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Original research

Does astigmatism alter with cycloplegia?

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Abstract

Purpose: To determine the effect of the cyclopentolate 1% on the cylindrical and spherical components of the refraction.
Methods: Three hundred seventy-five eyes of 195 subjects, including 74 males and 121 females, aged from 3 to 59 years were refracted before and 30 min after cyclopentolate 1% eye drop instillation. To compare cylindrical data, power vector analysis (J_0 and J_{45} cross cylinder) was applied.
Results: A statistically significant difference between the J_0 values of the noncycloplegic and cycloplegic refraction was revealed ($P = 0.006$) while the J_{45} values did not significantly differ. 95% limit of agreement for dry and cycloplegic values of the J_0 and J_{45} were −0.22 to 0.25 and −0.19 to 0.20, respectively. Astigmatism difference was separately analyzed in emmetropic, myopic and hyperopic eyes. The J_0 difference was significant ($P = 0.014$) only in hyperopic eyes. Spherical equivalent (SE) values in cycloplegic refraction were significantly more hyperopic than those yielded in dry refraction by mean difference of $+1.16 \pm 1.20$ diopters ($P < 0.0001$). Spherical equivalent difference (SED) values were negatively correlated with age.
Conclusions: Our findings indicated that cycloplegic drops caused a statistically significant shift in the "with the rule" and "against the rule" astigmatisms, although the oblique astigmatisms remained unaffected. Further research with larger sample sizes are needed to answer what mechanisms are involved in changing cylinder with cycloplegia.

Keywords: Astigmatism; Cycloplegia; Noncycloplegia; Agreement

Introduction

Astigmatism is one of the most prevalent refractive errors encountered in ophthalmic practice. Uncorrected remaining of the astigmatism can give rise to various kinds of visual and ocular symptoms, such as blurry vision, asthenopia (eye strain), glare, headache, and monocular diplopia.[1,2] The axis orientation of astigmatism is an important factor dramatically influencing the frequency and severity of the subjective symptoms.[2,3] As the axis orientation error in prescription becomes greater, the subjective complaints often become more. Exact determining of the cylinder axis is imperative to alleviate the astigmatism-induced asthenopia and prevent the meridional amblyopia.[3]

Various methods such as retinoscopy, autorefraction, and photorefraction can be used to evaluate the cylindrical

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component of the refraction. Ocular refraction procedures can be implemented in either non-cycloplegic (dry) or cycloplegic status. Seemingly, there is general consensus that the cycloplegic refraction is considered to be crucial in some situations such as idiopathic vision loss, high amount of anisometropia, latent hyperopia, accommodation anomalies, and esotropic eye squint.[4,5]

So far, variegated types of the cycloplegic agents have been introduced. The well-known cycloplegics are atropine, homatropine, scopolamine, cyclopentolate, and tropicamide.[6,7] Although much controversy still surrounds the choice of the better cycloplegic agents, the cyclopentolate 1% has been recommended by the majority of authors because of its adequate effectiveness and relatively fewer number of side effects.[8]

Almost all of the preceding studies have solely tended to focus on the spherical changes rather than the cylindrical modifications during the cycloplegic refraction. So far, there have not been a sufficient number of studies about the cylindrical component alterations with cycloplegic drop instillation.

With this study, we strived to find out whether or not cylindrical component of refraction alters with cycloplegia. It would be expected that both magnitude and axis values of the cylindrical refraction would be identical to those measured in dry status. However, in routine clinical practice, it has often been seen that the cylindrical properties of the refraction usually differ, though not always, in cycloplegic status compared with noncycloplegic one. Accordingly, a holistic comparison of the cylindrical component of refraction along with the spherical changes in non-cycloplegic with cycloplegic conditions was nicely addressed by this work. Addressing the cylindrical variations with cycloplegia was the main aspect of this survey.

Methods

A single center analytical prospective study was conducted on 375 eyes of 195 subjects aged from 3 to 59 (Mean ± Standard Deviation = 17.89 ± 9.56) years. Seventy-four (37.94%) subjects were male, and the remainder (62.06%) were female. The subjects of the present study were chosen from the patients who referred to the optometry clinic of Rehabilitation School of Iran University of Medical Sciences. We followed the tenets of the Declaration of Helsinki in obtaining and using the data in the present study. First, comprehensive information about the study's procedures and its possible side effects and complications were given to the volunteers. From all of the subjects a written informed consent was obtained before inception of the study. For individuals under age 15, parent approval was considered necessary to participate in this survey. The Ethics Committee of Iran University of Medical Sciences approved the study protocol. All participants signed a written informed consent.

Clarity of ocular media, lack of any active inflammatory or infectious corneal and intraocular disease, no history of contact lens wear at the time of enrollment, no history of undergoing refractive surgery, and having a wide anterior chamber angle were considered as inclusion criteria. The individuals who had dry eye, ocular surface pathologies, neurological problems interfering refraction procedures (e.g. head nodding), and binocular vision disorders such as nystagmus and strabismus were excluded. Neither aphakic nor pseudophakic eyes were recruited in our research.

To check possessing of the inclusion criteria, a thorough visual and ocular examination, comprising unaided and corrected distance visual acuity, ophthalmoscopy, and biomicroscopy was implemented for all of the volunteers. All of the volunteers were questioned about dry eye symptom experience and recent contact lens wear history. The findings were recorded in a paper sheet designed for this purpose. The subjects who met the inclusion criteria during the preliminary examination participated.

To rule out the possibility of angle closure after the cycloplegic administration, anterior chamber angle estimation technique was carried out for all subjects. We applied Van Herick angle estimation method using the slit lamp to approximate and qualitatively evaluate the peripheral depth of the anterior chamber. We categorized the angle size with a five-point scale from grade 0 (closed angle) to grade 4 (wide open angle). Each individual whose angle was equal and narrower than 2 (grades 0, 1, 2) was excluded from the survey.[9]

Dry refraction

The refractive status was assessed quantitatively using autorefractometer (Autorefractor, TOPCON, KR-8900, Japan) by an optometrist. Before beginning, we explained the procedure to the subject and gave him or her the needed instructions. The subject was asked to sit comfortably on the exam chair. He or she was requested to locate and keep his or her chin in the chinrest cup and his or her forehead against the forehead bar. We monitored and controlled the position of the subject's head on the chinrest. The subject was instructed to fixate the fixation picture into the device. We chose a back vertex distance value of 12 mm in this device. After the precise centering and focusing of the semi-circular mires, we started to perform the refraction. Sphere, cylinder magnitude, and axis orientation in each subject were measured 5 times consecutively. The average value of these measurements was recorded. We performed retinoscopy for both eyes as a confirmatory and supplementary test after the autorefraction in all of the subjects.

Cycloplegic refraction

After completing the non-cycloplegic refraction, one drop cyclopentolate 1% (CICLOPLEGICO, ALCON CUSI, S.A., El Masnou-Barcelona) was instilled into the subject's eye. At this time, the subject was asked to close his or her eye immediately for 2 min and occlude the nasolacrimal passage by pressing his or her fingers on the lacrimal puncta to minimize systemic absorption of the eye drop.[10] Thirty minutes was allowed to reach adequate cycloplegia.[8,11] After