A NEW METHOD TO QUANTIFY SUBJECTIVE ANISEIKONIA

UN NUEVO MÉTODO DE DIAGNÓSTICO Y CUANTIFICACIÓN DE LA ANISEICONIA SUBJETIVA

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ABSTRACT

Purpose: To design subjective aniseikonia measuring criteria in order to quantify its value and to use it to the clinical practice.

Material and Methods: In order to carry out the aniseikonia measurements, a sinoptophore (Clement Clark) was used and two tests (one per eye of each patient) were performed. A viewfinder capable of measuring the difference in size between subjective images in both eyes was used and a percentage scale of ratio between 0 and 30%, with an accuracy of 1% was developed. An observational descriptive study was performed on 358 patients, and a complete ophthalmological examination also performed. The patients were divided in 3 groups: emmetropic patients, ametropic patients with non-progressive spectacles, and ametropic patients with hydrophilic contact lenses.

Results: Of the 358 patients studied, 22.7% were men and 67.3% women. The average age was 38.3 (SD 17.3) years. 40.2% of the patients were emmetropic and 59.8% had some type of ametropia. When analyzing the refractive defect measured as the spherical equivalent we found a higher prevalence of myopia than hyperopia. The level of aniseikonia in the group of emmetropic patients was 1.6% (SD 3.11), in patients with glasses was 1.3%...
INTRODUCTION

Aniseiconia is an anomaly of binocular vision by which each eye of a patient perceives the image of an object in a different size (1,2). We classify aniseiconia depending on the perception of the patient as subjective/clinical aniseiconia and objective/theoretical aniseiconia. The former is the perception referred by the subject and the latter second is the one which the explorer is able to determine with mathematical methods.

Aniseiconia is one of the greatest problems than appear when prescribing corrective lenses in the presence of anisometropy. Although it is true that from the theoretical point of view aniseiconia is being the object of study, in daily ophtalmology practice the problem has not yet been solved. The measurement of this pathology is not a usual exploration since the market does not provide a method for its quantification (1,3), and therefore it is not possible to treat it correctly.

The objective of our study was to quantify subjective aniseiconia, i.e., to design a method for measuring the difference of apparent size of the object perceived in each eye by the patient, to apply it later to a group of subjects in order to validate the measurement system and propose it for habitual clinical practice.

SUBJECTS, MATERIAL AND METHODS

A specific test was designed to adapt it to the lens support of a Clement Clark 2051 ltd synoptophore. Two objects were created such that the comparison of their size by the patient indicated the existing percentage of aniseiconia. Since the target percentage can be of the order of 5% we thought it would be difficult to establish direct subjective comparisons between two objects with so little difference of size as can be verified carrying out the Zeiss test. For that reason we constructed the proportionality scale described below.

a) Foundation of our test

Two right-angle triangles are assumed, which we shall call ABC and ADE of figure 1a, where it is fulfilled that segment DE is proportional to BC, as segment AE is to AC (DE/BC = AE/AC). Therefore, it is possible to calculate the size of any vertical segment DE knowing AC and the distance AE to the vertex A, clearing our unknown factor (DE = AE·BC/AC). Figure 1b is equivalent to the triangle ABC of figure 1a, in which the leg (vertical segment) BC is deleted.

The hypotenuse AB and leg AC were divided in ten segments to form a scale, so that an arbitrary length value of 10 is attributed to each portion of
The leg BC is replaced by an arrow of the same size (fig. 1c). It is assumed that an arrow that fits in the scales in value 100 also has a size of 100, considered in its own units. If another arrow were constructed similar to that of figure 1c but of unknown size, it would suffice to overlap it to figure 1b so that it is vertical and its ends touch both scales. The value of any scale would measure the length of the arrow having the unknown size.

b) The test

Having designed these graphs it was decided to trim the drawing of the scale to avoid confusions and focus the patient’s attention on the portion which interests us, using solely the area between 70% and 100%, with a 1% discrimination (fig 1b). These graphs were printed (figs. 1b and 1c) simultaneously on a transparent sheet and assembled between glasses in the same way as the synoptophore series tests. The size of the figures is equal to the standard simultaneous perception tests of the synoptophore, being the largest size accepted by the device and the easiest to see.

