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Research Article

Comparing Visual Field Easy Application on a Tablet to HFA Amongst Glaucomatous and Non Glaucomatous Patients at Mzuzu Central Hospital

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Abstract

Introduction: Perimetry is an essential diagnostic test, especially in glaucoma, but also for diagnosing and monitoring the progression of many other eye diseases. Humphrey Field Analyser had been reported as the gold standard to measure visual fields in people. However, it's high cost has placed a great limitation to its use in many low income countries. Also, it's big size and fragility had meant that Humphrey visual field analyzer cannot easily be moved from one point to another therefore making it unavailable for outreach purposes in very rural areas. With recent advancement in technology, Visual field screening has been incorporated in electronic gadgets, making it easily affordable mobile and accessible to all. With these advances in visual field examination, studies are still ongoing to compare the sensitivity of HFA to the easy application used on gadgets. Malawi being one of the economically challenged countries in the world will benefit immensely from this cheap, readily mobile and less fragile equipment. In Malawi, such studies comparing HFA to EFA is rather scarce, hence the need to compare the two devices amongst the Malawian populace.

Aims: To compare the perimetric outcomes of perimetry easy field application run on tablet to Humphrey Field Analyser (HFA) at Academic Vision Centre.

Methodology: The study was an analytical, prospective cross-sectional designed to compare the perimetric outcomes from easy visual field application run on tablet and those from the Humphrey Field Analyser (HFA) SITA Fast c30-2. The study was conducted at Academic Vision Centre, Mzuzu Central Hospital in Malawi. Data collection was undertaken between May 2019 and June 2019. A total of 133 participants were recruited to the study. Out 133 participants 67 were known glaucoma patients and 65 were normal. Analysis comprised of comparing the extent of the visual field loss detected by both the VFE and HFA and clinically assessing the results for normality and duration taken for each device.

Results: Out of 133 participants, both devices agreed that 71 participants were having normal visual field representing 53%. The devices also found that 56 participants had constricted visual field representing 42%. Humphreys Visual Field Analyzer found out that 6 participants had constricted visual field while Easy Field application found them with full visual field difference error of 4.5% and there was a strong paired correlations of 0.914.

Average test duration for the Easy Field Application was 4.0015minutes for both test and retest, which is shorter than the average HFA test time for the same patients of 6.8137 minutes (P, 0.001).

Conclusion: As a screening tool, the VFE application is quick and easy to administer, preferred by patients and has good sensitivity and specificity for detecting the presence of an abnormal visual field when compared to HFA. In patients with extensive visual field loss, the VFE may overestimate visual field reduction.

Keywords: Perimetry; Humphrey Visual Field Analyser; Easy Field Application

Introduction

Visual field examination also known as perimetric eye examination is the science of measuring the visual field of a person [1]. The visual field is that area of space that a person can see at one time [1]. Although an individual normally functions binocularly, the visual field for clinical purposes is rarely tested under binocular conditions, rather it is tested monocularly [2]. The outer edges of the Hill of Vision represent the outermost limits of the area in space that can be seen at any one time, the absolute limits of the visual field. Outside of these edges, even a very large, very bright object cannot be seen [1].

Perimetry, is an essential diagnostic test, especially in glaucoma, but also for diagnosing and monitoring the progression of many other eye diseases [1]. According to World Health Organization, glaucoma is the second leading cause of blindness in the world after cataract [2]. Glaucoma is estimated to affect over 3 million Americans, but only half of them know that they have it [3]. It is also estimated that more than 120,000 people are blind from glaucoma in the United States. This accounts for 9-12% of all cases of blindness in the country [2]. In Africa out of 1843 pe,142 people are estimated to have glaucoma representing 7.7% (Amoaku and Ntim-Amponsah, 2004).

Possible risk factors for the development of glaucoma may include, age over 60years, family history of glaucoma, diabetes and high myopia in people (Kanski, 2010). Early detection and monitoring of glaucoma is key to its management this makes perimetric eye examination a very essential tool in the management of glaucoma.

As earlier stated, Visual field examination also known as perimetric eye examination is an important examination in the full evaluation of ophthalmology patients, especially among those with glaucoma, neuro-ophthalmologic as well as retinal problems [4].

