Original Article

Comparison of Sensitivity and Specificity of Blue Yellow Primetry versus Standard Automated Primetry in Early / Glaucoma Suspect Patients

Ejaz Ahmad Javed, Muhammad Nawaz, Muhammad Ahmad, Muhammad Sultan

ABSTRACT

Purpose: To compare the sensitivity and specificity of short wavelength automated Perimetry (SWAP) with standard automated perimetry (SAP) using the SITA program to detect early or glaucoma suspect patients. **Study Design:** Cross sectional prospective and comperitative study of perimetric diagnostic sensitivity and specificity of two perimetric methods in early or glaucoma suspect patients. **Study Duration:** June 2010 – May 2012. **Materials and Methods:** Fifty patients with ocular hypertension, early glaucoma or suspect patients were enrolled for the perimetric tests. After complete ophthalmic examination, each patient was tested with the standard automated perimetry (SAP), 30-2 thrice and then on short wavelength automated perimetry (SWAP; 24-2) once. **Results:** The average MD in the SWAP group was significantly higher than in the SAP Group (SWAP – 6.55ds SAP- 2.60db P<0.001). A significant difference also existed in PSD between the two groups (SWAP: 3.50db, SAP 2.50db, P<0.001). The test time was longer in the SWAP group than in the SAP group (SWAP: 15min, SAP 13min P<0.001). However the sensitivity indices were in normal limits. There were significant differences in number of depressed test point locations between two tests strategies. The number of eyes showing cluster of significantly depressed points were more with the SWAP test strategy than with SAP. **Conclusion:** The SITA, SWAP identified at least much earlier glaucomatous visual field defects than SITA, SAP. The study showed that greater MD and PSD with SWAP.

Keywords: Early glaucoma suspect, short wavelength automated perimetry (SWAP), standard automated perimetry (SAP), Visual field defects Best corrected visual Acuity (BCVA).

INTRODUCTION

Diagnosis of glaucoma requires a clinical triad, elevated intraocular pressure, structural alteration of the optic nerve head and visual field defects.[1] No doubt the white on white perimetry is the test of original importance but structural changes in optic disc are now considered subordinate for glaucoma assessment.[2]

Several studies have reported that foveal blue and blue-yellow color vision defects are present in patients with ocular hypertension and glaucoma and these deficits appear to be early indicators of glaucomatous damage. [3]. In the studies of Drance, Lakowski et al it was demonstrated that patient with ocular hypertension who had blue and blue-yellow color deficiencies had a much higher incidence of glaucomatous visual field loss as compared with normal color vision results.[4] By using special techniques that selectively examine the sensitivity of short wavelength sensitive cones, it is possible to detect glaucomatous visual field deficits at an earlier stage.[5]

Several studies have shown that short wavelength automated perimetry (SWAP) was more sensitive than SAP in detecting early glaucomatous defects and it have shown greater progression of existing glaucomatous defects. [6]

Corresponding Author
Dr. Ejaz Ahmad Javed
Assistant Professor Ophthalmology
PMC/Allied Hospital Faisalabad
E-mail: eajaved1@yahoo.com

MATERIALS AND METHODS

We selected 50 patients with 70 eyes suspected of having glaucoma, who met the following criteria.

Inclusion Criteria

- Best corrected visual acuity of 6/9 or better
  - IOP 21 mmHg
  - Clear ocular media
  - Normal ocular examination except for a suspicious optic disc.
  - No systemic, ocular or neurological conditions causing visual field defects.
  - Normal visual fields on standard white or white perimetry
  - Age range between 25-55 years.

Exclusion Criteria

- Previous Ocular surgery
- Media opacity
- Diabetes Mellitus, Hypertension
- Uncooperative, mentally retarded or illiterate patients
- Narrow Angle Glaucoma
- Secondary open angle glaucoma

After consent of every patient and approval of ethical committee, the systematic and ocular history was taken. Then complete ophthalmic examination was done e.g. visual acuity, refraction, slit-lamp examination of cornea, lens, anterior chamber, vitreous, fundus and motility test.

