

# Modified astigmatism dial diagram for locating eccentric fixation in patients with central scotoma

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**PURPOSE.** *Patients with central scotoma often develop eccentric fixation on a preferred retinal locus (PRL). Identifying the PRL is one of the first steps in low vision rehabilitation training. We present our evaluation of a simple test designed to locate the eccentric fixation in eyes with central scotoma.*

**METHODS.** *This was a prospective case series of consecutive patients with age-related macular degeneration and bilateral central scotoma. A numeral was added in the center of an astigmatism dial diagram. After one eye was patched, patients with central scotoma were asked to fixate the dial and describe it, then to look at the 12 o'clock position, and then around the clock. The eccentricity at which the central numeral was best seen was compared with the one determined by scanning laser ophthalmoscopy (SLO). The modified astigmatism dial test and SLO were done independently by two masked investigators. The results of the two methods were expressed in clock hour positions and were considered to be in agreement when they did not differ by more than one hour.*

**RESULTS.** *Nine consecutive patients (18 eyes) with severe age-related macular degeneration and bilateral central scotoma were tested. The six women and three men ranged in age from 61 to 86 years (mean 75.8 years). The pattern test correlated with SLO findings in 12 (66%) of the 18 eyes. When considering the best-seeing eye of each patient, results showed agreement in eight (88%) out of nine cases.*

**CONCLUSIONS.** *The modified astigmatism dial test appears useful for establishing the location of the eccentric fixation in the best-seeing eye of patients with bilateral central scotoma, allowing visual rehabilitation training to be started without delay. (Eur J Ophthalmol 2003; 13: 276-80)*

**KEY WORDS.** *Eccentric fixation, Scanning laser ophthalmoscopy, Central scotoma, Low vision rehabilitation, Preferred retinal locus*

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## INTRODUCTION

Patients with severe macular disease typically present with a bilateral central scotoma. They often develop one or several eccentric fixations located on the parafoveal or perifoveal retina. These areas are referred to as preferred retinal loci (PRL) (1-8). Several studies have described a preferred location of the PRL, usu-

ally in the superior half of the retina, more precisely in the superior and temporal portion of the retina of the right eye and in the superior and nasal portion of the retina of the left eye, so that it is to the right of the scotoma (3-8). The location of the PRL may depend on the direction of reading - from left to right in Western countries (3). However, many patients have a PRL in other parts of the retina adjacent to the macular scar (3-8).

The PRL, instead of the fovea, may serve as a reference for the oculomotor system, helping maintain the image within a circumscribed retinal area during fixation, without foveating during saccades (2).

Complete referencing to a preferred area has been observed in one-third of patients with severe age-related macular degeneration (AMD) (9, 10). Locating this area and stabilizing fixation on it are among the most important stages of visual training designed to maximize the usefulness of residual vision (11-13). Although scientific methodology and statistical analyses have not been applied, there is widespread acceptance that formal training improves the patient's ability to read when using low-vision aids and makes for better hand-eye coordination when writing or during daily living activities (13-17).

Various methods are currently used to locate the PRL, including asking the patient to fixate a small slit-lamp beam during fundus examination, a target during retinography, or the laser 50  $\mu\text{m}$  aiming beam (15). This last method is currently used to check the locus of the patient's fixation before photocoagulation (18). However, the most reliable method is to have the patient fixate a target projected directly onto the fundus through a scanning laser ophthalmoscope (SLO). This allows simultaneous visualization of the retina and the target; so the precise location of the PRL relative to the fovea can be determined (3-8).

We have developed a simple method for locating the PRL in patients with central scotoma (15), which has been used in our department since 1996. Here we describe the test and validate the results by comparing them with the results of SLO, which remains the gold standard for such testing.

## METHODS

### *Modified grid dial diagram*

An astigmatism dial diagram was modified by adding a numeral (Fig. 1) to the center. The dial is available in different sizes so that an appropriate size is available for any patient, regardless of the width of the central scotoma. One eye is patched and the patient is asked to look at the center of the clock and to describe what he or she can see. Limits and location of the scotoma can be identified precisely. Pa-

