

## Evaluation of fixation one year after perifoveal laser treatment of subfoveal choroidal neovascularization\*

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### Abstract

The natural prognosis of subfoveal neovascularization is severe visual acuity loss. Perifoveal laser photocoagulation is meant to spare a small portion of the central retina so as to possibly preserve foveal fixation. The aim of this retrospective study was to detect the persistence of central fixation and to evaluate the visual function of patients who had undergone perifoveal laser photocoagulation one year before, due to the presence of age-related macular degeneration with subfoveal neovascularization. The visual function was assessed by means of visual acuity (VA) measurement, central perimetry, scanning laser ophthalmoscope (SLO) scotometry and capability of using low-vision aids with success. Twelve eyes of 12 patients, 5 males and 7 females, with mean age  $72.6 \pm 9.62$  years, were included in the Study Group. Mean VA was  $0.22 \pm 0.089$  before laser treatment,  $0.17 \pm 0.054$  one week after laser treatment ( $p=0.0152$ ) and  $0.13 \pm 0.063$  one year after laser treatment ( $p=0.045$ ), with a statistically significant reduction of VA overtime (initial-final  $p=0.0015$ ). Mean lesion size was  $2.12 \pm 0.528$  disc diameters on the last follow-up fluorescein angiogram. One year after laser treatment, perimetry showed the persistence of central fixation in 2 eyes, while 10 eyes seemed to have lost it. SLO scotometry revealed central dot stimulus perception in 6 eyes and no central residual in 6 eyes. The SLO fixation plot showed persistence of central fixation also in 1 eye in which static perimetry had not detected it. The preferential retinal locus was located on the upper or upper-right margin of the lesion in 8 of the 9 eyes with paracentral fixation. All patients achieved a useful reading VA using low-vision aids, with  $7.16 \pm 6.1$  mean magnification power.

The eyes with central visual residual on SLO scotometry had a final VA slightly higher than those without central residuals (VA  $0.158 \pm 0.03$  and  $0.098 \pm 0.07$ , respectively), though the difference was not statistically significant ( $p=0.0977$ ).

### Introduction

In age-related macular degeneration, the spontaneous outcome of subretinal neovascularization has a very poor functional prognosis, even though visual acuity (VA) may be initially spared [1, 2].

Perifoveal laser photocoagulation, which spares the foveal avascular zone, prove defective in maintaining the macular function when the same is not affected directly by the pathologic process, but only indirectly by the persistent serous detachment or by the spreading of the underlying fibrovascular modifications.

The satisfactory results of perifoveal laser photocoagulation in patients with subfoveal neovascularization are not always related to the persistence of macular-function within the treated zone. Most treated patients, along with the untreated ones, develop an eccentric fixation within few months from the onset of the disease [3, 6].

Conventional automated perimetry is seldom helpful to assess the functional outcome of perifoveal photocoagulation since the performance is often unreliable [5].

Scanning laser ophthalmoscope (SLO) scotometry, alternatively, provides a more reliable and valuable tool to investigate visual residual and fixation area, since the

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CENTRAL 10 - 2 THRESHOLD TEST

NAME P. O.