We first arranged white on white perimetry and entered the patient profile and data. Every patient was briefed and instructed on Humphrey visual field analyzer, (model 750 i, Carl Ziess Meditec Inc, Dublin, CA, USA). The white on white perimetry (SAP) was done thrice and the last reading was taken for study. After about thirty minutes each patient was instructed for blue-yellow perimetry (SWAP) testing and then visual field was compared with SAP perimetric results. One eye of 10 patients showed significant changes on SAP perimetry while other eye was normal. This normal eye was supposed to be suspected glaucomatous and was taken into consideration for study. The other patients showed normal visual fields on SAP perimetry and still were suspected to be having glaucoma.

These patients were then prepared for SWAP, examination. The "suspected" normal fellow eyes (On SAP perimetry) were chosen for analysis. So 30 patients had both suspected glaucomatous eyes and 20 patients had one suspected glaucomatous eye. SWAP was performed with a Humphrey field analyzer

(HFA11 750 i Humphrey systems Dublin CA) using the program 24-2 with full threshold performance. A size 'V' light stimulus was chosen with a 440 nm wavelength blue spot projected onto a 530 nm wavelength yellow background at a maximal brightness of 100 dc/$m^{2..}$ SAP was also performed with Humphrey Field Analyzer (HFA-11 750 i), using the 30 – 2 full field threshold program. A size III stimulus was chosen with a maximal intensity of 10,000 asb, a duration of 200 ms, which projected onto a background bowl illuminated at 31-5 asb.

For both SWAP and SAP, automated gaze tracking system was turned on. During the test, blind spot fixation was mentioned not only by the Heijl- krakall method but also by an experienced perimetrist. The reliability of each visual field test was assessed, as fixation losses < 20%), false positive < 20%, false negative < 20%. Those exceeding 25% were considered unqualified field and were excluded.

The visual field charts were reviewed for mean deviation (MD), pattern standard deviation (PSD), test reliability (fixation losses, false positive, false negative).

RESULTS

Table-1

Six discrimination (50 patients)

Sr. No	Sex	No.	% Age
1	Male	40	80%
2	Female	10	20%

Table-2

Age (50 patients)

Sr. No	Age Rang (Years)	No.	% Age
1	25 – 30	2	4%
2	31 – 35	2	4%
3	36 – 40	6	12%
4	41 – 45	15	30%
5	46 – 50	15	30%
6	51 – 55	10	20%

Table-3
White on white perimetry (70 eyes)

Sr. No	Visual Field	No. Of Eyes	% Age
1	Abnormal	10	14.30%
2	Normal	60	85.70%

Table-4
IOP range mmHg (70 eyes)

Sr. No	IOP Range in MMHG	No. of eyes	% Age
1	17 – 18	10	14.30%
2	18.5 – 19	15	21.40%
3	19.5 – 20	20	28.60%
4	20.5 – 21	25	35.50%

Table-5
CD Ratio (70 eyes)

Sr. No	CD Ratio Range	No. of eyes	% Age
1	0.4 – 0.5	25	35.71
2	05. – 0.6	30	42.85
3	0.6 – 0.7	15	21.43

Table-6
Visual Acuity (70 eyes)