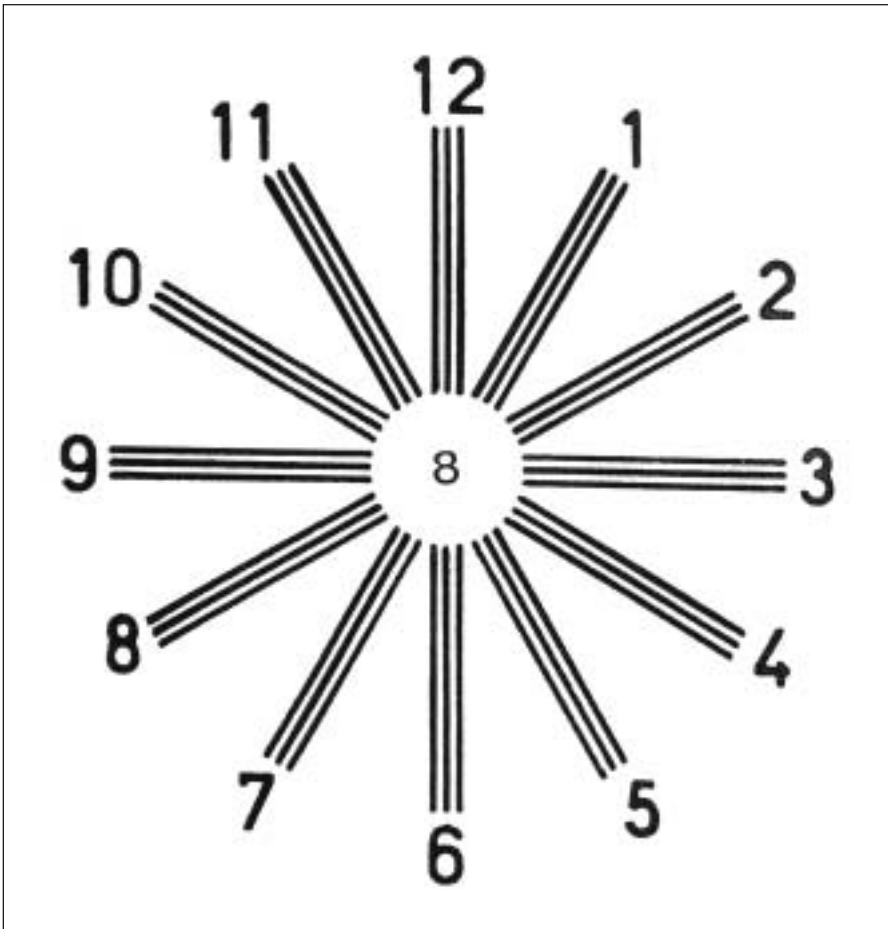
tients who have developed a stable PRL can immediately see the central numeral. However, most patients put their scotoma in the center of the Figure, and therefore do not see the central numeral. In this case, the therapist asks the patient to look at noon, and then to follow the numbers around the clock, and to say when he or she discerns something in the center of the clock. In most instances, patients can see the central numeral in a definite direction of the gaze, and it is therefore easy to correlate this direction with the location of the PRL. Results are expressed in hours from the patient's perspective. For example, a scotoma located at the top of the pattern corresponds to better vision at 6 hours, which means there is a PRL in the superior half of the retina, or at 6 hours from the patient's perspective.

### *Scanning laser ophthalmoscope*

We used a prototype of SLO that allows simultaneous visualization of the fundus and the target (19). In brief, the subject is seated with the head supported by a chin and forehead rest, and looks with one eye toward the spherical mirror that projects the stimulus created by the SLO on the retina in a Maxwellian view.

Mydriasis was obtained by instillation of one drop of tropicamide. The laser beam intensity was modulated in real time in such a way as to create an image on the retina. This was the stimulus image that the subject observed, and at the same time the means by which the fundus was illuminated and scanned at video frequency. The reflected light was used to create a video image that showed the position of the retina with respect to the stimulus image. Each image was composed of 600 lines of 800 pixels. The video image of the ocular fundus can be recorded on a videotape. Because the laser beam is influenced by the stimulus that the subject sees, the SLO recording shows fundus and stimulus superimposed, and allows each stimulus element to be located in relation to the lesion.

For this study we asked patients to read single letters chosen from the Early Treatment Diabetic Retinopathy Study chart. All patients were tested with the same letters. SLO results were recorded on a fundus photograph and translated into hours, according to the area of the patient's visual field. For example,



**Fig. 1** - An astigmatism dial diagram has been modified by adding a numeral to the center. The patient is asked to look at the center of the clock and to describe what he or she can see.

a PRL at 10 hours on the temporal retina of a right eye corresponded to better vision at 8 hours from the patient's perspective.

The modified astigmatism dial test and SLO were done independently by two masked investigators and the results were compared by a third investigator. A correlation was considered satisfactory when the results of the two tests did not differ by more than one hour. Because the correlation was either satisfactory or not satisfactory, no statistical analysis was done.

### Patients

We included patients older than 60 years, with bilateral severe exudative AMD, including classic or occult choroidal neovascularization treated by photocoagulation, or spontaneous fibrous scarring of these lesions. Lesions were considered to be stable if unchanged for at least six months.

Patients underwent both tests on the same day. According to French legislation, institutional review board approval was not required for this study, but informed consent was obtained from each patient.