STIMULUS III, WHITE, BCKGND 31.5 ASB BLIND SPOT CHECK SIZE III

STRATEGY FULL THRESHOLD

BIRTHDATE 31-10-25 DATE 07-01-83

FIXATION TARGET CENTRAL ID TIME 12:43:08

RX USED OS DCX DEG PUPIL DIAMETER 3.0 MM VA 0.1

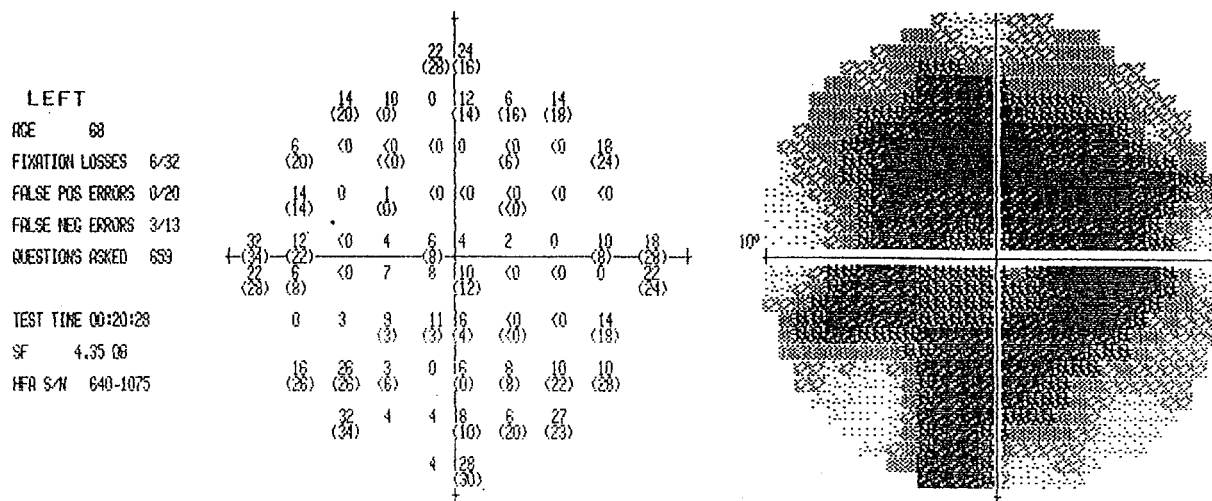


Figure 1. Humphrey 10.2 perimetry showing the persistence of central fixation.

stimuli can be directly projected onto specific retinal locations [6].

The aim of this study was to verify, by means of conventional automated perimetry and of SLO scotometry, the persistence of central fixation and areas of central vision one year after perifoveal laser photocoagulation of subfoveal choroidal neovascularization and to assess the relationship between such residuals and the success of low-vision aids.

## Subjects, materials and methods

For this retrospective study, we reviewed all the patients suffering from bilateral age-related macular degeneration who had undergone perifoveal krypton-laser photocoagulation of subfoveal choroidal neovascularization in the macula out-patient service of our Department of Ophthalmology and Visual Sciences during the first six months of 1993. The eyes had been treated according to the technique described by Coscas et al. [3]. The inclusion criteria were:

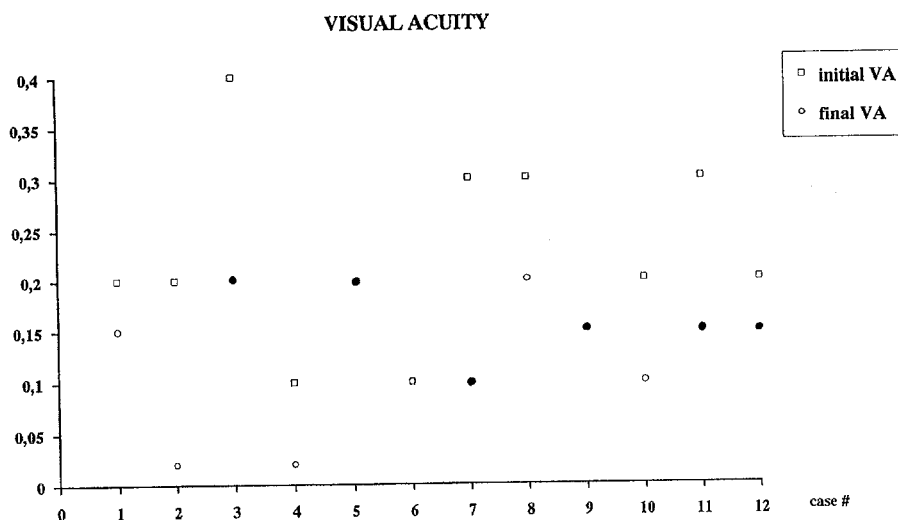
- Persistence of central fixation at the first control following the laser treatment between 1 and 2 weeks after the photocoagulation. Central fixation was demonstrated by the capability to fixate and locate

onto the fovea the split mire of the fluorangiograph and the aiming beam of the krypton laser and by the presence of central visual residuals on automated central visual field examination (Humphrey Central 10-2 Threshold Test, size III). Scanning Laser Ophthalmoscope (SLO) scotometry was not carried out since the instrument was not yet available.