Sr. No	BCVA	No. of eyes	% Age
1	6 / 6	50	71.43
2	6 / 9	20	28.57

Figure-1

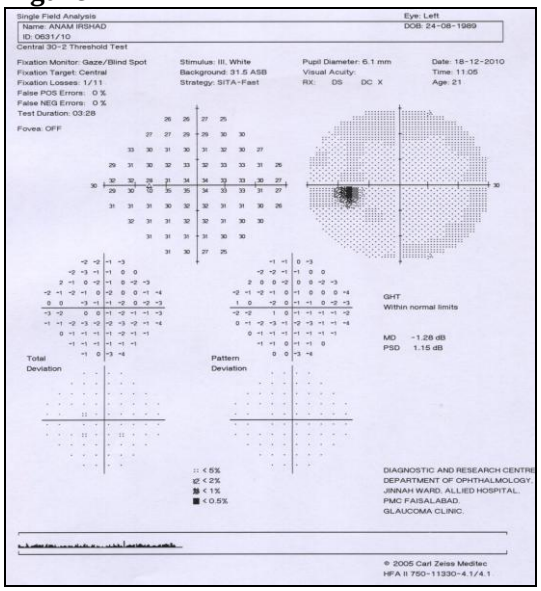


Figure-2

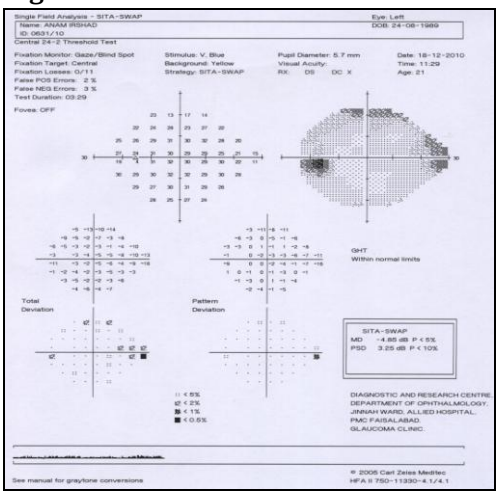


Figure-3

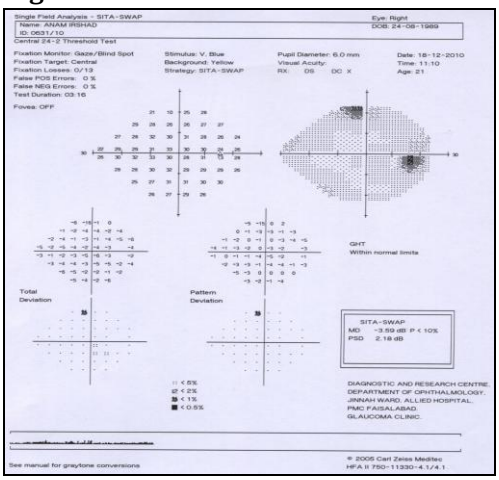


Figure-4

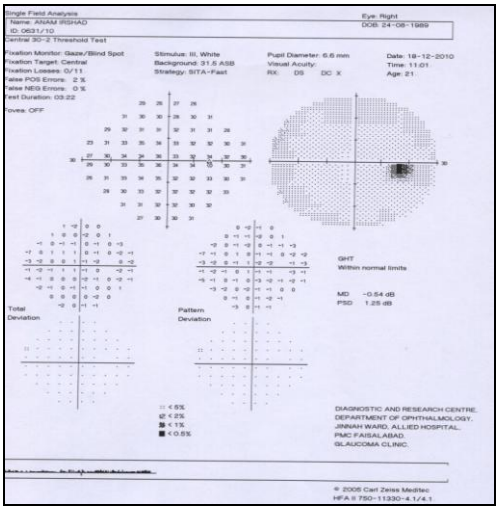


Figure-5

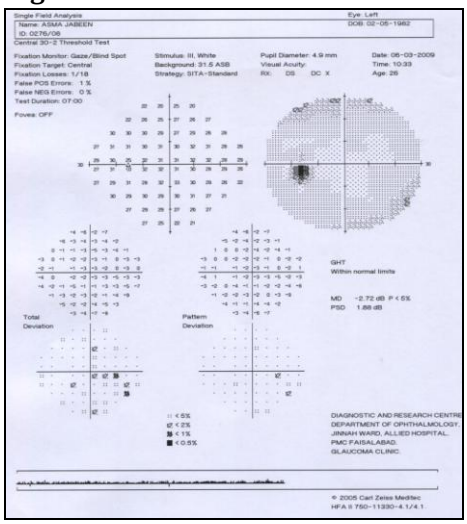
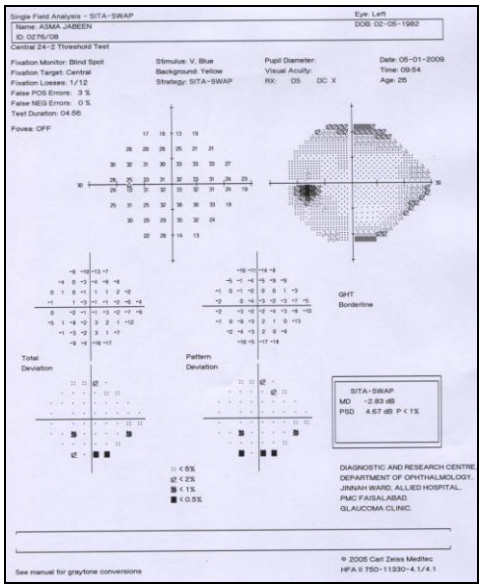


Figure-6



The average MD in the SWAP was 6.50 ± 3.20db and in the SAP group was 2.70 ± 1.70db (P<0.001). The average PSD in the SWAP group was 3.50 ± 0.30db, and was 2.50 ± 0.9db in the SAP group (P<0.001).

