Comparison of Cycloplegic and Manifest Refraction in Children and Adolescents

ABSTRACT

Purpose: To determine the relation between manifest refractive error and cycloplegic refractive error in children and adolescents in Campinas - SP, Brazil, and to compare the results with previous published studies.

Methods: Dynamic and static retinoscopy was performed in children and adolescents. To obtain cycloplegia, three drops of 1% cyclopentolate was instilled in each eye every 5 minutes. Maximum cycloplegic effect was achieved after 45 minutes. The working distance for retinoscopy was 67 cm. During retinoscopy, the room was dimly illuminated, and patients were instructed to look at a spot of light at a distance of 6 m. Retinoscopic findings were measured before and after cycloplegia.

Results: Two hundred and twenty-two (222) eyes of one hundred and eleven (111) children and adolescents were included. The average age of the participants was 10 years (range 4 to 15 years); 57 (51%) were girls, and the other 54 (49%) were boys. The most common refractive error in younger children was hyperopia, whereas myopia was the most common error in older children. The value of the latent error (the difference between cycloplegic and non-cycloplegic error) increased with hyperopia, especially in younger patients. The value decreased gradually in patients with moderate hyperopia and myopia.

Conclusion: The cycloplegic refraction is more sensitive than the subjective one to measure refractive error at all age groups especially in children and young adults. The cyclo-refraction technique is highly recommended to precisely measure the refractive error in momentous conditions such as refractive surgery, epidemiological research, and amblyopia.

INTRODUCTION

Visual impairment affects 7.5 million school-aged children, 7-25% preschool, and school-aged children, according to other studies. As claimed by the World Health Organization, only 25% of these children present symptoms; hence a detailed ophthalmologic examination is necessary to diagnose the majority of the cases.

Evaluation and detection of potential eye defects should be performed early in life, as a delay in the diagnosis leads to a lower chance of correction. Furthermore, refractive errors contribute to low school performance and socialization.

Cycloplegia is a necessary procedure in the diagnosis and treatment of important ophthalmic disorders, particularly in children and adolescents who are at the critical age of visual maturation and have higher amplitudes of accommodation. Cycloplegic refraction helps to determine full hyperopia in patients with accommodative esotropia and prevents overcorrection in myopic patients. Cycloplegic examinations not only...
Cycloplegia is used to obtain paralysis of accommodation by blocking the action of the ciliary muscle. The best way to inhibit the accommodative power of the eye is to use cycloplegic drops.\(^8\) The shorter acting agents, cyclopentolate and tropicamide, are the most accepted topical ocular cycloplegic agents. Although atropine provides the greatest amount of cycloplegia, it has a potential for many side effects. The cyclopentolate has fewer complications, is easier to administer, and has a shorter duration of action.\(^9\)\(^10\)

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Some studies have compared the non-cycloplegic (manifest refractive error) and cycloplegic ametropias of children and adolescents. Some of these studies have used the latent error (comparison of the difference in refractive error found before and after cycloplegia).\(^13\) The aim of this study was to determine the relation between the manifest refractive error and the cycloplegic refractive error of children and adolescents in Campinas - SP, Brazil, and also to compare our results with previous studies.

**METHODS**

Brazilian school students were recruited from a vision screening local program. Dynamic and static retinoscopy was performed on every school student participating in the screening.

The working distance for retinoscopy was 67 cm. During retinoscopy, the room was dimly illuminated, and the students were asked to look at a spot of light at a distance of 6 m.

To obtain cycloplegia, one drop of 1% cyclopentolate was instilled in each eye, followed by another drop 5 minutes later; a 3rd drop was instilled 5 minutes later.

Maximum cycloplegia in this study was achieved after 45 minutes.

**RESULTS**

The prevalence of refractive errors based on the age of the two hundred and twenty-two (222) eyes of one hundred and eleven (111) children and adolescents were analyzed (Table 1).

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>4 - 6 (n=37)</th>
<th>7 - 9 (n=80)</th>
<th>&gt; 10 (n=105)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Myopia</td>
<td>0.5 - 3 (n (%))</td>
<td>0.5 - 3 (n (%))</td>
<td>0.5 - 3 (n (%))</td>
</tr>
<tr>
<td>Hypermetropia</td>
<td>3 - 6 (n (%))</td>
<td>3 - 6 (n (%))</td>
<td>3 - 6 (n (%))</td>
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</tbody>
</table>

**DISCUSSION**

It is important to identify visual impairment in preschool and school age children (the age that the eye’s development is completed), as it interferes with the learning process and psychosocial development.\(^14\)

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**TABLE 1.** Prevalence of refractive errors before and after cycloplegia, based on age.
There is an age-related shift in refractive error from hyperopia in young children towards myopia in older children, as we can observe in other studies.15

Cycloplegic refraction is necessary because the non-cycloplegic refractometric measures lead to a misclassification of refractive error in children and adolescents, leading to wrong prescriptions.16,17

The use of cyclopentolate in refraction is superior in cycloplegia compared with the use of Trophein.18 In our study, cycloplegia was achieved after 3 drops of 1% cyclopentolate, enough to obtain paralysis of accommodation. Some studies demonstrate that the cycloplegic auto-refractometer and other high technology equipment underestimate hyperopia in children.19,20

We found that the value of the latent error increased with hyperopia. Different authors have found the same tendency.21

Bannon et al.12, in an extensive review of the literature, pointed out that 74.4% of the patients had a spherical value of manifest and cycloplegic refraction that varies from -0.50 D to +0.50 D. And the greatest difference was found in the hyperopic cases, especially in young hyperopic patients.

Young et al.22, in a study with 570 subjects found that the value of the latent error increases with hyperopia and diminishes with myopia. According to Rengstorff19, in low refractive error and myopia, there is no difference in refractive error with or without cycloplegic drugs, as we can infer from our findings.

In conclusion, the cycloplegic refraction is more sensitive than the subjective one to measure refractive error at all age groups, especially in children and young adults. The cyclo-refraction technique is highly recommended to precisely measure the refractive error in momentous conditions such as refractive surgery, epidemiological researchers, and amblyopia. □

References