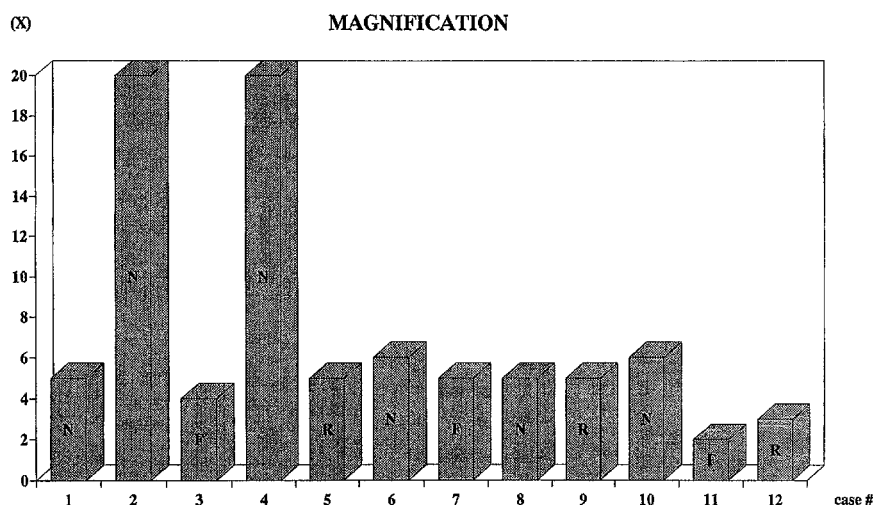
- Success of the laser treatment, i.e. no recurrence or persistence of neovascularization at the outer margin of the scar at the end of the follow-up.
- Fellow eye with disciform macular degeneration, poorer VA and no central fixation. All subjects underwent clinical evaluation of reading using low-vision aids within the first month and one year after the perifoveal laser photocoagulation. Both optical (aplanatic or galileian systems) and electronic devices were used (range 2–20 magnifications).

Reading VA was performed using the “A” series of Keeler at 25 centimeters. A useful final reading VA was defined as “A 7” or better.

One year after the laser treatment, the eyes meeting the inclusion criteria underwent both conventional automated central visual field examination (Humphrey Central 10-2 Threshold Test, size III stimulus) and SLO scotometry (Rodstock SLO, size III stimulus, 0 dB light intensity), since the latter equipment had in the



Graph 1. Pre-treatment and final visual acuity of 12 eyes with subfoveal choroidal neovascularization successfully treated by perifoveal krypton laser photocoagulation. Central dot stimulus perception at SLO scotometry (open circle), no central residual (solid circle).



Graph 2. Magnification of low-vision aids for reading and visual acuity of patients with SLO central fixation (F), central dot stimulus perception (R) and no central residual (N).

meantime become available. Scotometry was carried out by presenting 100 to 130 stimuli within and around the treated area, so as to keep the test time below 15 minutes, to avoid loss of attention and collaboration.

Detection of at least 5 stimuli at the same retinal location within the treated zone was considered as a reliable criterion to affirm the persistence of central visual residual.

The central fixation target was used for Humphrey perimetry and the smallest fixation cross seen by the patients was chosen for Rodenstock SLO, in order to

allow a more precise execution in case of persistence of foveal fixation.

The data is presented as mean  $\pm$  SD. Statistical evaluation of the results was performed using an unpaired t-test.

## Results

31 eyes of 31 patients were treated by perifoveal laser photocoagulation. 8 patients had a higher VA in the