The process of performing perimetric eye examination can be computer supported or done manually using kinetic or using static targets [1]. Humphrey visual field analyser is often regarded as the gold standard for visual field examination [4]. This is because of its good sensitivity and specificity to a variety of visual-field defects, such as optic-nerve defects including those caused by glaucoma, retinal and neurological lesions [1]. However, these Standard [2] automated perimetry (SAP) are mostly expensive, big and not easily moveable [3]. Due to its high cost, the Humphrey visual field analyser is mostly found in tertiary hospitals. In low income providing these services for all people has proven abortive except for in tertiary hospitals, thereby making this essential service accessible to only few individuals who are able to access eye care services from these places [3].

With the new era in technology, gadgets have found a place in medicine. Software and hardware developments are increasingly used in medicine at a quick pace. This has not left ophthalmology aside [5]. Recently, the development and rapid accessibility of portable tablet devices such as the iPad (Apple, Cupertino, CA) have seen these devices become suitable as low-cost, portable, and reliable vision testing instruments due to its good dynamic range of luminance and high spatial resolution that make them suitable as low-cost, portable, tangent perimeters [6].

These portability has made the device suitable for vision screening in very unusual situations, such as at a bedside while at home, in a clinic waiting room, or in rural and remote areas. Also, the ubiquity of tablet devices raises the possibility that patients could perform unsupervised examinations including perimetric tests as part of a home-monitoring program [6].

IPad “Visual Fields Easy” created by George Kong software is a free and easily downloadable application which has been described as a hand held tool to examine and reflect visual fields. However, its accuracy and reliability are still being tested [6].

In Malawi, only referral hospitals are equipped with automated perimetry machines like the Humphrey or the Octopus visual field analyzer due to their cost. However with the introduction of the tablet into eye care and proof of reliability of its come perimetric services can be made available in every district hospital hence the background for this research work.

Methodology

This study was designed as an analytical, prospective cross-sectional study which tried to compare the perimetric outcomes from easy visual field application run on tablet and those from the Humphrey Field Analyser (HFA) SITA Fast c30-2. The study was conducted at Academic Vision Centre, Mzuzu Central Hospital in Malawi. Data collection was undertaken between May 2019 to June 2019. A total of 133 participants were recruited to participate

in the study. Out of 133 participants 67 were known glaucoma patients and 65 were normal patients who came in for other reasons. Analysis comprised of comparing the extent of the visual field loss detected by both the VFE and HFA and clinically assessing the results for normality and duration taken for each device.

Optometric procedures

This study employed an analytical, prospective cross-sectional design. Participants were recruited using probability (random) sampling method. A total of 133 participants were recruited after Sample size was calculated using Yamane method (N/1+Ne). The calculated sample size of 132 was increased to 133 assuming a 10% non-response. Random sampling method was used to recruit participants from patients attending clinics at Mzuzu Central Hospital.

Approval for the research was sought and gotten from Mzuzu University Faculty of Health Sciences Research Ethics Committee. In order to conduct this research at Mzuzu Central Hospital, assent was sought from its research committee. Also, written informed consent was gotten from all the people who participated in this study. Questionnaires were used to obtain participants' ocular history, medical, drug and family history. While collecting the data for this research, the researchers ensured that no harm came to any of the participants. Also the researchers used codes as a means of identification as such ensuring the confidentiality of the participants. After consents were acquired and the questionnaires returned, the questionnaires were screened for any ocular pathologies which may interfere with the findings of the study. Ocular screenings which entailed, Visual acuity measurement (unaided and pinhole) using the LogMar Chart at 6 meters was done, Slit lamp Biomichroscopy was used to evaluate the external part of the eyes, direct ophthalmoscopy was done to access the integrity of the fungal background, tonometry using icare tonometer was done to rule out increased IOP at the time of the research and refraction was done (at far and near).

Patients with near and far distance visual acuity less than 20/40 vision post refractive error correction, patients with pathologies such as pterygium encroaching to the papillary axis, cornea scar and severe dry eyes or recent intraocular surgery were excluded from this study.

A total of 61 participants had normal optic nerves and the remaining (72) patients had cupped optic disc and were previously diagnosed of glaucoma with various degrees of scotoma.

Patient testing was performed in a dim, quiet room without distractions. The tablet screen was cleaned before each test to avoid glare. Testing was performed with the adequate corrective lenses in place. Prior to commencing testing, clinician administering the test gave the patient explanation of the test and what they were expected to do including not to move their head position throughout the test. The patient had one eye occluded with an eye patch while the other eye is examined after the participant was seated comfortably at a table with the tablet placed at 33 cm.

