Original Article

"Continuous Stimulus at The Physiological Blind Spot to Improve Fixation during Perimetry: An Experimental Pilot Study"

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Purpose: To evaluate if patients can fixate better during perimetry if a continuous stimulus on the physiological blind spot (CSPBS), present throughout the test, becomes visible to them in real time as soon as fixation is lost, the patient being properly educated accordingly prior to the test.

Material and Methods: Subjects between the ages of 20 to 60 years, having no major ocular or systemic disease, underwent a simulation of automated perimetry using a software developed by the Author, with a 21-inch personal computer monitor used as a campimeter. There was an option in the software whether or not a conspicuous CSPBS was presented throughout the test. Fixation losses were recorded by Heijl-Krakau method. Patients who consistently had fixation loss of more then 30% without a CSPBS were subsequently tested with the CSPBS present during the test.

Results: 9 subjects out of 50 initially tested (18%), persistently had more then 30% fixation losses with out CSPBS during the test. Seven out of these 9 (14% of the total) showed improvement in fixation when tested with a CSPBS. The remaining 2 (4% of the total) had poor fixation in the presence of CSPBS also.

Conclusion: CSPBS present throughout an automated perimetry test can potentially improve fixation and should be evaluated on larger scale.

Proper fixation at a target is important for a reliable perimetric test[1,2], and much advancement has been made to ensure it by devising several strategies to monitor fixation, e.g., visualizing eye movements directly by a telescope or through a video camera, the Heijl-Krakau method, and gaze tracking[3]. In the majority of automated perimeters currently used clinically, the patient is warned through a human or computer generated voice message after a certain amount of fixation loss is detected. However it is a common observation that some people are still unable to fixate properly. If, however, a patient can be made aware of fixation loss in real-time, he or she can re-fixate immediately as a feedback response, thus minimizing the total duration of inaccurate fixation during the test.

A study is presented to evaluate the usefulness of presenting a conspicuous stimulus on the testing screen, continuously throughout an automated perimetry test, at the area representing the physiological blind spot. This stimulus falls on the optic nerve, and hence remains invisible to the patient, as long as the proper fixation is maintained. It becomes visible as soon as the fixation is lost, as the stimulus falls on the light sensitive retina, thereby warning the patient of a fixation loss in real time.

MATERIAL AND METHODS

Description of the software and hardware.

The Author developed a simple program in basic language that presents supra threshold stimuli randomly over the personal computer monitor. A flat screen 21-inch monitor (Optiquest Q110, CA, USA) was used as a campimeter in this study, with the subject seated such that the eye being examined was about 40 centimeters away from the center of the screen, with the chin and head supported by a chin rest taken from a slitlamp. In this position the central 25 degrees of the patient's visual field can be assessed.

The software first presented a central fixation target, and then the physiological blind spot could be delineated using a bright red spot that could be moved horizontally and vertically, and also altered in size. Subsequently, supra threshold stimuli were presented randomly across the screen, which were not corrected for the age or the retinal area, as the main purpose of the study was determination of the fixation pattern and not the retinal sensitivity. Any key pressed in response to the stimulus was recorded as a stimulus seen. The test could proceed in either of the two ways:

(i) Test A. The perimetric test proceeded without a CSPBS, as in currently used perimeters.

(ii) Test B. There was a conspicuous CSPBS present throughout the perimetric test.

The CSPBS was in the form of a bright red circular spot. The fixation losses were recorded according to Heijl-Krakau blind spot monitoring. Immediately before the presentation of the stimulus at the blind spot for this purpose the red CSPBS disappeared, and reappeared soon after. 10 such blind spot monitoring stimuli were presented during the test; and if a key was pressed in the presence of such a stimulus a fixation loss was recorded.

Test procedure

Each subject was tested for one eye. After giving the usual instructions for conventional automated perimetry, the subjects were given two one-minute training tests with test A, and then the complete Test A was carried out. If the subject showed fixation losses of more then three, he or she was asked to repeat the test at another date, again preceded by the training tests. The subjects, who still had fixation losses of more then three, were then tested with Test B. This time the patients were instructed that a red light would become visible to them as soon as the fixation was lost, and hence they should re-fixate as soon as they glimpse the red spot. They were asked to move their eyes intentionally before proceeding with the test to clarify the phenomenon of red light appearance, which disappeared with re-fixation. Two one-minute training tests with Test B were repeated before the start of the test.

Selection of patients

Subjects between 20 to 60 years of age, who attended the outpatient clinic, whether as patients or attendant of the patients, were offered to take part in the study. 50 consecutive subjects who agreed, and had no ocular or systemic disease likely to influence the performance, were included in the study, provided that they were able to complete all the required tests. Informed consent was obtained.

RESULTS

Of the 50 subjects, 31 were males and 19 females. 9 subjects (18% of the total 50) showed fixation losses of more then 3 on repeated testing with test A. (The results of performance of these 9 subjects are given in the (Table 1). 7 subjects out of these 9 (14% of the total), showed improvement (i.e. 3 or less fixation losses) with test B. The other 2 subjects (4% of total) had more than 3 fixation losses in test B also.

DISCUSSION

The blind spot has been used during perimetry to record fixation losses i.e. in the Heijl-Krakau monitoring, and to determine the correct distance between the subject's eye and the screen[4], but to the Author's knowledge no study has been carried out to determine it's value in enhancing fixation by means of a conspicuous stimulus, that falls on the area representing the physiological blind spot, throughout the test. In this study such a stimulus was used in the form of a bright red spot, which remained invisible to the subject as long as the fixation was maintained. As the eye deviated significantly from the fixation target the image of the red spot fell on the light sensitive retina and suddenly became visible to the subject. This possibility of awareness of a fixation loss in real time, and hence the opportunity for the subject to immediately re-fixate will reduce the actual duration of incorrect fixation.

In this study an obvious improvement in fixation was obtained in a substantial number of patients by using the CSPBS, thereby providing proof of principle and justifying a controlled study of this simple method to achieve better fixation during perimetry.

Since the currently available automated perimeters do not offer the option of a CSPBS during the test, the Author wrote a simple program in Q basic language that presents supra threshold stimuli randomly over the personal computer monitor. This software is quite easy to use on any personal computer. The stimuli are supra threshold without being precisely corrected for age, retinal area etc., since the only purpose of this study was to observe the fixation behavior.

Table 1: Performance of patients who had fixation losses of more then 3 in test A

Pts	Age	Sex	Fixation losses		Decrease in fixation loss with CSPBS
			Test A	Test B	
1	42	M	7	2	5
2	55	F	5	0	5
3	60	F	8	9	1
4	45	F	4	0	4
5	50	F	6	0	6
6	55	M	4	2	2
7	53	F	10	10	0
8	60	F	7	3	4
9	45	M	4	0	4

Although the majority of the participants were able to perform satisfactorily with out the CSPBS, this study shows that there are patients in whom the presence of a CSPBS can improve fixation. It also indicates that there is a small population in which fixation remains poor regardless of the CSPBS. This study, however, was relatively small in terms of number of participants, and hence the influence of factors, such as age, sex, level of education etc. cannot be determined with confidence. Similarly, since only normal subjects were included, it does not represent the behavior of patients with visual field defects. Larger studies in different populations are therefore required.

Although it was not tested in this study, increasing the size of the CSPBS could theoretically reduce small deviations. Such deviations have been shown to occur in a high proportion of subjects undergoing the automated perimetry without affecting the reliability of the usual tests[5]. However this can be useful in the high-resolution perimetry[6] where minor deviations are more likely to affect reliability.

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