Взаємозв’язок деяких біомеханічних і біометричних показників ока в дітей з осьовою та рефракційною міопією слабкого ступеня
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Мета роботи – вивчити взаємозв’язок біометричних і біомеханічних показників корнеосклеральної капсули ока в дітей з осьовою та рефракційною міопією слабкого ступеня.

Матеріали та методи. Основа міопія діагностована у 32 дітей (64 ока), рефракційна міопія – у 18 дітей (36 ока). Група контролю – 16 дітей без офтальмологічної патології (32 ока). Офтальмологічне обстеження: візометрія, авторефрактометрія, біомікроскопія, офтальмоскопія, визначення аксіальної довжини ока та кореального гістерезису.

Результати. Вірогідні відмінності визначені в показниках діоптрійності рогівки: 42,2 діоптрії в пацієнтів з осьовою, 44,7 діоптрії з рефракційною міопією (р<0,05), а також між пацієнтами з рефракційною міопією та групою контролю: діоптрійність рогівки становила 42,6 діоптрії (р<0,05). Вірогідні відмінності в аксіальній довжині ока між осьовою та рефракційною міопією – 24,5±0,64 мм та 23,1±0,43 мм (р<0,05). Кореальний гістерезис знижений у середньому в 1,2 та 1,1 разів порівняно з емметрійними очами. Кореальний гістерезис не залежить від сферичного компоненту короткозорості, знижується в залежності від аксіальної довжини ока та сферичного компоненту міопії.

Висновки. У пацієнтів з осьовою та рефракційною міопією слабкого ступеня кореальний гістерезис знижений у середньому в 1,2 та 1,1 раза порівняно з емметрійними очами. Кореальний гістерезис не залежить від сферичного компоненту короткозорості, знижується збільшенням аксіальної довжини ока у 82 % випадків при осьової та в 76 % випадків при рефракційній міопії.

Ключові слова: діагностика, діти, міопія.

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elevance. Among the factors influencing the occurrence and development of myopia, violation of the strength properties of the fibrous capsule is the leading one as well as biomechanical features of postnatal development of the eyeball [1,2].

In this regard, interconnection of biomechanical and biometric parameters of the eye has clinical significance for the diagnostics and forecasting the development of myopic process. Evaluation of these indicators in children and adolescents acquires special significance, when refractogenesis is incomplete and there is a necessity to differentiate its natural course against pathological changes, peculiar to progression of myopia and development of myopic complications in the eye fundus.

The literature describes various indicators and methods of investigation of biomechanical properties of the eyeball. Thus, we know the method of determining of biomechanical properties of corneoscleral capsule of the eye in terms of acoustic density of the sclera, which corresponds to the amplitude attenuation of the echo signal reflected from the eye sclera. However, the results of this technique are influenced by a number of factors: rigidity, thickness and radius of cornea curvature, the volume of the eyeball. Another technique that allows receiving uninterrupted dependence of the “stress-strain” in the local dosage load on the analyzed portion of corneoscleral capsule is uncomfortable and difficult in pediatric practice [1].

Opportunities of investigation corneoscleral layer of the eye in clinical diagnostic practice on the device of the analyzer of biomechanical properties of the eye (Ocular Response Analyzer, ORA, Reichert) are described in the literature [3,7]. This device allows a contactless measure of corneal-compensated intraocular pressure and the pressure according to Goldman, and also to evaluate some biomechanical characteristics that reflect the visco-elastic properties of the corneal tissue: corneal hysteresis and factor of resistance. At the same time, it is proved that the data of ORA reflect biomechanical response to the impact of air pulse not only of the cornea, but of the corneoscleral capsule in general [3]. It was noted a diagnostic value of biomechanical parameters of the cornea and sclera, investigated on ORA during the excimer laser correction, for the diagnostics of keratoconus and glaucoma [3,5,7]. Messages of researchers about the biomechanical properties of the corneoscleral layer in patients with various refractive errors, investigated on ORA, show a decrease in corneal hysteresis and factor of resistance on myopic eyes compared to hyperopic [4]. Data from other researchers show that in myopic refraction of high degree there is a reduction of corneal hysteresis [4,6,7].

Many studies have shown that myopia is associated with changes in biometric parameters of the eye, among which changing in axial length of the eyeball in children is one of the reliable indicators of the progression of this disease and their assessment is included into the algorithm of investigation [1,2].

Therefore, evaluation of the relationship between biomechanical and biometric parameters of the eye in these categories of patients requires an additional study. Evaluation of these indicators in children with mild myopia acquires special significance, when the probability of amplification of refraction is especially high and ophthalmologists should be aimed at early detection of risk groups of progression of myopia.

Aim of the research – to study the relationship of biometric and biomechanical indicators of corneo-scleral capsule of the eye in children with axial and refractive mild myopia.

Materials and methods
We examined 50 children (100 eyes) with mild myopia. Axial myopia was diagnosed in 32 children (64 eyes), refractive myopia – 18 (36 eyes). The control group included 16 children without ophthalmic diseases (32 eyes). Visual acuity in children with myopia was 1.0 with a correction. We performed a standard eye examination, including visometry, automated refractometry on the device “HUVITZ MRK-3100 Premium” before and after the instillation of a solution of 1 % Cyclomedi, biometry and ophthalmoscopy. In order to determine the axial length of the eyeball we used biometric device IOL Master (Carl Zeiss, Germany). Biomechanical index of corneo-scleral capsule of the eyeball – the corneal hysteresis – CH (Mm Hg) was determined on the analyzer of biomechanical properties of the cornea (Ocular Response Analyzer, ORA, Reichert, USA).

