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ORIGINAL ARTICLE

Study on accommodation by autorefraction and dynamic refraction in children

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KEYWORDS
Autorefraction;
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Abstract
Purpose: Childhood accommodation interferes with accurate diagnosis of the latent refractive errors. Dynamic retinoscopy offers accurate measurements of accommodative response, while an autorefractometer can predict the accommodative system activation in children. A correlation of the accommodative effort with the dynamic refraction has been investigated in emmetropic children, before and after cycloplegia.
Methods: A prospective clinical study of accommodative effort in 149 emmetropic children, in the age group 3–16 years, has been conducted using TOPCON AR RM-8000B autorefractor. Dynamic refraction was performed by monocular estimation method before and after cycloplegia, using the retinoscope mirror light as target. Retinoscopic reflex produced 'with the motion' was corrected with positive spherical lenses, and that 'against the motion' was corrected with negative spherical lenses, to achieve neutralization.
Results: Mean accommodative effort measured for 149 children included in the study was -0.63 ± 0.69 D and dynamic refraction was -0.07 ± 0.44 D before cycloplegia, while the mean was + 0.52 D after cycloplegia, irrespective of the method used. Autorefractor measured −0.17 D of accommodative effort per unit change in dynamic refraction before cycloplegia and +0.90 D after cycloplegia.
Conclusions: The performance of TOPCON AR RM-8000B autorefractor was comparable to dynamic retinoscopy. Presence of many children, and in turn, large number of accommodative response data in 11–13 and 14–15 years group is probably linked to prolonged reading/writing. The accuracy and the agreement of the actual accommodative measurements revealed after cycloplegia.

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PALABRAS CLAVE
auto-refracción;
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esfuerzo acomodativo;
dióptero

Estudio sobre acomodación mediante auto-refracción y refracción dinámica en niños

Resumen
Objetivo: La acomodación infantil interfiere con la precisión diagnóstica de los errores refractivos latentes. La retinoscopía dinámica ofrece mediciones precisas de la respuesta acomodativa, mientras que el auto-refractómetro puede predecir la activación del sistema acomodativo en niños. Se ha investigado la correlación entre el esfuerzo acomodativo con la refracción dinámica en niños emétropes, antes y después de la ciclopejía.
Métodos: Se realizó un estudio clínico prospectivo del esfuerzo acomodativo en 149 niños emétropes, dentro del grupo de edad de 3 a 16 años, utilizando el auto-refractómetro TOPCON AR RM-8000B. Se llevó a cabo la refracción dinámica mediante el método de estimación monocular, antes y después de la ciclopejía, utilizando la luz del retinoscopio como objeto de fijación. El reflejo retinoscópico producido 'a favor' se corrigió con lentes esféricas positivas, y el reflejo 'contra' se corrigió con lentes esféricas negativas, para lograr la neutralización.
Resultados: El esfuerzo acomodativo medio, medido en los 149 niños incluidos en el estudio fue de -0,63 ± 0,69 D, siendo la refracción dinámica de -0,07 ± 0,44 D antes de la ciclopejía, mientras que la media fue de + 0,52 D tras la ciclopejía, independientemente del método utilizado. El auto-refractómetro midió un esfuerzo acomodativo de -0,17 D por unidad de cambio en la refracción dinámica antes de la ciclopejía, y de +0,90 D tras la misma.
Conclusiones: El desempeño del auto-refractómetro TOPCON AR RM-8000B fue comparable al de la retinoscopía dinámica. La presencia de muchos niños y, a su vez, el gran número de respuesta acomodativa en el grupo de edades de 11−13 y 14−15 años, están probablemente vinculados a la lectura/escritura prolongadas. La precisión y concordancia de las mediciones acomodativas reales se revelaron tras la ciclopejía.

Introduction

Accommodation system of the human eye is a highly complicated function essential to execute very fine and detailed work, without exerting much strain on the eyes. Duane (1912) has deduced the corrective formula based on the accommodative amplitude in 1000 subjects aged 8−70 years, which is useful even today for treating accommodative dysfunctions.[1] The accommodative amplitude starts declining from age 3 to 40 years in a curvilinear manner.[2] The daily variation of the accommodative amplitude is 1.00 D, although the day-to-day values are relatively stable (±0.50 D), according to a study of diurnal variation of tonic accommodation.[3] Increasing accommodative response has been correlated with increased ciliary muscle thickness in children.[4]

Dynamic retinoscopy (DR) is the method of choice for rapid assessment of accommodative abilities in children to identify hyperopic and accommodative insufficiency.[5] DR is also an objective and efficient technique for assessing maximum accommodative amplitude in early childhood.[6,7] Accommodative amplitude can be measured subjectively by Donders push-up or Sheard's methods. Other objective methods of assessing accommodation include monocular estimation method (MEM), Nott dynamic retinoscopy, Bell retinoscopy and autorefraction (AR).

There are very few studies on accommodation by autorefraction and dynamic refraction in emmetropic children. A previous study on accommodative lag measurements, by the two methods in low myopic children with normal visual acuity, concluded that the retinoscopy methods underestimated the accommodative lag compared to the open-field autorefractor.[8,9]

Accommodative effort (AE), defined as positive or negative response to near target fixation, can be objectively measured by these two techniques. Measurement of distance refraction by AR is nearly accurate in adults, as there is progressive decrease in the accommodative capabilities. However, the performance of AR in children is less reliable. Despite the auto fogging system incorporated in the autorefractors, distance refraction values were not accurate in children with strong accommodative abilities. The readings were negative indicating spherical correction and highly variable on repeated acquisition. The changes are attributed to rapidly adjusting accommodative system, particularly in children. It could also be due to the exertion of the accommodation. In the present study, AR is compared with dynamic retinoscopy using MEM, before and after cycloplegia in emmetropic eyes.

In view of the paucity of studies, the objective of the present study is to compare the accommodative effort by the gold standard cycloplegic refraction with autorefraction and dynamic refraction in emmetropic children.

Methods

A prospective clinical investigation was conducted in the ophthalmology outpatient department, between October 2011 and April 2013, which recruited children between 3 and 16 years of age. Institutional ethical committee approved