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SITA standard testing with Humphrey visual field analyzer versus full threshold testing with frequency doubling perimetry: a comparison of patient preference and perception

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Abstract

Purpose: *To compare patient preference for Swedish Interactive Threshold Algorithm (SITA) standard 24-2 protocol in Humphrey visual field analyzer (HVF) and full threshold N-30 protocol in frequency doubling perimetry (FDP) by primarily evaluating their perception about the test procedure and test targets along with surveying the factors that influence the patient concentration during perimetry and elements that determine the level of perimetry task difficulty.*

Methods: *This study enrolled a subset of subjects from the Chennai Glaucoma Study. Each subject underwent a comprehensive ophthalmic examination after which they were randomly allocated to perform HVF and FDP with a 30-minute interval between the two procedures. SITA standard 24-2 protocol in HVF and full threshold N-30 protocol in FDP were used. This was followed by the administration of a questionnaire that mainly assessed the components such as (a) the patient preference for test procedure and test targets, (b) the factors influencing the patient concentration during perimetry performance, and (c) the impression about the level of perimetry task difficulty. The patient responses from the survey for each of the subcategories were obtained and analyzed using Chi-square test.*

Results: *A total of 42 subjects with a mean age of 59.7 (SD 9.7) years were included, among which 18 (42.86%) were male and 24 (57.14%) were female. Thirty-two (76.19%) subjects felt both FDP and HVF were easy to perform, eight subjects (19.05%) felt that both perimetry techniques were difficult to perform, and two subjects (4.76%) found FDP procedure was easier than HVF, whereas the distribution was not statistically significant (Chi-square, $p = 0.7$). Pressing the button as a response to peripheral stimulus perception and inability to maintain steady central fixation for prolonged duration were the most commonly reported factors that influenced the level of difficulty of the perimetry tasks. A dark room ambience set for performing HVF was preferred by 32 (76.20%) subjects.*

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Conclusion: *There was no significant difference in the patient preference for test procedure and peripheral test targets. A black central fixation as in FDP and dark room ambience set for HVF were preferred.*

Keywords: *frequency doubling perimetry, full threshold perimetry, Humphrey visual field, patient preference*

Introduction

Standard automated perimetry (SAP) and frequency doubling perimetry (FDP) are two alternate technologies available to quantify the extent and degree of visual field loss due to glaucoma.[1] The Humphrey visual field analyzer (HVF) with SAP (750 I series; Carl Zeiss Meditec, Dublin, CA, USA) estimates differential light sensitivity using white targets and is considered as the gold standard in evaluating the visual field.[1,2] The frequency doubling perimetry (FDP) (Welch Allyn, Skaneateles Falls, NY, USA, and Carl Zeiss Meditec, Dublin, CA, USA) utilizes low-spatial-frequency sinusoidal grating target. It is a rapid, compact, and effective method of assessing the visual field, thus used as a screening tool.[3,4] The two techniques differ in various aspects such as the test strategy (type of central fixation and peripheral targets), test protocol, test duration, seating posture, type of eye patching, illumination of testing environment, and also in learning curve.[5,6]

Previous studies have reported a strong correlation between FDP and SAP while predicting visual field deficits with good concordance with respect to sensitivity and specificity.[5,6] Since perimetry is a psychophysical procedure that relies on precise subjective responses for determining sensitivity threshold, evaluating patient preference to either of these techniques might have clinical significance. Assessment of patient preference with respect to testing method, target characteristics, physical and mental aspects affecting the test performance, the levels of difficulty of the perimetry tasks, and so on, can help investigators to develop future prototypes of perimeters.

Therefore, this study aimed at comparing patient preference for Swedish Interactive Threshold Algorithm (SITA) standard 24-2 protocol in HVF and FDP by primarily evaluating their perception about the test procedure and test targets along with surveying the factors that influence the patient concentration during perimetry and elements that determine the level of perimetry task difficulty.