Before placing the patient in the synoptophore, we explained the exploration we were going to carry out, describing it as totally innocuous, fast and simple. Through the lenses the subject would see two scales and an arrow. In fact, he would see the scale with one eye and the arrow with the other.

c) Finding the percentage of aniseiconia

In order to find the image size difference (in percentages) between one eye and the other it was enough to deduct the number of the test scale referred by the patient from 100% in order to obtain the patient’s subjective percentage of aniseiconia. So as to always proceed in the same way when carrying out the study, the arrow was placed in the right eye and the scale in the left eye.

With the aim of quantifying aniseiconia, a descriptive cross-sectional observation study was made in the period between 2000 and 2003. The exclusion criteria were: the absence of binocular vision, using progressive or bifocal corrective eyeglasses, the use of non-hydrophillic contact lenses, the presence of any type of anterior and posterior ocular pathology and any physical or mental disability which restricted the exploration.

The sample consisted of 358 subjects divided in three groups; eyeglass users, contact lenses users and emmetrope patients. Some patients were valued only with eyeglasses or with contact lenses. Nevertheless, there was a group of patients who used eyeglasses and contact lenses, and the subjective aniseiconia was assessed in both situations. For later comparisons the group spherical equivalent (SE) was determined and the patients were divided in myopic when they needed correction with negative lenses = 0.5 dioptres ≤ (Dp), hypermetropic if wearing corrective lenses over +1 Dp and emmetropic if they did not require optical correction. In addition, anisometropy was defined as the difference of correction between the eyes greater or equal to 1 Dp.
To the effects of this work we must emphasize that aniseiconia was considered to be subjective with any number over 0%, but subjective aniseiconias greater or equal to 1% were considered pathological.

RESULTS

Of the 358 subjects analyzed (716 eyes), 32.7% were men and 67.3% women. The average age of the sample was of 38.34 (OF 17.5) years. 59.5% (213 patients) were ammetropes. Of the ammetrope subjects, 39.25% (84 patients) were contact lens users. If we take into account the number of eyes, the largest optical refraction defect was myopia (37.8% right eyes, and 37.6% left eyes of the total of ammetropic eyes). The percentage of anisometropy of all patients was of 16.5% (N=59) with an anisometropy average of 2.83 (OF 2.68) Dp.

Of the total of studied patients, 38.3% had subjective aniseiconia. When dividing the sample of patients between emmetropes, ammetropes using eyeglasses and ammetropes using contact lenses, the average of subjective aniseiconia and the percentage of subjects with significant aniseiconia (>1%) was:

— Group of emmetropes: average 1.6% (SD 3.11), 60 patients (35.7%) (fig. 2).
— Group of ammetropes using eyeglasses (N=213): average 1.3% (SD 2.81), 76 patients (35.7%) (fig. 3).
— Group of ammetropes using contact lenses (N=84): average 1.1% (SD 2.96), 29 patients (30.95%) (fig. 4).

No significant differences were found in subjective aniseiconia by age groups in patients using contact lenses and eyeglasses. However, significant differences were found in subjective aniseiconia in the sub-group of emmetropes (p=0.002) in the group over 61 years of age (table I).

When making one comparison for t student paired bilateral data no significant differences ins subjective aniseiconia were found with eyeglasses and contact lens users [N=48, p= 0.537, mean difference -0.25, 2.78 and IC to 95% (-1.059, 0.559)].

When studying the average of subjective aniseiconia in both ammetrope groups, divided between anisometropes or not, we did not detect significant differences.