For the reliability analysis, the average fixation loss in the SWAP group was 6.50 ± 7.8% and was 6.40 ± 8.40% in SAP group (P=0.90) the false positive rate was 0.70 ± 1.91% in the SWAP group (P=0.07) and the false negative rates were 2.15% ± 4.0 and 1.25 % ± 3.50% respectively (P=0.55).

Thus our results showed that there were statistically significant differences in MD, PSD, and other parameters.

DISCUSSION

The superiority of SWAP in detecting the early or suspected glaucoma is well established. [7]

According to a study of Jonson et al, blue on yellow perimetry can be an early indicator of glaucomatous damage and is predictive of impending glaucomatous visual field loss as compared to standard perimetry in ocular hypertensive patients. [8]

In this study we compared all points on printouts of both SAP and SWAP. We excluded the eyes which SAP fields were abnormal and included the eyes with normal SAP results. All normal eye on SAP fields showed abnormal fields on SWAP. Thus concluding that SWAP detects early glaucoma as compared to SAP. These results are comparable to study of Sample and Taylor et al. [9]

As Compared with previous studies our data also showed statistically significant differences in MD and PSD between SWAP and SAP.[10] We enrolled the patients between age 25 years to 55 years and with Best corrected visual Acuity (BCVA) up to 6/9. This reduced the chances of nuclear sclerosis, as it develops with increasing age. The progressive yellowness of the lens reduces the intensity of the blue light within the age.[11]

As we considered the 3rd reading of SAP and it was 4th on SWAP so learning effect issue was not significant for the study. This was in correlation to study of Soliman. [12]

Although the idea that SWAP can detect early glaucomatous changes but diagnostic efficiency seemed to be poorer than that of standard automated perimetry; as it requires greater cooperation by patients. Furthermore the question of variation of test strategy 24 – 2 (SWAP) to 30 – 2 (SAP) is different in two tests that may be affecting study results. Also stimulus size is different in two modes of tests that may also be limiting test reliability. So all these limitations in the machines are questionable.[13] Now most of the focus is on macular visual field, including central vision, is of paramount importance. Even a glaucomatous patient can enjoy normal daily activities with the perifoveal vision. In a recent study on glaucomatous patients assigned the greatest importance to near vision tasks,

for example reading, as they use perifoveal vision. [14, 15]
The visual field estimation with white on white perimetry (SAP) and blue on yellow perimetry SWAP show only functional activity. So a structure-function relationship of macular visual field sensitivity and the ganglion cell complex thickness in glaucoma is studied by Jung Hwa Na etc. It was determined that GCC by Spectral Domain (SD), OCT showed a statistically significant structure-function association with macular visual field [16].
So it is clear logically that the best way to evaluate the structure-function association in glaucoma is to compare local sensitivity to local structure measurements.[17]
In human, loss of ganglion cell and reduced nerve fiber thickness also have been observed in the posterior pole region of glaucomatous eyes.[18]
Further readings and studies are required on our own population and to set the criteria for SWAP testing.

CONCLUSION

1. Short wave automatic perimetry is superior in detecting the early glaucomatous damage as compared to standard automated perimetry.
2. In patient where SAP fields are normal in the presence in strong suspicion, we should proceed for SWAP, although this test needs greater cooperation from the patient. SWAP is a useful addition to an already available arnamentorum to detect glaucomatous damage.
3. Further studies are required to compare these two methods of perimetry with same stimulus size and intensity are required to support these findings.