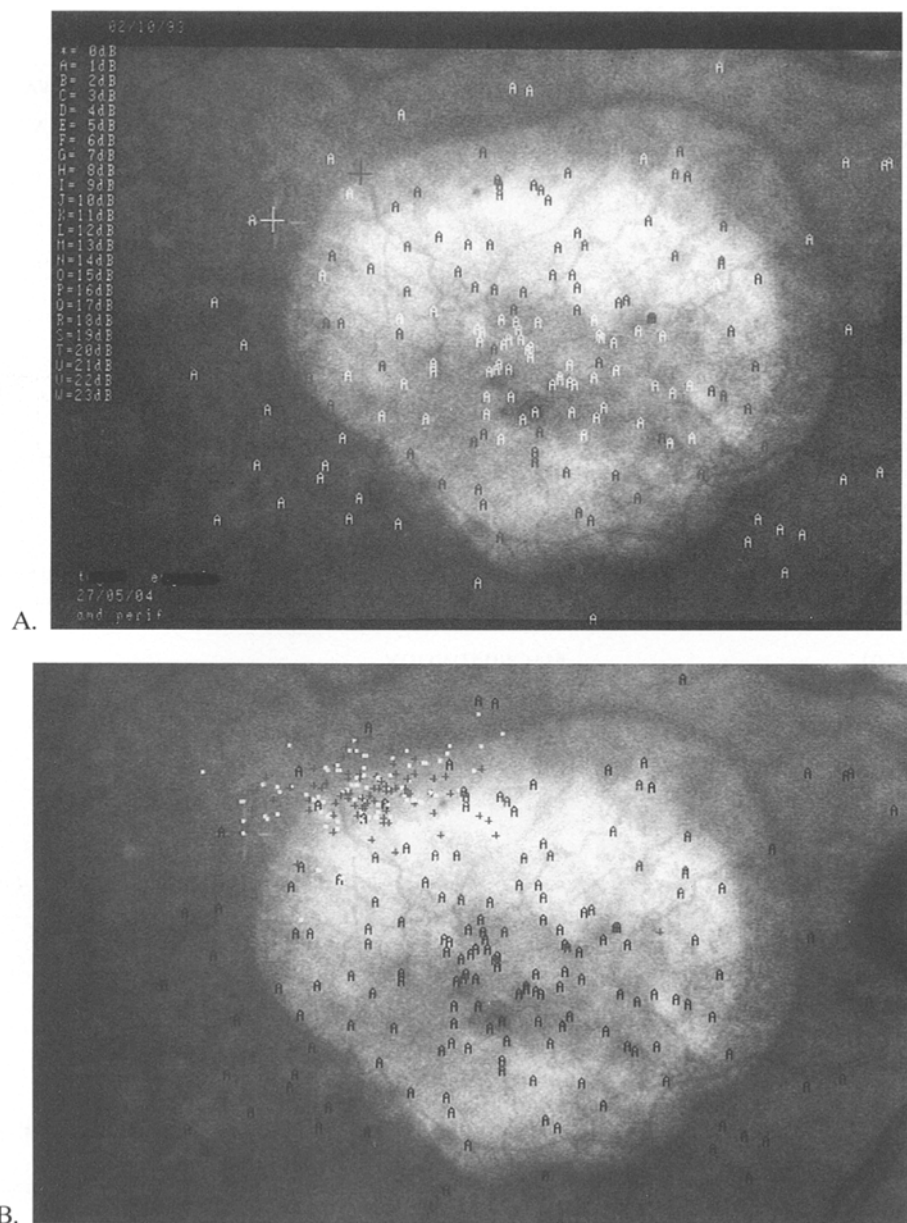


Figure 2. SLO showing (A) presence of central residual and (B) fixation at the superior right margin of the treated area. (C) Humphrey 10-2 perimetry showing eccentric fixation tangent to the scotoma in the same eye.

fellow eye, 1 died during the follow-up, 7 failed to present at the final visit, 3 developed a large recurrence of the SCNV, and 12 eyes (5 right and 7 left eyes) of 12 patients, 5 males and 7 females, were enrolled. Mean patient age was  $72.6 \pm 9.62$  years (range 55–87).

Mean VA (Graph 1) was  $0.22 \pm 0.089$  before laser treatment,  $0.17 \pm 0.054$  one week after laser treatment ( $p=0.0152$ ) and  $0.13 \pm 0.063$  one year after laser treat-

ment ( $p=0.045$ ), with a statistically significant reduction of VA over time (initial-final  $p=0.0015$ ).

Mean lesion size was  $2.12 \pm 0.528$  disc diameters, as revealed by fluorescein angiography performed at the last follow-up examination.

One year after laser treatment, perimetry showed persistence of central fixation in 2 eyes (VA 0.3 and 0.15, respectively, Figure 1), whereas 10 eyes seemed

CENTRAL ID - 2 THRESHOLD TEST

NAME	T	E	BIRTHDATE	27-05-04	DATE	20-11-91
STIMULUS	III, WHITE, BCKGD 31.5 ASB		BLIND SPOT CHECK SIZE	III	FIXATION TARGET	CENTRAL
STRATEGY	FULL THRESHOLD		RX USED	+3 DS	DCX	DEC
					PUPIL DIAMETER	4.0 MM
					VA	0.1