The viewing distance for this examination was measured using a fixed piece of string (33 cm) from the tablet screen to bridge of patient's nose at the start of the test. The tablet screen was straight (not tilting) with respect to the viewing plain. The screening distance was ensured not to change during the tablet examination.

In order to examine the participants using the HFA, practitioner made sure that the test was clearly explained to the participants. The test type and eye were firstly selected and the patient details accurately entered (details entered included number coding assigned to the patient, pupil size, age, sex and IOP). Afterwards, participant was instructed to maintain fixation on the central target and is given a buzzer to only press when they see a light stimulus. The eye not being tested is occluded using a patch (provided by the HFA manufacturers as accessory and) the room lights are dimmed prior to commencement of the test.

The patients were positioned appropriately and comfortably against forehead rest and chin rest. Minor adjustments were made to the head position so as to center the pupil on the display screen to allow eye monitoring throughout the test. After each test, the examiner ensured to print the result for each participant as well as save the record in the computer for references and storage.

Prior to each test, a short practice test lasting approximately 2 to 3 minutes was administered to ensure each participant understood the test procedure and is familiar with the voice prompts.

The visual field outcomes of easy field application perimetry were compared against those from the HFA 24-2 SITA standard. Participants were tested twice on the easy field application

perimetry to establish test–retest repeatability. Participants who showed high false positives greater (were considered as trigger happy) and false negatives (may not have understood the instructions greater than 15% were disqualified during the assessment.

Participants tested on both the HFA also EFA to enable good comparison.

Results

The study was carried out amongst glaucomatous and non-glaucomatous eyes comparing visual field easy application on a tablet to HFA at Mzuzu central hospital. This chapter will present the studying findings according to the objectives of the study.

Demographic data presentations

Out of 133 participants screened using the two devices 71 were males, 62 were females. 34 males and 28 females were non-glaucomatous patient whereas 36 males and 35 females were known glaucomatous patients. The table below represents the demographic information.

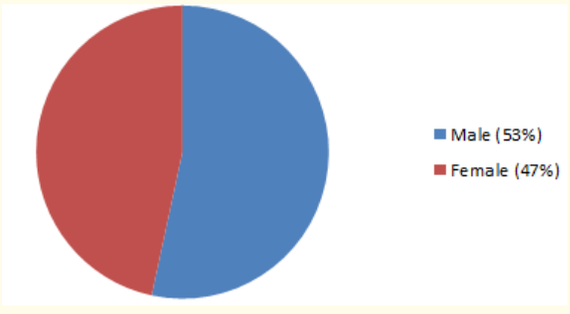

Figure 1: Distribution of study sample (n = 133) based on gender.

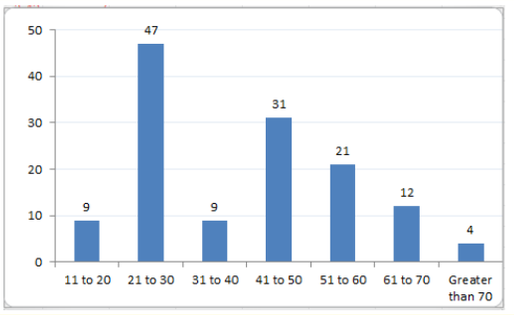

Figure 2: Distribution of study sample (n = 133) based on age range.

Comparison of HFA and EFA amongst non-glaucomatous patients

Among the non-glaucomatous participants, visual field examination using Humphrey Visual Field Analyzer showed 28 males representing 39.4% and 25 females representing 40.3% within gender respectively had no glaucoma. Among non-glaucomatous using Easy Field Analyzer 25 males representing 35.2% and 23 females representing 37.1% were confirmed to have no glaucomatous defects. In total HFA found out that 53 people of 62 non-glacoumatous were real non-glacoumatous representing 85.5% while 9 people (14.5%) had other visual defects not related to glaucoma e.g. ring scotoma and junction scotoma. On the other hand EFA found out that 48 people of 62 non-glacoumatous were real non-glacoumatous representing 77.4%. 14 people representing 22.6% had other visual defects other than glacoumatous scotomas.

HFA EFA			Non glucoma (n = 62)	
Gender	Male No defects detected	Count	28	25
		% within Gender	39.4%	35.2%
	Male Other visual field defects detected	Count	5	7
		% within Gender	7.04%	9.9%
	Female No defect detected	Count	25	23
		% within Gender	40.3%	37.1%
	Female Other visual field defects detected	Count	4	7
		% within Gender	6. 5%	11.3%
Total %		Count	53	48
		85.5%	77.4%	

Table 1: Tabulation of HFA and EFA amongst non-glaucomatous patients.