Materials and methods

Study population

This study included a cohort of subjects from the urban division of the Chennai Glaucoma Study (CGS), which was a population-based cross-sectional study. The design and methods of CGS were published earlier.[7] The study was approved by the Institutional Review Board, Vision Research Foundation, Chennai, and a

written informed consent was obtained from all subjects. All the study participants underwent a comprehensive ophthalmic examination including objective and subjective refraction, anterior segment examination using slit lamp biomicroscopy, Goldmann applanation tonometry, grading of the lens opacification based on lens opacification classification system II (LOCS II),[8] and visual field assessment using HVF and FDP followed by dilated fundus examination. The right eye of subjects with visual acuity better than 0.2 log MAR with cataract less than NII, CI, and PI on LOCS II were included. Subjects with any corneal or retinal pathology that would affect perimetry performance or test reliability were excluded.

Each subject was randomly allocated to perform HVF and FDP, and the order of perimetry was determined by simple randomization approach by flipping a coin. A minimum of 30 minutes of interval/rest was provided between the two procedures. Examiner gave verbal instructions in the subject's vernacular language or in English before and during the course of testing. All subjects had an experience of performing either of these perimetry techniques more than once in the past. In both the perimetry techniques, performance with fixation losses of >20%, false negatives, and false positives of >33% were considered unreliable, and the test was repeated in such responses.[9] The test was also repeated in cases with artifacts and with field defects that were not corresponding to structural abnormality of the optic nerve head.

Components of questionnaire

The questionnaire was administered orally to all subjects. The questionnaire was framed in English and was administered by the interviewer in the local language (Tamil). The translation was validated before its incorporation in this study. The questionnaire had a total of 13 questions (Appendix A), which were generally pertaining to three categories such as (a) the patient preference for test procedures and test targets, (b) the factors influencing the patient concentration during perimetry performance, and (c) the impression about the level of perimetry task difficulty.

Questions formulated for assessing the patient preference included the easiness/comfort of perimetry procedures, preference for central fixation, and peripheral test targets used in both the perimetry techniques in terms of recognition. Questions regarding physical factors such as noise distractions during the course of testing, type of eye patching used, and mental factors like fear for failing/repeating the test, fatigue, and so on, were included in the questionnaire, which was thought to have potential influence on the patient's concentration while performing the test.

The impression about the level of perimetry task difficulty was analyzed by incorporating questions related to difficulty in maintaining steady central fixation for a prolonged duration, difficulty in recognizing peripheral targets

against the used background intensity, and difficulty in pressing the response button during peripheral stimulus perception.

Questions for understanding the preferred time gap between the tests as well as the perception about the ambience of the testing environment were integrated. The obtained patient responses were coded, which were used along with the responses obtained using Likert scales for performing Rasch analysis.[10]

The patient responses obtained from the survey for each of the subcategories were analyzed using Chi-square test. The McNemar's test was conducted for comparative analysis of responses obtained from those questions that were based on Likert scale method. The five-point Likert scale was converted into a dichotomous scale for the McNemar's probability value. For those questions where 2 × 2 tables could not be formed without empty cells, Fisher's exact test was performed.

Results

Among 42 subjects, 18 (42.86%) were male and 24 (57.14%) were female and the mean age of the group was 59.7 (SD 9.7) years. Sixteen subjects were diagnosed to have angle-closure glaucoma, 11 had open-angle glaucoma, 14 had ocular hypertension, and 1 subject was normal. The order of testing was randomized and 31 subjects (73.81%) performed visual field testing by FDP prior to HVF, whereas 11 subjects (26.19%) performed HVF first. Twenty subjects (47.62%) had performed the test four times on both the machines, 18 subjects (42.86%) have undergone the test three times, and 4 subjects (9.52%) underwent the test twice prior to inclusion to the study.