### LOW PATIENT RELIABILITY

RIGHT

```

AGE          87
FIXATION LOSSES  10/28 00:00
FALSE POS ERRORS 0/18
FALSE NEG ERRORS 1/14
QUESTIONS ASKED 530
FOVER: 8 DB
TEST TIME 00:20:19
SF          3.88 DB
HFA 9/21   640-1075

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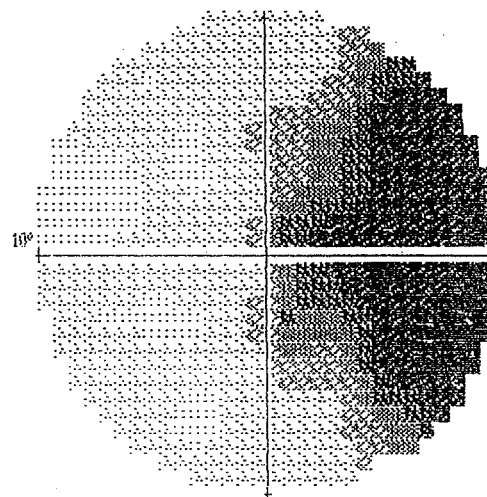
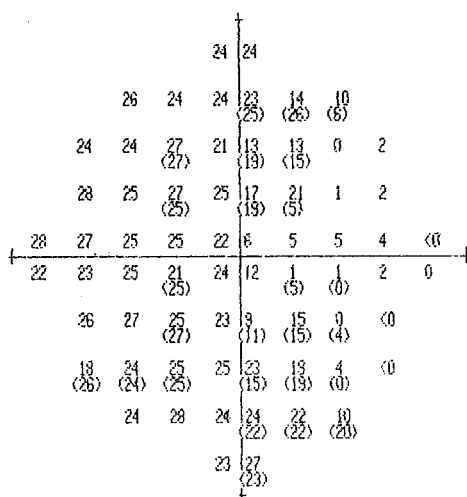


Figure 2. Continued.

to have lost it. SLO scotometry revealed central dot stimulus perception in 6 eyes (Figure 2) and no central residual in 6 eyes.

An SLO fixation plot showed persistence of central fixation also in 1 eye in which static perimetry had not detected it (Figure 3).

In the 9 eyes with offset fixation, paracentral fixation, as revealed by SLO scotometry, was located in different areas tangent to the scotoma. In no case did fixation lay onto the inferior or left margin of the scotoma: 8 patients revealed a preferential retinal locus (PRL) at the upper or upper-right margin of the lesion (Figure 4), and one had a PRL on the right margin of the lesion.

All patients achieved a useful reading visual acuity using low-vision aids, with  $7.16 \pm 6.1$  mean magnification power (Graph 2).

The eyes with central visual residual on SLO scotometry had a final VA slightly higher than those without central residuals (VA 0.1580.03 and  $0.098 \pm 0.07$ , respectively), though the difference was not statistically significant ( $p=0.0977$ ).

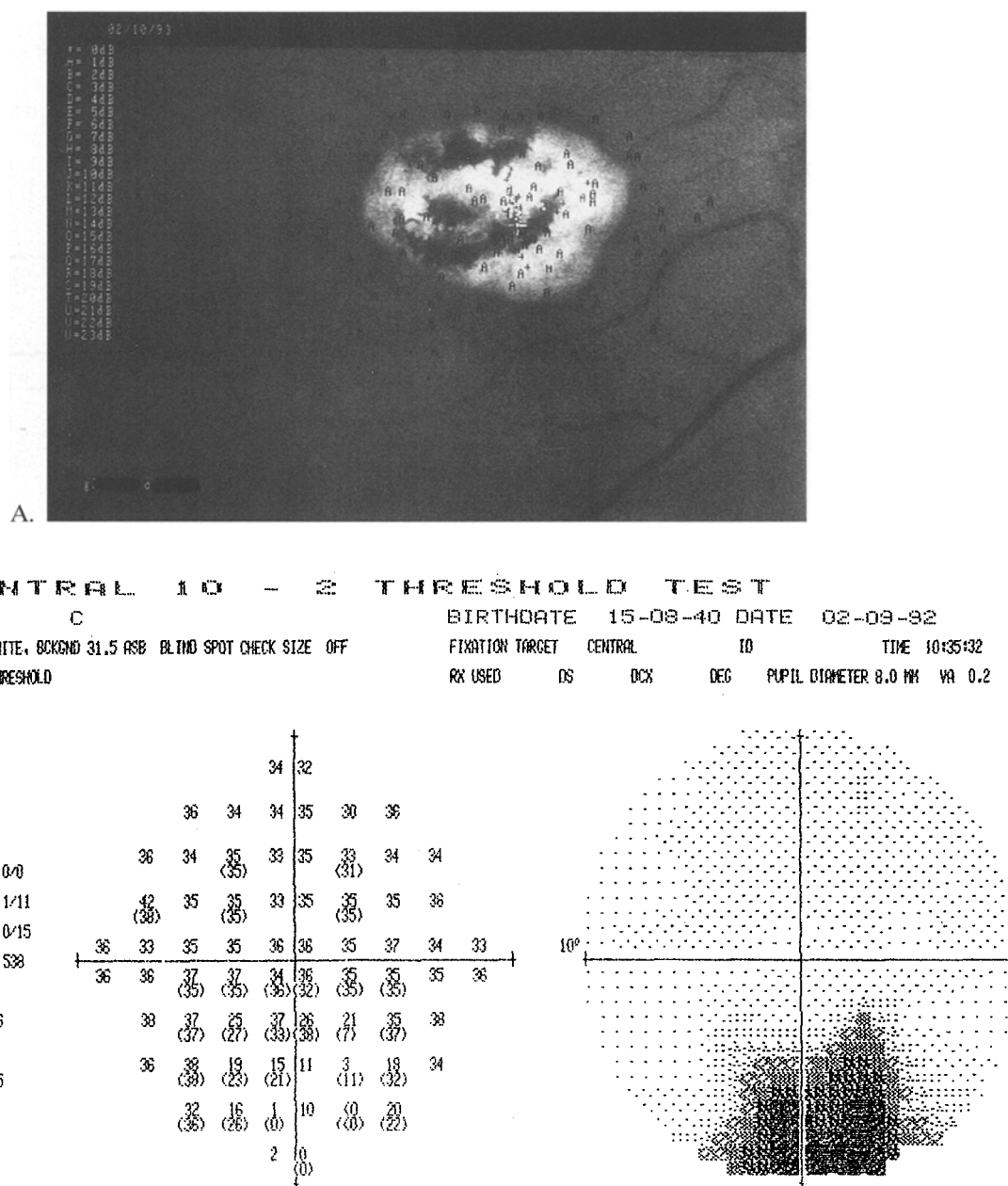
