The purpose of the study: to evaluate the indicators of stereovision using the Titmus test for an accurate assessment of stereovision and its correction in children and adolescents. Materials and methods. The study was carried out in 143 patients (286 eyes), including 73 girls (51.0%) and 70 boys (49.9%). The participants were divided into two groups: the first group involved 6 children with myopia and 11 children with hypermetropia; the second group included 126 people with astigmatism. The second group with astigmatism (252 eyes) included 24 children with myopic astigmatism (19.04 %), 92 children with hypermetropic astigmatism (73.01 %) and 10 people (7.93 %) with mixed astigmatism. All patients of the two groups underwent advanced testing of visual functions that involved a series of the following procedures: visiometry with distance correction, autorefractometry (assessment of spherical refraction and astigmatism using an autorefractometer) before and after cycloplegia, assessment of binocular vision by four-point color test, Worth test, (assessment of the nature of vision), heterophoria measurements (cover test), ophthalmoscopy with a wide pupil (diagnosis of the retina and optic nerve). Results. All 143 patients (286 eyes) were examined by using the Titmus test. The findings obtained showed that gross changes were observed in 14 (5.6 %) patients with astigmatism in the first group and pronounced changes were found in 81 (45.0 %) patients with hypermetropic astigmatism in the second subgroup. In this study, the Titmus test was carried out at medium distances that should be taken into account when assessing stereovision by graded tests. Conclusion. The use of the Titmus test can significantly improve the accuracy of measuring stereovision indicators; it makes screening procedures more comfortable and increases the effectiveness of timely diagnosis of binocular vision disorders. Screening examination of stereovision is promising, as it will significantly improve the quality of screening diagnostics of stereoscopic perception.

Key words: Titmus test, children, diagnostics, screening, stereovision.

This work is a part of ongoing PhD dissertation in medicine "The effectiveness of early diagnosis of pediatric refraction disorder by the device "Plusoptix A- 09" and "Titmus" test."

Materials and methods

The study involved 143 patients (286 eyes): 73 girls (51.0%) and 70 boys (49.9 %). The participants were divided into two groups: the first group involved 6 children with myopia and 11 children with hypermetropia; the second group included 126 people with astigmatism. The second group with astigmatism (252 eyes) included 24 people with myopic astigmatism (19.04 %), 92 children with hypermetropic astigmatism (73.01 %) and 10 people (7.93 %) with mixed astigmatism.

All patients of the two groups underwent advanced testing of visual functions, which included the following procedures: visiometry with distance correction, autorefractometry (assessment of spherical refraction and astigmatism using an autorefractometer) before and after cycloplegia, assessment of binocular vision by a four-point color test, the Worth test, ophthalmoscopy with a wide pupil to diagnose the state of the retina and optic nerve. The participants were patients of the paediatric department of the Academician Zarifa Aliyeva National Center of Ophthalmology.

All 143 patients (286 eyes) were examined by the Titmus test. In all subjects, visual acuity and the nature of vision were assessed by a four-point color test and binocular vision by the Titmus stereotest (at a distance of 30 cm). The groups of patients with ametropia without binocular disorders having passed the test demonstrated findings within conditional reference ranges; while the group of...
ametropes with strabismus coped worse with the task. In the group with strabismus, many children were unable to recognize certain stimuli of the Titmus test. According to the findings of the nature of vision, most children were found to have orthophoria (binocular nature of vision); the Titmus stereotest revealed that stereoscopic vision was absent in 14 patients. It should be noted that binocular perception may deteriorate with various ametropias (the results in the group with ametropia was worse than the results in the group with emmetropes).

The Titmus test, or Stereo Fly Acuity test, is the most popular and accessible test of stereo acuity worldwide; it is considered a standard diagnostic technique for measuring depth of visual perception. The test is based on horizontal retinal disparity of two images and the identification of a shape that is apparently closer. The Titmus test is a two-page booklet with various stimuli at different angles of disparity. The standard set includes: a "Fly" test for the presence or absence of stereopsis; a graded test of nine stimuli with four Wirt circles arranged crosswise (disparity range from 800 to 40); a graded test with images of animals (three rows of five figures) for young children (disparity range from 400 to 100); polaroid stereo glasses. The first test is intended for indicative identification of the presence or absence of stereoscopic mechanisms in a child. It is assessed as normal, when putting on stereo glasses, the fly depicted strongly protrudes above the surface of the leaf. The standard task given to the subject is to take hold of the wing with the fingers. If the subject puts his fingers not above the sheet, but on the image plane, it points out the problems with stereovision. The second and third tests make it possible to measure the thresholds of stereo perception with certain accuracy by the ability to accurately indicate a figure protruding from the plane. This test is designed for children from 3 months to 12 years old.