Thirty-two subjects (76.19%) showed equal preference to the test procedures in terms of easiness and comfort level whereas 8 subjects (19.05%) felt difficulty in performing both the procedures and 2 subjects (4.76%) found FDP was easier than HVF, and the difference was not statistically significant ($p = 0.79$, 95% confidence interval: −0.127 to 0.223). Thirty subjects (71.43%) preferred a central black fixation target as in FDP and 17 subjects (40.47%) preferred a central yellow fixation target of HVF, 11 subjects (%) were comfortable with either of the fixation target (Chi-square, $p = 0.008$). Twenty-eight subjects (66.67%) had difficulty in responding to target stimuli on both the perimetry techniques and the other 14 subjects (33.34%) had no difficulty with either of the target stimuli. Eleven subjects (26.19%) found both of the testing procedures to be equally fast, 24 subjects (57.14%) found FDP to be faster, 6 subjects (14.29%) felt HVF was comparatively fast ($p = 0.0001$), and 1 subject felt neither of the perimetry techniques was fast.

Time taken to perform both perimetry procedures was analyzed. Mean

test duration of HVF was found to be 342.94 (SD 58.60) seconds, whereas the mean test duration for FDP was 325.40 (SD 18.96) seconds, and there was no statistically significant difference in test duration between the two perimetric techniques (p = 0.062, 95% confidence interval: −1.002 to 38.191).

When analyzing the mental factors that can influence patient concentration during test performance, 26 subjects (61.90%) were responded to have fear of failing the test and 27 subjects (64.29%) had fear of repeating the entire perimetry procedure. In 16 subjects (38.10%), the test was repeated, of which 9 subjects (56.25%) were asked to repeat the test once and 7 (43.75%) subjects repeated the test twice. When subjects were asked to recollect the number of times the test was repeated, three subjects were unable to recall the number of times they repeated the perimetry procedure. Physical factors such as noise distractions during the test procedure and type of patch used for the nontested eye (p = 0.614) were not reported as significant factors affecting their concentration.

The responses obtained for those questions included for analyzing the impression about the level of perimetry task difficulty are summarized in Table 1.

A dim lit testing environment as in HVF was preferred by 32 subjects (76.19%) and 14 (43.75%) of these did not prefer the illuminated testing environment in case of FDP (p = 0.04). The mean preferred gap by the patients between both the procedures was 15.91 (SD 7.35) minutes.

Table 1. Comparative analysis of factors influencing the difficulty level of perimetry tasks

Questions	Easier		p value
	HVF	FDP	
Was the testing procedure easy/difficult?	32	34	0.79
Was the maintenance of steady central fixation easy/difficult?	17	30	0.008
Was the recognition of peripheral test targets easy/difficult?	8	8	NA
Was pressing the response button easy/difficult?	14	14	NA

NA: not applicable

Discussion

The assessment of visual function using perimetry technique is an essential component in glaucoma diagnosis and SAP is considered as the reference standard for plotting the visual field. SITA standard 24-2 protocol in HVF evaluates visual sensitivity at 54 test locations within the central 24° visual field. This protocol relies on summary indices and Glaucoma Hemifield Test for detecting glaucomatous field loss. In comparison with this gold standard, FDP is an effective screening mode in clinical setting with a sensitivity of 78.1 and 89.1% specificity.[11] FDP is recommended as a promising method for identifying retinal ganglion cell damage at an early stage compared with the SAP and effective in monitoring visual field progression.[12,13]

Diagnostic and screening tests should be sensitive, specific, and patient acceptable. The patients had equal preference for overall comfort with both the procedures and a black central fixation target as in FDP was highly preferred compared with yellow target as in HVF, in which the target contrast against the testing background could be considered as a possible influential factor. No test preference for either of the peripheral test stimuli was found. Although results show that FDP is faster than HVF by 18 seconds, there was no statistically significant difference ($p = 0.062$).

Fear of failing/repeating the test was found as the most commonly reported psychological factor that might have potential influence on patient's concentration that can affect the reliability of test measurements. Any kind of noise distractions from conversations or any other source either within the test room/outside did not have a significant effect on the patient concentration. Barkara *et al.* had described that conversing on cellular phones with the use of hands-free headsets caused some subjects to miss significantly higher number of points, react slower to each stimulus, and perform the test with less precision, and moreover, there was a significant increase noted in fixation loss and test duration.[14]

Pressing the button as a response to peripheral stimulus perception and inability to maintain steady central fixation for prolonged duration were the most commonly reported factors that increased the level of difficulty of the perimetry tasks. A darker room ambience of HVF was more preferred than illuminated testing room in case of FDP. Dark rooms were preferred due to factors like ease of perceiving target in a darker environment compared with normal room illumination.