### RESULTS

Nine consecutive patients (18 eyes) with AMD and central scotoma were tested. There were six women and three men; aged from 61 to 86 years (mean 75.8 years) (Tab. I). Macular lesions were exudative lesions (i.e., choroidal neovascularization) treated with perifoveal photocoagulation in 16 eyes and spontaneous fibrous scars in two.

The results of the modified astigmatism pattern test were obtained in less than 3 minutes in each patient. SLO imaging of the fundus allowed us to find one PRL of eccentric fixation for each eye. The PRL was in the

superior and temporal portion of the retina in six out of nine right eyes, and in the superior and nasal portion of the retina in five of the nine left eyes. comparison of the results of the two tests showed agreement, within one hour, in 12 (66%) of the 18 eyes (Tab. I). When considering the best-seeing eye of each patient, results showed agreement in eight of the nine cases. For the worse-seeing eye, agreement was present in only four eyes.

## DISCUSSION

SLO remains the method of choice for evaluating the PRL, and also allows dynamic examination of visual strategies used by the patient for spotting, reading, and other visual tasks. In the current study, the PRL was located in the superior and temporal portion of the retina of the right eye and in the superior and nasal portion of the retina of the left eye in 11 out of 18 eyes. This preferential location is in agreement with previous reports (3-8).

However, SLO is an expensive method and is mostly used for fluorescein or indocyanine green angiography not for functional assessment of vision. Rehabilitation therapists – e.g., orthoptists in France and Italy – have developed their own methods for finding the PRL without examining the fundus or dilating the pupil. One of the most widely used methods consists of asking the patient to fixate on the therapist's face, then directing the gaze clockwise from the hair

and finding the position of the gaze that best allows observation of the therapist's nose. However, initial location of the PRL remains difficult (16).

The modified astigmatism dial test may help patients be more aware of the value of their eccentric viewing, and quickly suggests the location of the PRL in patients with central scotoma: results were obtained in less than 3 minutes in each patient. The method has some limitations, however.

First, some patients did not yet have a stable PRL. These cases probably account for most of the failures of the method, which requires more cooperation from the patient than simply looking at a letter projected onto the retina, as with SLO. We selected patients who appeared to have been stabilized for at least six months to improve the chances of including cases with truly stable PRL. Second, looking clockwise at a dial might be different from spotting a single character. The pattern is a large target, and it is not certain that identifying the best position of gaze that allows visualization of a central numeral is similar to spotting a single character projected onto the retina. This also may account for some failures of the method. Third, even when the method was adequate, the PRL found was only the one used for fixating single characters, such as letters. It has recently been seen that patients may use several PRL, depending on the visual task, size of the letters, illumination, and other factors (20). Some patients even use a combination of several PRL as a complex but useful strategy for reading full texts (21). This test would obvi-

**TABLE I - RESULTS ARE EXPRESSED IN CLOCK HOURS FROM THE PATIENT'S PERSPECTIVE. A correlation was considered satisfactory (bold) when the results of the two tests did not differ by more than one hour**

Patient	Sex	Age, yr	VA Right Eye (RE)	Dial Test RE	SLO RE	VA Left Eye (LE)	Dial Test LE	SLO LE
1	F	80	20/200	6:30	3:00	20/800	6:00	3:00
2	M	82	20/126	<b>6:00</b>	<b>6:00</b>	20/160	<b>6:00</b>	<b>5:00</b>
3	F	77	20/126	<b>6:30</b>	<b>7:00</b>	20/200	6:00	9:00
4	F	71	20/200	<b>6:00</b>	<b>6:00</b>	20/200	<b>7:00</b>	<b>7:00</b>
5	F	70	20/200	12:00	9:00	20/100	<b>9:00</b>	<b>10:00</b>
6	F	81	20/200	<b>7:30</b>	<b>7:30</b>	20/800	9:00	6:00
7	M	75	20/400	<b>9:00</b>	<b>8:00</b>	20/100	<b>7:00</b>	<b>7:30</b>
8	M	61	20/100	<b>3:00</b>	<b>2:00</b>	20/80	<b>1:00</b>	<b>12:00</b>
9	F	86	20/400	10:30	6:00	20/100	<b>7:00</b>	<b>7:30</b>

VA = Visual acuity; SLO = Scanning laser ophthalmoscope

ously not be very precise in such cases. The main advantage of the method is that the modified astigmatism pattern dial is inexpensive and easy to use. It provides an approximate location of the PRL in two-thirds of eyes with central scotoma. Results are far better when considering the best-seeing eye of patients, with agreement with SLO findings in eight out of nine cases. This is important for patients because most of the visual training will be monocular; i.e., with

patching of the worse-seeing eye (12). Fast location of the PRL may thus allow visual training to be started without delay.

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