A TRICHRONOMIC TEST FOR SPHERIC AND ASTIGMATIC REFRACTION

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ABSTRACT

An improved chromatic rotatable refraction test for simultaneous spheric and astigmatic refraction is described. Its new features are interposition of a bright yellow stripe between the conventional red and green fields and a pair of parallel test lines, which traverse vertically all colored fields. Thereby astigmatic errors become easily visible.

Chromatic refraction tests - based on the chromatic aberration of the eye - are sensitive detectors for spheric and astigmatic optical errors. They have become very practical in office practice for the checking of spherical refraction in the form of 'red-green' or 'duo-chrome tests'. For astigmatism, however, they have only rarely been applied, although several times described and recommended (Dobson, 1928; Jacobs, 1932; Stepanik, 1956; Frey, 1956).

It is the purpose of this communication to discuss the reasons for this discrepancy between spheric and astigmatic tests and to present a new device which enables the simultaneous checking of spheric and astigmatic refractional errors.

The underlying principle of all chromatic refraction tests is the separate presentation to the eye of the two foci created by long and short waved rays of the visible spectrum. This can be achieved in two ways:

1) By blocking the central spectral part by a suitable filter, e.g. cobalt glass. Thereby two foci are created: a blue in front of the red, on which the observer's retina has successively to be focused.

2) The method of simultaneous comparison. In this method, black opaque test types are presented on red and green adjacent illuminated fields, utilizing these colors as carriers. The presently described device is based on this method.

For spherical testing, it is sufficient to present test figures of any shape: letters, numbers, etc. For astigmatic testing, however, linear figures are required. The reason is that for spherical testing maximal point focusing must
be achieved, while in astigmatism focal lines must be checked. Therefore, in all previously published astigmatic tests, multilinear test figures of different patterns were applied on adjacent red and green illuminated fields: parallel lines on radial rectangular fields, V-type figures, or star figures.

The observer was posed before a twofold task:
1) to check for the spheric component, which is determined by comparing distinctness on the red and green fields;
2) to check for the astigmatic component, where inaccuracy of the astigmatic axis is manifested by a kink of the test line on the red-green borderline.

The recognition of this critical kink met with difficulties for two main reasons:
1) by its situation among multilinear test lines;
2) by its position on the red-green background.

Red and green are of low luminosity to the human eye: Luminosity is maximal in the central yellow part of the visible spectrum and decreases markedly towards the short and long waved edges. But low luminosity causes low contrast of the test figures.

These two facts: low contrast and central position of the critical kink amidst multilinear test figures, created difficulties of visibility and interpretation. It seems to me that these were the main disadvantages which caused the failure of astigmatic chromatic tests in office practice.

To overcome these difficulties, two innovations have been introduced in the presented device:
1) A bright yellow stripe has been interposed between the conventional red and green fields.
2) The test figure has been simplified: It consists of a single pair of parallel black lines which traverse diametrically the red-yellow-green fields, vertical to their borderlines.

DESCRIPTION OF THE INSTRUMENT

1) The distance test (Fig. 1) consists of a rotatable drum which is internally illuminated by a 15 W bulb. Its measures are about 18 cm diameter and 8 cm depth. Its front face is made of semi-transparent, white plastic material, on which colored semi-transparent cellophane foils of the required colors have been glued: a red foil of about 650 nm.; a blue-green of about 530 nm.; and a central yellow part, 10 mm wide of about 585 nm. The test figure consists of two parallel black stripes of 2 mm width, 2 mm apart, traversing diametrically and vertically to the green-yellow-red borderlines. A