To analyze if the patients were given enough time gap in between the two tests, the patients were asked to quote their preferred rest duration (in minutes). All the patients mentioned preferred time gap of 15.91 ± 7.35 minutes, which was significantly less than the provided time interval. Therefore, the provided

time gap was considered to be sufficient for overcoming the fatigueness that arise from performing the perimetry. This will be relevant information that can be considered during the administration of two perimetry procedures consecutively.

One of the limitations of this study was that all the participants had previous experience with both the perimetric procedures since they belonged to CGS[7] follow-up study, which would have led to a patient bias toward either of these testing procedures. Even if the order of performing the perimetry procedures were randomly decided using simple randomization technique, a large proportion (73.81%) of patients underwent FDP prior to HVF. Unequal participants among the two groups would have been probably due to the smaller sample size which might have a potential bias on the patient's perception.[15] A sufficient time gap was provided between the two procedures with a thought to minimize the effect of fatigueness. Considering block randomization would have been a better way to ensure a balance in sample across the two groups over time. It was ideal to consider few external factors such as waiting time and comfort level in waiting room for an elaborate view of potential elements that influence patient preference and perception about perimetry testing.

Conclusion

There was no significant difference in the patient preference for test procedure and peripheral test targets while performing visual field evaluation using HVF and FDP. A black central fixation as in FDP and dark room ambience set for HVF were preferred. The central black fixation target as in FDP and a dark room ambience as in HVF were mostly preferred by the study participants.

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Appendix A

Questionnaire to compare patient's comfort in taking the visual field test using the HVF and the FDP

1. How many times have you taken the eye tests using
   a. HVF
      i. 0
      ii. 1
      iii. 2
      iv. 3
   b. FDP
      i. 0
      ii. 1
      iii. 2
      iv. 3

2. Which of the following do you feel is easier to see while taking the test?
   a. Vertical lines
   b. White spots

3. Do you find it difficult to concentrate on the central fixation point while taking the test?
   a. Yes
   b. No
   c. Unable to decide

4. Which machine are you more comfortable with when you are required to take the test?
   a. HVF
   b. FDP
   c. Neither
   d. Both

5. Which among the two machines do you think is a faster method to take the test?
   a. HVF
   b. FDP
   c. Neither
   d. Both are equal

6. Which among the two machines do you think is an easier method to take the test?
   a. HVF
   b. FDP
   c. Neither
   d. Both are equal

7. Do you get disturbed and hence not perform the test accurately because of any of the following reasons in your immediate environment?
   a. Noise from outside/conversations that take place in the room where the test is conducted

Very high	High	Less	Very less	Not at all

   b. Fear of failing the test

Very high	High	Less	Very less	Not at all

c. Fear of being asked to repeat the test

Very high	High	Less	Very less	Not at all

d. Black/white patches on the other eye

Very high	High	Less	Very less	Not at all

e. Fatigue/lack of enough sleep

Very high	High	Less	Very less	Not at all

If you have filled in option (e):

8. How many hours of work do you put in on an average day?
   a. 4-6 hours
   b. 6-8 hours

9. Do you work overtime/night shift, etc…?
   a. Yes
   b. No

10. Do you prefer to take the test in a
    a. Dark room
    b. Brightly illuminated room

11. How many times were you asked to repeat the test the last time you took it?
    i. 0
    ii. 1
    iii. 2
    iv. Can't recall

12. How long a gap do you require before retaking the test?

    _____

13. Which test did you take first?
    a) FDP
    b) HVF

14. Kindly grade the following test conditions with respect to the difficulty/ comfort level.

Condition	Machine	Very difficult	Moderately difficult	Mildly difficult	Easy	Very easy
Testing procedure	HVF					
	FDP					
Ability to comprehend instructions	HVF					
	FDP					
Pressing the button	HVF					
	FDP					
Being able to focus on the fixation point	HVF					
	FDP					
Ability to see the targets against the background	HVF					
	FDP					