Statistical data processing has been done using the Statistica for Windows 6.0 with a preliminary evaluation of the normality of the distribution in a number of variations. At normal distribution data were presented in the format M±δ, where M – the average value, δ – standard quadratic deviation. In the absence of normal distribution the data were described as a median and 50 % inter percentile range in the form of Me (X25; X75), where Me – median, X25 – 25 th percentile, X75 – 75 th percentile. To evaluate the differences in the two groups, obeying the normal distribution of a number of variations, we used Student’s t-test. In the absence of a normal distribution of the variables in the test samples we used the nonparametric Mann-Whitney test. Differences were considered significant at p<0.05.

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Student’s t-test with a preliminary evaluation of the normality of the distribution in a number of variations. In the absence of a normal distribution of the values in the test samples we used the nonparametric Mann-Whitney criterion. Differences were considered significant at $p < 0.05$.

**Results**

Indicators of visual acuity without optical correction and spherical component are shown in Table 1. It is evident that these figures do not differ significantly between patients with an axial and refractive myopia. Significant differences were determined in the indicators of dioptic power of the cornea: $42.2 \pm 0.33$ dpt in patients with axial and $44.7 \pm 0.64$ dpt with refractive myopia ($p < 0.05$). This indicator also has a significant difference between patients with refractive myopia and the control group, in which the diopter power of cornea was $42.6 \pm 0.05$ dpt ($p < 0.05$). There are also significant differences in the indicators of the axial length of eyes between axial and refractive myopia – $24.5 \pm 0.64$ mm and $23.1 \pm 0.43$ mm ($p < 0.05$). Significant difference with the control group in the axial length marked only in eyes with axial myopia $22.7 \pm 0.33$ mm and $24.5 \pm 0.64$ mm, respectively ($p < 0.05$). CH indicator determined significantly reduced on eyes with both the axial and refractive myopia. but in varying degrees: with axial myopia up to 11.5 and 12.2 in eyes with refractive myopia. which was significantly lower than in the indicators of emmetropic eyes of the control group 13.7 ($p < 0.05$).

**Table 1**

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Axial myopia (n=64)</th>
<th>Refractive myopia (n=36)</th>
<th>Control group (n=32)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual acuity without correction</td>
<td>0.22±0.15*</td>
<td>0.26±0.15*</td>
<td>0.99±0.01*</td>
</tr>
<tr>
<td>Spherical component of refraction</td>
<td>-1.62±0.85*</td>
<td>-1.55±0.76*</td>
<td>+0.28±0.24*</td>
</tr>
<tr>
<td>Diopter power of cornea, dpt</td>
<td>42.2 (42.0; 42.5)*</td>
<td>44.7 (44.0; 46.2)*</td>
<td>42.6 (42.2; 43.2)*</td>
</tr>
<tr>
<td>Corneal hysteresis</td>
<td>11.5 (10.8; 12.3)*</td>
<td>12.2 (11.2; 13.9)*</td>
<td>13.7 (12.8; 14.1)*</td>
</tr>
<tr>
<td>Axial length of the eye, mm</td>
<td>24.5±0.64*</td>
<td>23.1±0.43*</td>
<td>22.7±0.33*</td>
</tr>
</tbody>
</table>

Notes: * – statistically significant difference with control group ($p < 0.05$); • – statistically significant differences between axial and refractive myopia ($p < 0.05$).

Further evaluation of the relationship between the studied indicators in patients with axial and refractive myopia showed that CH is inversely related to the axial length of the eyeball: in patients with axial myopia: the correlation coefficient was: r -0.32, $p < 0.05$; with refractive myopia r -0.36, $p < 0.05$. In addition, we revealed correlation between diopter power of cornea and axial length of the eyeball, which was: r -0.53, $p < 0.05$ in eyes with axial myopia and r -0.42, $p < 0.05$ in eyes with refractive myopia. Comparative analysis showed no significant differences between the CH and the axial length of the eye and the spherical component of myopia. Reducing of corneal hysteresis in children with mild myopia, compared with the control group of healthy children, and also revealed correlation of this parameter with the axial length of the eyeball in myopia in pediatric practice may indicate a change in the strength properties of the fibrous capsule of the eye as a whole. This is consistent with the data of other researchers who have established the decrease of corneal hysteresis in myopic eyes compared with hypermetropic eyes and also in the eyes of patients with high myopia [4]. And also with the data obtained by Z. Jiang and coauthors, who have established a positive correlation between corneal hysteresis and refraction in myopia [6].

From our results it is evident that the decrease of strength properties of corneoscleral capsule of the eye doesn’t depend on the type of myopia and occurs both in the eyes with axial and refractive myopia, i.e. it does not depend on the type of myopia. Significant differences between the average values of corneal hysteresis in patients with myopia of different types from the children with emmetropia have practical value for early prediction of progressive course of myopia in children.

**Conclusions**

1. In patients with axial and refractive myopia we determined reduction of corneal hysteresis compared to the emmetropic eyes on average in 1.2 and 1.1 times, respectively.

2. Corneal hysteresis is independent of spherical component of myopia and decreases with increasing of axial length of the eye in 82 % of cases with axial myopia and in 76 % of cases with refractive myopia.

3. The relationship between biomechanical and biometric indicators is informative evaluation in predicting the course of myopic process in children with mild myopia regardless of the type of myopia.

**Prospects for further research.** It is advisable to conduct the dynamic control on changes of biometric and biomechanical parameters during the observation of patients with mild myopia and the formation of the risk groups of progression of myopia.

**Conflicts of Interest:** authors have no conflict of interest to declare.

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