## Discussion

Perifoveal laser photocoagulation of subfoveal choroidal neovascularization, introduced by Coscas and Soubrane in 1987, proved effective in containing the natural evolution of the disease [4]. The final goal of this treatment is the preservation of central vision residuals which may, theoretically, make the use of low-vision aids easier. The persistence of such residuals is not always assured by the treatment and the time they will last is unpredictable and subject to interindividual variability. In Coscas' controlled study, 17 of the 52 eyes treated still had an area of central vision at the end of the 25-month mean follow-up time, and its presence was assessed by threshold perimetry and by the capability to fixate the laser aiming beam or the fluorangiograph mire.

Similar results were reported by Schneider [7] who observed that 12 out of 24 patients who had an area of central vision immediately after the treatment still had it at the end of a mean follow-up period of 4 to 30 months.

In our study of perifoveal laser treatment, we focused our attention on the visual function within the treated zone after a mean-term follow-up (12 months).

Computerized perimetry could reliably identify the persistence of central fixation in 2 of the 12 cases.



B.

Figure 3. Fixation behavior in the center of SLO Scotometry (A) and Humphrey 10-2 perimetry showing eccentric fixation adjacent to the scotoma (B) in the same patients.

whereas in 10 of the 12 cases it pointed out an eccentric fixating area tangent to the photocoagulated zone.

In the cases with eccentric fixation, threshold perimetry could not detect any seeing point within the scotoma corresponding to the treated retinal area. Test reliability was sometimes largely impaired by the frequent fixation losses brought about by the foveal damage. Moreover, in the Central 10-2 examination,