The Titmus test is a three-dimensional polaroid vectograph in the form of a booklet consisting of two tables viewed by the patient through polaroid glasses. On the right side of the booklet there is a large fly, on the left there are circles and animals. The recommended distance to carry out this test is 405 mm.

1. "Fly" is a test for rough stereopsis (3000 arc seconds), and especially informative for young children. The fly should look voluminous, and a child is offered to "lift" it by one of the wings. In the absence of a rough stereopsis, the fly looks flat, as in the photo (if you turn the booklet over, the image becomes flat). If the patient insists that the wings of the fly protrude, the stereoscopic vision assessment is incorrect.

2. "Wirt Circles" are a series of step tests to assess stereo vision. Each of the V squares consists of 4 circles. Each of the circles has a certain degree of disparity and, with normal stereopsis, protrudes over the plane. Stereoscopic visual acuity is calculated according to the table attached to the test. The disparity angle ranges from 800 to 40 arc seconds. If the patient sees a shift of the circle to the side, he does not have stereoscopic vision, but is oriented monocularly.

3. "Animals" test is similar to the test with circles and consists of 3 lines of animals, one of which protrudes over the plane. The degree of misperception ranges from 400 to 100 arc seconds.

**Results and discussion**

According to the data obtained, in the first group, strabismus was less than 15° in 17 people with astigmatism, strabismus angle of 15-29° was detected in 7 children (31.8%) with hypermetropic refraction and in 83 children (29.2%) with astigmatism. It should be noted that an angle of strabismus equal to or greater than 30° was detected in 10 patients (3.5%) with astigmatism (Table 1).

<table>
<thead>
<tr>
<th>Strabismus</th>
<th>Myopia</th>
<th>Hypermetropia</th>
<th>Astigmatism</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td>Not detected</td>
<td>12</td>
<td>0.0</td>
<td>15</td>
</tr>
<tr>
<td>&lt; 15°</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td>15-29°</td>
<td>0</td>
<td>0.0</td>
<td>7</td>
</tr>
<tr>
<td>&gt;30°</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
</tr>
</tbody>
</table>

**Table 1** Parameters of the angle of strabismus in patients of the first group with ametropia

According to the data obtained in the second subgroup, 3 children (6.1%) with myopic astigmatism, 11 children (5.4%) with hypermetropic astigmatism and 3 children (9.1%) with mixed astigmatism, had the angle of strabismus less than 15°; the angle of strabismus 15-29° was detected in 3 patients (6.1%) with myopic astigmatism, in 71 children (35.1%) with hypermetropic astigmatism and in 9 children (27.3%) with mixed astigmatism. An angle of strabismus equal to or greater than 30° was detected in 10 patients (3.5%) with astigmatism (Table 2).

<table>
<thead>
<tr>
<th>Strabismus</th>
<th>Myopic astigmatism</th>
<th>Hypermetropic astigmatism</th>
<th>Mixed astigmatism</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td>Not detected</td>
<td>43</td>
<td>87.8</td>
<td>112</td>
</tr>
<tr>
<td>&lt; 15°</td>
<td>3</td>
<td>6.1</td>
<td>11</td>
</tr>
<tr>
<td>15-29°</td>
<td>3</td>
<td>6.1</td>
<td>71</td>
</tr>
<tr>
<td>&gt;30°</td>
<td>0</td>
<td>0.0</td>
<td>8</td>
</tr>
</tbody>
</table>

**Table 2** Parameters of the angle of strabismus in patients of the second subgroup with ametropia
was detected in 8 children (4.0%) and in 2 children (6.1%) with mixed astigmatism (Table 2).

Thus, in the first group, the angle of strabismus 15 -29° was most often observed in patients with astigmatism - 83 patients (29.2%), and in the second subgroup, the angle of strabismus 15 -29° was most often observed in patients with hypermetropic astigmatism - 71 children (35.1%).

The obtained data on the binocular test in group 1 patients showed that binocular vision was observed in 12 patients with myopic refraction, in 12 (54.5%) with hypermetropic refraction and in 142 (56.3%) children with mixed astigmatism.