Accordingly, in eyeglass users the subjective aniseiconia average in anisometropes was of 1.28% (SD 2.98) and in non-anisometropes of 1.26% (SD 2.75), while among contact lens users the subjective aniseiconia average in anisometropes was of 1.2% (SD 3,54) and in non-anisometropes of 1.09% (SD 2.63).

The percentage of patients with significant subjective aniseiconia in anisometropes and non-anisometropes in the group of eyeglass users was 43.9% and 41.6% respectively as opposed to 50.1% and 58.4% of patients without aniseiconia in anisome-
tropes and non-anisometropes respectively. These differences were not statistically significant with p=0.796.

In the group of contact lens users the percentage of patients with subjective aniseiconia in anisometrope patients was of 53.3% and in non-anisometrope patients 51.4% as opposed to a percentage of 46.7% and 48.6% of anisometropes and not anisometropes without subjective aniseiconia. These differences were not statistically significant either with p=0.897 (table II).

**DISCUSSION**

In our work we have made screened aniseiconia in 358 subjects. This number is below that studied by Hawkswell (4) in 1973 (1,000 subjects), Hughes (5) in 1937 (650 subjects), but above the samples of Burian (6) (320), Hicks (7) (280 subjects), Linsk (8) (265 subjects), Guillan (9) and Guillot (10) (100 subjects).

After reviewing existing references on the methods for measuring aniseiconia, it is surprising that in recent years the market still does not provide any suitable instrument for its study and quantification. It is a pity that the spatial econometer of the American Optical Corporation was discontinued in 1970 (11) because, in our opinion, it was the best method for measuring subjective aniseiconia in the clinic.

Wit (12) proposed a new form of measurement of aniseiconia which he called «aniseiconia inspector». In fact, the method was already described, but he modernized it by fitting it in a computer program for Windows. It is the same design as the New Aniseiconia Test by Awaya et al (NAT) (13). Without a doubt it seems to us a good method, but we think that it has not yet been tried in sufficient amounts of patients to declare it useful. For this reason we cannot know if it truly works in daily practice.

We can include our method within the group of flat test or amblyoscope methods, since it consists in the quantification of the size difference of perceived images of an object by both eyes. Weiss (14) and Winn (15) made measurement studies of subjective aniseiconia devising tests adapted to the conventional synoptophore, in a form similar to the method proposed in this study. These authors refer that the use of synoptophore adapting special figures has many advantages for the measurement of subjective aniseiconia. Fontaine refers to the use of the synoptophore as a qualitative diagnosis method for subjective aniseiconia but does not quantify it (16).

The design of our test has the advantage that it can be distributed as a computer file, printed in any type of color printer and will always maintain its validity regardless of the final exact size. In addition, it is an inexpensive exploration due to the low cost of the necessary instruments.

We considered that the interpretation of the test by the explorer and the patient is simple. We have verified that is a reproducible method, because during the analysis development phase the patient measurement was made on several occasions after a time interval without obtaining appreciable differences. With the synoptophore we can correct physiological defects in the alignment of the eyes, since the controls and lenses of the device are adaptable, as also observed by Winn (15).

By way of drawback of our method we can mention the necessity of having a synoptophore, which not all specialists have. It is an exploration limited to one plane, because we determine aniseiconia only in the vertical meridian. We must remember that Winn (15) only quantified aniseiconia in one plane.

**Table I. Subjective aniseiconia in emmetrope patients by age groups**

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Average subjective Ac. in emmetropes (%)</th>
<th>SD</th>
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<tbody>
<tr>
<td>0-20 years</td>
<td>1.40</td>
<td>2.17</td>
</tr>
<tr>
<td>21-40 years</td>
<td>1.07</td>
<td>1.72</td>
</tr>
<tr>
<td>41-60 years</td>
<td>0.93</td>
<td>2.32</td>
</tr>
<tr>
<td>&gt;60 years</td>
<td>3.53</td>
<td>5.41</td>
</tr>
</tbody>
</table>