fixation losses are subject to artifacts due to incorrect blind spot location, since this cannot be visualized.

SLO scotometry proved more sensitive in detecting central vision residuals: central fixation was present in 3 of the 12 eyes whereas in 3 of the 9 eyes with eccentric fixation, an area of vision was detected within the treated zone. The discrepancy between the findings related to persistence of central fixation could be explained by

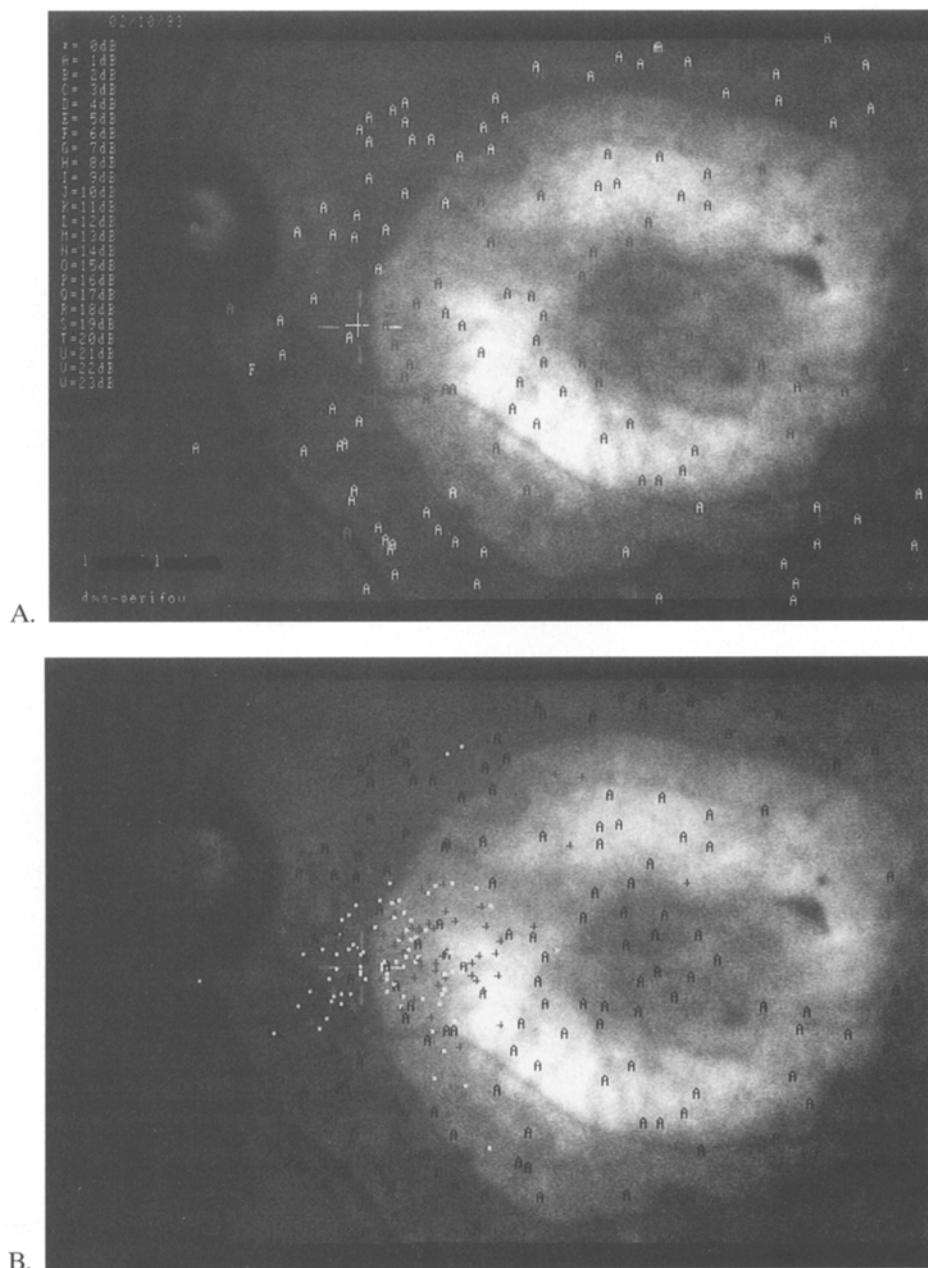


Figure 4. Scanning Laser Scotometry showing (A) absence of central residual, (B) eccentric fixation, right to the lesion and (C) Humphrey 10-2 perimetry with deep central scotoma and fixation adjacent to the lesion.

the larger size of the SLO fixation target, which can stimulate the foveal region more effectively.

It has been demonstrated that fixation is more frequently offset hominously to the right superior macular quadrant in the left-to-right readers [7, 8], and this finding was confirmed in this study, since it was verified in 8 of the 9 eyes with eccentric fixation. By means of

projection of reading digits on the retina, some Authors [9] demonstrated that fixation is influenced by early reading learning mechanisms. The left-to-right readers subjects suffering from abilateral scotoma displace fixation in the temporal hemiretina in the right eye and in the nasal hemiretina in the left eye [9]. Conversely, right-to-left readers develop an eccentric fixation with