REFERENCES

1. Su. W.W, with C,S , Chang HL, Shen Su. Chin, comparison of standard white on white automated perimetry and short wavelength automated perimetry in early glaucoma patients; Dept of Ophthalmology, Chang Gung memorial hospital, Taipei , Chang Gung Med. J 2004; 27:188 – 192.
2. Quigly HA, Addicks EM, Green WR. Optic nerve damage in human glaucoma. III quantitative correlation of nerve fiber loss and visual filed defects in glaucoma, ischemic neuropathy, papilloedema, and basic neuropathy, Arch Ophthalmol 1982; 100: 135 – 46.
3. Johnson CA, Adams AJ, Casson EJ, Brandt JB, Blue on Yellow perimetry can predict the development of glaucomatous visual field loss. Arch Ophthalmol 1993: 111: 645 – 50.
4. Drance SM, Lakowski R, Schulzer M, Douglas GR, Acquired color vision changes in glaucoma with use of 100 hue test and pickfard anomaloscope as predictor of glaucomatous field changes. Arch, Ophthalmol 1981; 99: 829 – 31.
5. Su WW. et al. Can SWAP detect glaucoma earlier than W.W comparison of SAP with SWAP in early glaucoma patients. Chang Gung Med J. 2004; 27: 188 – 192.
6. Johnson CA, Adams AJ, Casson CJ, Brandt JD,. progression of early glaucomatous visual field loss as detected by blue on yellow and standard white on white automated perimetry. Arch Ophthalmol 1993; 111: 651 – 6.
7. Sample PA, Weinreb RN, progressive color visual field loss in glaucoma. Invest Ophthalmol Vis Sci 1992; 33: 2068 – 71.
8. Johnson CA, Short wavelength automated perimetry in low medium and high risk ocular hypertensive eyes, initial base line results, Arch Ophthalmol 1995; 113: 70 – 6.
9. Sample PA, Taylor JDN, Martinez G, Lusky M, Weinreb RN, Short wavelength color visual fields in glaucoma suspect at risk. Am J Ophthalmol 1993; 115: 225 – 33.
10. Mansberger SL, Sample PA, Zangwill L, Weinreb RN, Achromatic and short wavelength automated perimetry in patients with glaucomatous large cups. Arch Ophthalmol 1999:117; 1473 – 7.
11. Sample PA, Esterson FD, Weinreb R.N A practical method for obtaining an index of lens density with an automated perimeter. Invest Ophthalmol Vis Sci 1989; 30: 786 – 7.
12. Soliman MAE, de Jong LAMS, Ismail AAA, Van den Berg TJTP, de Smet MD. Standard Achromatic perimetry, Short wavelength automated perimetry and frequently doubling

technology for detection of glaucoma damage. Ophthalmology 2002; 109: 444 – 54.
13. Soliman MA, de Jong LAMS, Ismail AAA, Van den Berg TJTP de Smet MD. Standard Achromatic perimetry, Short wavelength automated perimetry and frequently doubling technology for detection of glaucoma damage. Ophthalmology 2002; 109: 444–54.
14. Burr JM, Kilonzo M, Vale L, Ryan M. developing a preference based glaucoma utility index using a discrete choice experiment. Opton Vis Sci 2007; 84: 797-808.
15. Aspinall PA Johnson ZK, Azware – Blanco A, Brico R, Vickers A. evaluation of priorities of patients with glaucoma. Invest Ophthalmol Vis Sci 2008; 49: 1907-1915.
16. Jung Hwa Na, Michael S, Kook, Youngrok Lee, and Seunghee Back. Structure function relationship of macular visual field sensitivity and the ganglion cell complex thickness in glaucoma. Glaucoma, 2012; 5031-5044.
17. Hood DC, Anderson SC, Wallm, Kardon RH. Structure versus function in glaucoma; an application of a linear model. Invest Ophthalmol Vis Sci 2007; 48: 3662-3668.
18. Zeimer R, Asrani S, Quigley H, Jampel H. Quantitative detection of glaucomatous damage at the the posterior pole by retinal thickness mapping, A Pilot study. Ophthalmology; 1998; 105: 224-231.

AUTHORS

- **Dr. Ejaz Ahmad Javed**
  Assistant Professor Ophthalmology
  PMC/Allied Hospital Faisalabad
- **Dr. Muhammad Nawaz**
  Associate Professor Ophthalmology
  PMC/Allied Hospital Faisalabad
- **Dr. Muhammad Ahmad**
  Associate Professor Ophthalmology
  Isalam Medical College, Sialkot
- **Prof. Dr. Muhammad Sultan**
  Professor of Ophthalmology
  PMC/Allied Hospital Faisalabad

Submitted for Publication: 06-03-2013

Accepted for Publication: 04-07-2013
After minor revisions