**Table II. Percentage (%) of patients with/without significant subjective aniseiconia (AC) divided in anisometropes (ANISOM) and non-anisometropes (non-ANISOM) in the group patients using eyeglasses and contact lenses**

<table>
<thead>
<tr>
<th></th>
<th>ANISOM with AC</th>
<th>ANISOM without</th>
<th>Non-ANISOM with</th>
<th>Non-ANISOM without AC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glasses</td>
<td>43.9%</td>
<td>50.1%</td>
<td>41.6%</td>
<td>58.4%</td>
</tr>
<tr>
<td>Contact lenses</td>
<td>53.3%</td>
<td>46.7%</td>
<td>51.4%</td>
<td>48.6%</td>
</tr>
</tbody>
</table>
plane, opting for the horizontal meridian. Like most instruments described to quantify subjective aniseikonia in the literature, our method aims at measuring aniseikonia in the far gaze.

We have found that 38.3% of the studied subjects suffer subjective aniseikonia in percentages similar to those reported by Hawkswell (4), Guillot (17), Burian (6) and Guillian (9), who found a prevalence of 42%, and appreciably above the 10-15% found by Hughes (5).

In the group of the eyeglass users we found subjective aniseikonia in 35.7% of the patients, results similar to those described by Duke-Elder (18) (20-30%). We were not able to find bibliographical references to establish comparisons with our findings neither of aniseikonia in emmetropes nor in contact lens users, although we can affirm that some reviewed authors (19,20) indicate they found emmetrope patients with subjective aniseikonia.

No differences were found neither in the average nor in the percentage of subjective aniseikonia patients who were anisometrope and non-anisometrope and users of eyeglasses as well as contact lenses. This absence of difference could be due to the small number of patients being compared. Nevertheless, even though initially there is a high percentage of patients with significant subjective aniseikonia, none of these patients referred symptoms. The tolerance of aniseikonia varies between individuals, each having an individual threshold. Clinical aniseikonia is defined as the amount of aniseikonia which must be corrected to eliminate the symptoms. The aniseikonia which is worse tolerated is that which creates an image with meridional distortion and of marked form if oblique. The binocular system can compensate differences of up to 3% of retinal image sizes, but greater differences could unbalance the system giving rise to binocular inhibition.

It is striking that the subjective aniseikonia average and the percentage of patients who exhibit it is very similar between eyeglass and contact lens users. This is in contradiction with the belief among ophthalmologists about contact lenses diminishing the degree of aniseikonia. In this study we considered the way of correcting ametropia (using eye glasses or contact lenses) because we know that these optical factors have a bearing on the size of the retinal image (objective aniseikonia) and therefore we initially thought that they could influence in the perception by the subject (subjective aniseikonia).

As shown in the results, we did not find statistically significant differences between the subjective aniseikonia averages when comparing eyeglass and contact lens users.

As conclusion it can be affirmed that there is an important percentage of subjects with subjective aniseikonia in the studied population, although not all suffer symptoms suggestive of aniseikonia. The symptoms they usually refer are not characteristic of aniseikonia because they correspond to fixation astenopy (irritation in binocular vision, migraine, chronic nauseous feelings, difficulty of merging images, different size of objects when comparing them with each eye). In addition we know that the tolerance of aniseikonia varies from one person to another, each one having an individual threshold (17). Clinical aniseikonia is defined as the amount of aniseikonia which must be corrected to eliminate the symptoms. Normally this happens when the difference of perceived size between both eyes approaches 0.75% (21). The aniseikonia which is worse tolerated is that which creates an image with meridional distortion and of marked form if oblique. The binocular system can compensate differences of up to 3% of retinal image sizes, but greater differences could unbalance the system giving rise to binocular inhibition (11).

Having a method for quantifying subjective aniseikonia could be the first step to explain this disorder so as to find a way to solve it.

REFERENCES


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17. Gillott HF. The effect on binocular vision of the variations in the relative sizes and levels of illumination of the ocular images. III. Br J Physiol Opt 1957; 14: 43-58.


