes in refractive error prior to the onset of presbyopia.

Methods: The Aston Longitudinal Assessment of Presbyopia (ALAP) study is a prospective 2.5 year longitudinal study, measuring objective refractive error using a binocular open-field WAM-5500 autorefractor at 6-month intervals in participants aged between 33 and 45 years.

Results: From the 58 participants recruited, 51 participants (88%) completed the final visit. At baseline, 21 participants were myopic ($MSE -3.25 \pm 2.28$ DS; baseline age 38.6 ± 3.1 years) and 30 were emmetropic ($MSE -0.17 \pm 0.32$ DS; baseline age 39.0 ± 2.9 years). After 2.5 years, 10% of the myopic group experienced a hypermetropic shift (≥ 0.50 D), 5% a myopic shift (≥ 0.50 D) and 85% had no significant change in refraction (< 0.50 D). From the emmetropic group, 10% experienced a hypermetropic shift (≥ 0.50 D), 3% a myopic shift (≥ 0.50 D) and 87% had no significant change in refraction (< 0.50 D). In terms of astigmatism vectors, other than J_{45} ($p < 0.001$), all measures remained invariant over the study period.

Conclusion: The incidence of a myopic shift in refraction during incipient presbyopia does not appear to be as large as previously indicated by retrospective research. The changes in axis indicate ocular astigmatism tends towards the against-the-rule direction with age. The structural origin(s) of the reported myopic shift in refraction during incipient presbyopia warrants further investigation.

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PALABRAS CLAVE

Presbicia;
Miopía;
Error refractivo

Refracción durante la presbicia incipiente: Estudio de evaluación longitudinal de la presbicia de Aston (ALAP)

Resumen

Objetivo: Investigar los cambios en el error refractivo sin cicloplégico con anterioridad a la aparición de la presbicia.

Métodos: El estudio de la evaluación longitudinal de la presbicia de Aston (ALAP) es un estudio longitudinal prospectivo de 2,5 años que mide el error refractivo objetivo utilizando un autorrefractor binocular de campo abierto WAM-5500 a intervalos de 6 meses, en participantes con edades comprendidas entre 33 y 45 años.

Resultados: De los 58 participantes estudiados, 51 de ellos (88%) completaron la visita final. Al inicio, 21 participantes eran miopes (MSE $-3,25 \pm 2,28$ DS; edad basal: $38,6 \pm 3,1$ años) y 30 eran emétopes (MSE $-0,17 \pm 0,32$ DS; edad basal: $39 \pm 2,9$ años). Transcurridos 2,5 años, el 10% del grupo de participantes miopes experimentó un cambio hipermetrópico ($\geq 0,5$ D), el 5% un cambio miópico ($\geq 0,5$ D), y el 85% no experimentó cambio refractivo significativo alguno ($< 0,5$ D). En el grupo emétope, el 10% experimentó un cambio hipermetrópico ($\geq 0,5$ D), el 3% un cambio miópico ($\geq 0,5$ D), y el 87% no experimentó cambio refractivo significativo alguno ($< 0,5$ D). En términos de vectores astigmáticos, todas las mediciones permanecieron invariables durante el periodo de estudio excepto J_{45} ($p < 0,001$).

Conclusión: La incidencia del cambio miópico en la refracción durante la presbicia incipiente no parece ser tan grande como anteriormente indicado en investigaciones retrospectivas. Los cambios en los ejes indican que el astigmatismo ocular tiende hacia la dirección contra la norma con la edad. El(los) origen(es) estructural(es) del cambio miópico reportado en la refracción durante la presbicia incipiente justifica la investigación futura.

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Introduction

Age-related changes in refraction have been well documented cross-sectionally and longitudinally during childhood,^{1,2} early adulthood^{3,4} and presbyopia.^{5,6} Whilst a significant body of work charts myopia genesis and progression in children,⁷⁻¹³ there is also evidence of myopia onset and progression during adulthood.^{4,14,15} Indeed, Rahi et al.¹⁶ reported 49% of 2487 randomly selected British adults aged 44 years were myopic (MSE ≤ -0.75 D), with over 80% of the myopia occurring after the age of 15 years (late onset myopia).^{17,18}

Considering the typical change in refraction between the ages of 35–65 years,¹⁹ a hypermetropic shift has consistently been documented by cross-sectional^{14,20-29} and longitudinal^{5,6,15} studies, with a myopic shift reported after 65 years, possibly due to the onset of crystalline lens nuclear sclerosis.³⁰ Current understanding of the optical and structural changes that occur during the development of presbyopia suggest the origin of the hypermetropic shift between the ages of 35–65 years could be the manifestation of previously latent hypermetropia,³¹ which can no longer be overcome due to a reduction in amplitude of accommodation, or the crystalline lens paradox, where the increase in crystalline lens thickness and curvature is over-compensated for by a reduction in the average refractive index of the crystalline lens.^{5,14,32}

However, Pointer and Gilmartin³³ have presented retrospective data revealing 20% of myopic participants

experienced a myopic shift in refraction of 0.50–0.75 D between the ages of 35–44 years, otherwise classified as the period of incipient presbyopia i.e. before a reading addition correction is considered clinically necessary. Incipient presbyopic participants were largely omitted from the aforementioned adult studies. Despite reporting a hypermetropic shift (≥ 0.50 D) in refraction in emmetropic and hypermetropic individuals after the age of 40 years, Grosvenor and Skeates⁵ isolated retrospective longitudinal myopic participant data to find the hypermetropic shift in refraction was less prevalent amongst myopic participants (19%). In fact, most myopic participants remained stable (66%) or became more myopic by ≥ 0.50 D (15%) after the age of 40 years. Further, refractive data from 15 population-based cohort and cross-sectional studies analysed by the European Eye Epidemiology (E³) Consortium demonstrates a small (1.7%) increase in the prevalence of low myopia (classified as ≤ -0.75 to > -3.00 D) between the ages of 35–39 years and 40–44 years, which could reflect further a myopic shift in the incipient phase of presbyopia.¹⁹ The ocular changes driving this putative myopic shift in refraction during incipient presbyopia are currently unknown. Moreover, it is unclear why myopic individuals appear to be at a greater risk of a myopic shift in refraction than emmetropic individuals during incipient presbyopia. Perhaps the effects of the crystalline lens paradox are less pronounced in myopic eyes due to their thinner crystalline lenses^{4,17,34} or previous axial elongation acts as a predisposition for future continued axial elongation.

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