Monocular vision was detected in 10 children (45.5%) with hypermetropia and 110 people (43.7%) with mixed astigmatism (Table 3).

Table 3
Indicators of the binocular test in patients of the first group

<table>
<thead>
<tr>
<th>Worth test</th>
<th>Myopia</th>
<th>Hypermetropia</th>
<th>Mixed astigmatism</th>
<th>N</th>
<th>%</th>
<th>N</th>
<th>%</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Binocular vision</td>
<td>12</td>
<td>0.0</td>
<td>12</td>
<td>54.5</td>
<td>142</td>
<td>56.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monocular vision</td>
<td>0</td>
<td>0.0</td>
<td>10</td>
<td>45.5</td>
<td>110</td>
<td>43.7</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The obtained data on the binocular test in the patients of the 2nd subgroup showed that binocular vision was found in 38 patients (80.9%) with myopic refraction, in 88 people (48.9%) with hypermetropic refraction and in 16 children (64.0%) with mixed astigmatism.

Monocular vision was detected in 9 children (19.1%) with myopia, in 92 (51.1%) patients with hypermetropia and in 9 children (36.0%) with mixed astigmatism (Table 4).

According to the data obtained in patients of the first group, normal indicators were obtained in 12 patients (100%) with myopic refraction, in 12 children (54.5%) with hypermetropic refraction and in 142 people (51.1%) with mixed astigmatism.

Pronounced changes were found in 10 patients (45.5%) with hypermetropia and in 96 children (38.1%) with astigmatism. Gross impairment of stereovision was detected only in 14 children (5.6%) with astigmatism (Table 5).

The findings described above point out that in the first group monocular vision was detected in 110 patients (43.7%) with mixed astigmatism, and in the second subgroup monocular vision was observed in 92 children (51.1%).

Table 4
Binocular test indicators in patients of the second subgroup

<table>
<thead>
<tr>
<th>Worth test</th>
<th>Myopic astigmatism</th>
<th>Hypermetropic astigmatism</th>
<th>Mixed astigmatism</th>
<th>N</th>
<th>%</th>
<th>N</th>
<th>%</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Binocular vision</td>
<td>38</td>
<td>80.9</td>
<td>88</td>
<td>48.9</td>
<td>6</td>
<td>4.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monocular vision</td>
<td>9</td>
<td>19.1</td>
<td>92</td>
<td>51.1</td>
<td>9</td>
<td>36.0</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

It should be noted that normal indicators of stereoscopic vision were detected in 38 children (80.9%) with myopic astigmatism, in 88 children (48.9%) and in 16 patients (64.0%). Pronounced changes were found in 9 children (19.1%) with myopic astigmatism, in 81 children (45.0%) with hypermetropic astigmatism and in 6 people (24.0%) with mixed astigmatism. Gross violations were detected only in 11 children (6.1%) with hypermetropic astigmatism and in 3 patients (12.0%) with mixed astigmatism (Table 6).

The Titmus test findings showed that gross changes were observed in 14 (5.6%) patients with astigmatism in the first group, and in 81 (45.0%) children with hypermetropic astigmatism in the second subgroup.

In this study, the Titmus test was carried out at medium distances. This should be taken into account when assessing stereovision using graded tests. In addition, the test contained certain stimuli (depending on the modification of the test) with different disparity values that enabled to identify a graded assessment of violations. It has been shown that the Titmus test with disparity values from 3...
angles. min can be quite reliable in diagnosis of binocular disorders, the results of such tests are consistent with generally accepted diagnostic tests (four-point test, etc.) [1, 5].

The Titmus test can be very helpful in conducting fast screening examinations to detect the impairment of the mechanisms of binocular stereovision. The results obtained demonstrate the prospects of implementing this test in routine research check-up for functional testing of binocular vision [1].

Conclusions

Overall conclusions show that the Titmus test is reliable and valid, and can be used to improve the accuracy of measuring stereovision, make screening procedures more comfortable and enhance the effectiveness of timely diagnosis of binocular vision disorders. Screening examination of stereospecies is promising as it will significantly improve the quality of eye health monitoring.

Prospects for further research imply the development of methods for correcting the most common functional disorders.

