The Use of Scanning Laser Ophthalmoscope Microperimetry to Detect Visual Impairment Caused by Macular Photocoagulation

Satoshi Ishiko, MD; Hironobu Ogasawara, MD; Akitoshi Yoshida, MD; Kazuomi Hanada, MD

BACKGROUND AND OBJECTIVE: To demonstrate the effectiveness of scanning laser ophthalmoscope (SLO) microperimetry in detecting retinal sensitivity and in describing areas of unstable fixation following photocoagulation therapy.

PATIENTS AND METHODS: Two patients with iatrogenic vision loss resulting from photocoagulation therapy underwent a fundus examination, SLO microperimetry, and fluorescein angiography. One patient also underwent indocyanine green angiography.

RESULTS: Two types of visual acuity decrease—sudden-onset and late-onset—were demonstrated following macular photocoagulation, the former resulting from incorrect identification of the fixation point, and the latter from enlarging photocoagulation scars placed in close proximity to the fovea. In one case, SLO microperimetry detected dense scotoma corresponding to the patient’s symptoms and an unstable fixation point. In the other case, different retinal sensitivities were found in the photocoagulation scars. No differences were found with fluorescein angiography or indocyanine green angiography.

CONCLUSION: SLO microperimetry might be effective for quantitative assessment of retinal sensitivity in photocoagulation scars and for detecting fixation points and determining their stability.


INTRODUCTION

The treatment of diabetic maculopathy is important for diabetic patients. Maculopathy causes different degrees of visual impairment, and longstanding macula edema can damage retinal function irreversibly. Macular photocoagulation treatment is one possible therapy for diabetic maculopathy. The

Early Treatment Diabetic Retinopathy Study Research Group reported that either focal or grid photocoagulation reduces the risk of visual loss from clinically significant macular edema. However, photocoagulation itself puts the patient at risk of having visual field loss or visual acuity impairment.

Microperimetry using the scanning laser ophthalmoscope (SLO) can detect a scotoma under direct visualization of the fundus. Because microperimetry allows the stimulation of any fundus lesion, we can measure limited focal retinal sensitivity, such as that caused by photocoagulation scars. Furthermore, the technique can measure not only the scotoma, but also the fixation points. In the present study, we used
SLO microperimetry to evaluate the sensitivity of photocoagulation scars and the fixation points in two patients with visual impairment caused by macular photocoagulation therapy.

**PATIENTS AND METHODS**

Two patients were referred to our hospital after undergoing macular photocoagulation therapy. A best-corrected visual acuity measurement, a fundus examination, and an estimation of retinal sensitivity and fixation points (detected using SLO microperimetry) were performed. SLO microperimetry was performed under the following conditions: a stimulation time of 100 milliseconds; a spot size of the stimulation equivalent to Goldmann I or II; and intensities of 0, 15, and 20 dB. Fluorescein angiography (FA) was performed in both patients, and indocyanine green angiography (ICGA) was performed in one patient.

**RESULTS**

**Case 1**

A 55-year-old man had undergone bilateral treatment with panretinal photocoagulation. He was referred to our hospital for examination with the complaint of sudden visual loss (0.5 [20/40] to counting fingers) and randomized scotoma in the right eye that developed immediately after he received macular photocoagulation treatment for diabetic macular edema.

On fundus examination, the photocoagulation scars, which had been applied in a C-shaped pattern around the central area, were thought by the referring physician to be foveal lesions. FA showed that the interiors of the photocoagulation scars were hypoﬂuorescent, and the margins of the scars were hyperfluorescent (Fig. 1A). Hypofluorescence in the scars also was observed on ICGA (Fig. 1B). There was no active retinopathy on either angiography. When SLO microperimetry was performed, all the scars had a dense scotoma (Fig. 2A). The scotoma detected by SLO microperimetry corresponded to the patient's symptoms. The fixation point was unstable, and some scars were detected very close to the new area of fixation points estimated by SLO microperimetry (Fig. 2B).

**Case 2**

A 64-year-old man had been treated with bilateral macular photocoagulation for diabetic retinopathy 5 years previously. The patient was referred to our hospital with the complaint of decreasing visual acuity. The visual acuity in his right eye gradually had decreased over the previous year from 0.8 (20/25) to 0.5 (20/40). The visual acuity in his left eye had remained stable, and cataract had not progressed markedly in either eye. On fundus examination, the photocoagulation scars were determined to have enlarged over the previous year. There were no significant retinopathy changes, and no active retinopathy was found on FA at the initial examination or at a follow-up visit 11 months later. With SLO microperimetry, we were able to find differences in retinal sensitivity among the photocoagulation scars that were unremarkable on FA (Fig. 3A). The unstable fixation point was detected between and very close to two photocoagulation scars (Fig. 3B).
Figure 2. Micropereimetry using the scanning laser ophthalmoscope (case 1). The red "As" indicate insensitive points; the blue As indicate sensitive points. (A) All the scars have a dense scotoma. (B) The photoagulation scars are very close to the new area of the fixation points.

Figure 3. Micropereimetry using the scanning laser ophthalmoscope in case 2. The red "As" indicate insensitive points; the blue As indicate sensitive points. (A) Differences in retinal sensitivity are present among the photoagulation scars. (B) The area of the fixation points is found between and in close proximity to two photoagulation scars.

**DISCUSSION**

In this study, we demonstrated two types of visual acuity decrease that developed after macular photoagulation: sudden-onset and late-onset visual impairment.

The first case, which may have resulted from misjudgment of the fixation position, could have been avoided by performing a careful fundus examination. However, sometimes it is difficult to detect the fovea because of macular edema or degeneration. In addition, the fixation point can change as a result of macular edema or degeneration from the area where the foveal lesion was observed. Because this patient had previously undergone macular photoagulation therapy at another hospital before his initial examination at our institution, clinical information concerning visual acuity and the fixation point before the treatment was limited. Furthermore, we had no information about the parameters of the photoagulation, such as laser wavelength, power, duration, spot size, and number. However, this particular case was probably caused by the macular photoagulation therapy, because the visual impairment increased immediately afterward. The impairment of the fixation point can induce a sudden severe visual loss, resulting in a change of location of the fixation points, as well as instability.

The decrease in visual acuity in case 2 was caused by expanding photoagulation scars and could have been avoided if the treatment had been performed sufficiently far from the fovea. Regrettably, the patient's visual impairment worsened following enlargement of the scars. The enlarging scars might make his fixation point unstable between the two photoagulation scars. The physician should be aware that photoagulation scars can expand gradually.
It is difficult to measure the sensitivity of the focal area using conventional perimetry because we cannot determine the location of the actual stimulation spot; thus, the correlation between the stimulate spot and the retinal area is only an estimation. Furthermore, it is difficult to measure the sensitivity in patients with low vision or central visual field loss because of unstable fixation. In such patients, the moving fixation points are not easily detected with conventional methods.

SLO microperimetry enables the ophthalmologist to perform focal sensitivity testing of any retinal location under direct visualization, and indicates the areas of unstable fixation. Our results using this method demonstrate that photocoagulation scars have different levels of sensitivity, as reported previously. These differences were not observed on fundus examination, FA, or ICGA.

SLO microperimetry may be an effective examination for quantitative assessment of the retinal sensitivity of photocoagulation scars. It is important to detect the fixation point or areas before performing macular photocoagulation. SLO microperimetry is a useful way to detect the fixation area, even if the fixation is unstable.

REFERENCES