References


Реферат

ОЦІНКА РЕЗУЛЬТАТІВ ПОКАЗНИКІВ СТЕРЕОЗОРУ ЗА ДОПОМОГОЮ TITMUS ТЕСТА У ДІТЕЙ І ПІДЛІТКІВ З АНОМАЛІЯМИ РЕФРАКЦІЇ

Гасанзаде Л. Ю.

Ключові слова: Titmus тест, діагностика, скринінг, стереозор.

Із здійснення дослідження включено 143 пацієнта (286 очей), з них 73 дівчинки (51,0%) та 70 хлопчиків (49,9%). Пацієнти були поділені на 2 групи.

Першу групу склали пацієнти з міопією (6 дітей), гіперметропією (11 дітей). Другу групу склали із 126 осіб з астигматизмом: міопічним астигматизмом (24 дитини (19,04%)), гіперметропічним астигматизмом (92 дитини (73,01%)), та 10 дітей (7,93%) зі змішаним астигматизмом.

В дослідженні брали участь 143 пацієнта (286 очей), із них дівчинок було 73 (51,0%) і хлопчиків - 70 (49,9%). Першу групу склали пацієнти з міопією (6 дитин), гіперметропією (11 дитин). Другу групу склали з астигматизмом: міопічним (24 дитини), гіперметропічним (92 дитини) та 10 дітей зі змішаним астигматизмом.

Висновки.

З усіх 143 хворих (286 очей) провели дослідження за допомогою Titmus тесту. Отримані результати Titmus теста показали, що суттєві зміни спостерігалися у 14 (5,6%) пацієнтів з астигматизмом у першій групі, та виражені зміни з гіперметропічним астигматизмом у 81 (45,0%) пацієнта другої підгрупи.

Ці результати важливи для підходу до вибору методів для корекції стереозору та підвищення ефективності виявлення порушень."
Вступ
Враховуючи часте та тривале застосування сучасних електронних пристроїв, частота людей, які користуються розумними комп’ютерними пристроями щодня, досягла 3 годин і більше на тиждень [1,4,14], що дає змогу стрімко розвиватись комп’ютерному зоровому синдрому (КЗС), що викликаний втомою очей [3,4,6,10,12,13,15]. Через тривалу залежність та використання комп’ютерного обладнання, захворювання очної поверхні хворoba сухого ока (ХСО) з’являється не тільки у людей похилого віку, але й у більшості молоді з поширенням 61% [2,5,17]. Згідно зі статистичним звітом TFSOS DEWS II [16], розвиток КЗС та ХСО має загальний фактор ризику для втрати захисту, правильне використання пристроїв комп’ютерних пристроїв протягом 20 хвилин не викликає зменшення частоти кліпань та не змінює якість зорового приймання.

Результати.
Всім 143 батьками, які користувалися комп’ютерними пристроями, проведено визначення змін слізної плівки після використання комп’ютерних пристроїв. Результати дослідження. Після 20 хвилин впливу комп’ютерних пристроїв протягом 20; 30; 40 та 60 хвилин. Після 20 хвилин впливу комп’ютерних пристроїв протягом 20; 30; 40 та 60 хвилин. Число випадків, в яких вплив комп’ютерних пристроїв протягом 20 хвилин не викликає зменшення частоти кліпань, зменшилося у 11% (p<0,05); частота кліпань зменшилася у 12% порівняно з початковими даними (p<0,05). Після 40 хвилин впливу кількість обстежених з патологічним показником слізного шару зросла до 16% (p<0,01). Після 60 хвилин впливу кількість обстежених з потоншенням ліпідного шару зросла до 16% (p<0,01). По-перше, деякі автори свідчать про гіперемію очей, що губить комп’ютерну нормальний спритт. На сьогодні, комп’ютерна нормальна спритт використовується у гіперметричному астигматизмі, в яких якісті зорової роботи протягом 60 хвилин.

Має місце недостатнє висвітлення проблеми змін товщини ліпідного шару слізної плівки. Матеріали і методи. Нами було обстежено 335 чоловік (670 очей) у віці від 18 до 48 років, у середньому (28±0,74). Дослідження проходило у два етапи: I – аналізували зміни слізної плівки після використання комп’ютерних пристроїв; II – аналізували зміни слізної плівки після використання комп’ютерних пристроїв.

Ключові слова: спритт, комп’ютер, комп’ютерний зоровий синдром, комп’ютерний астигматизм.

Виконавець: Дун Фан Хуї, Безкоровайна І.М.

Полтавський державний медичний університет

Актуальні проблеми сучасної медицини