Comparison of HFA and EFA amongst glaucomatous patients

Out of 71 participants who were known glaucomatous patients, visual field examination using Humphrey Visual Field Analyzer detected visual field defects in 34 males representing 47.9% and 28 females representing 45.2%. In total HFA found out that 62 people of 71 glaucomatous had altitudinal scotoma and arcuate scotoma representing 87.3% glaucomatous while 9 other people on HFA had other visual defects not related to glaucoma eg ring scotoma and junction scotoma representing 12.7%. Among glaucomatous participants using Easy Field Analyzer 28 males representing 39.5% and 25 females representing 40.3% had visual field defects related to glaucoma. In total EFA found that out of 71 glaucomatous participants, 53 had altitudinal scotoma and arcuate scotoma representing 74.6% glaucomatous while 18 other people on EFA had other visual defects not related to glaucoma eg ring scotoma and junction scotoma representing 25.4%.

		HFA			EFA		
Gender		Altitudinal scotoma	Arcuate	Others	Altitudinal scotoma	Arcuate	Others
Male	Count	25	9	5	20	8	9
	% within Gender	35.2%	12.7%	7.04%	28.2%	11.3%	12.7%
	% of Total	18.8%	6.8%	3.8%	15.0%	6.0%	6.8%
Female	Count	20	8	4	17	8	9
	% within Gender	32.3%	12.9%	6.5%	27.4%	12.9%	14.5%
	% of Total	15.0%	6.0%	3.0%	12.8%	6.0%	6.8%
Total	Count	45	17	9	37	16	18
	% within Gender	33.8%	12.8%	6.8%	27.8%	12.0%	13.5%

Table 2: Tabulation of HFA and EFA amongst glaucomatous patients (n = 71).

Discussion

This chapter discusses the findings of the study and makes recommendations for practice, education and research. The focus of this study was to compare HVFA to EFA among glaucomatous and non-glaucomatous people respectively.

Comparing HVFA to EFA amongst non glacoumatous people

According to findings of this study, 62 non-glaucomatous participants, who were tested using HVFA, 53 of them showed full visual field representing 85.5% while 9 people (14.5%) had other visual defects not related to glaucoma e.g. ring scotoma and junction scotoma. But when they were tested using EFA tablet discovered that 48 participants had had full visual field representing 77.4%. EFA also detected 14 people with other visual defects other than glacoumatous scotomas representing 22.6%. This shows that EFA is very sensitive in picking visual field defects in non glaucomatous patients more when compared to HFA.

Out of 62 non-glaucomatous participants, EFA detected 48 participants had had full visual field representing 77.4% with a mean defect of 0.83 and a pattern deviation of 0.88.

The findings of this study agrees with a cross-sectional study conducted at University of Melbourne, Centre of Eye research Australia, Department of Ophthalmology to determine the comparison between the parametric outcomes from perimetry software Melbourne Rapid Fields (MRF) run on an Apple iPad tablet and those from the Humphrey Field Analyzer (HFA). The findings showed that MRF demonstrated a high level of concordance in its outcomes with HFA (intraclass coefficient [ICC] ¼ 0.93 for mean defect [MD] and 0.86 for pattern deviation [PD]) [6]. Also, Konstantinos., *et al*. [7] carried out a similar study to present a visual field examination method using virtual reality glasses and evaluate the reliability of the method by comparing the results with those of the Humphrey perimeter. Konstantinos., *et al*. [7] found a very high correlation coefficient (r = 0.808, P,0.0001) between the virtual reality visual field test and the Humphrey perimeter visual field. So, the correlation between the findings of Humphreys visual field analyser and Easy field tablet necessitates the widespread use of easy field system which is portable, cheap, mobile and the easy to measure the visual field compared to Humphreys visual field analyser.

So far, other literatures have not been found which are in contrast with the findings of this study. This is so because little has been done on comparing Easy Field Application to Humpreys Visual Field Analyzer.

Comparison of Easy Field application perimetry result to Humphreys Field Analyzer result among people with glaucoma

According to findings of this study, out of 71 glaucomatous participants who were tested using EFA, 20 males (15.0%) and 17 (12.8%) females had altitudinal scotoma within their respective gender. 8 males (6.0%) and 8 female participants (6.0%) also showed arcuate scotoma.

This study also established that out of 71 glaucomatous participants, the HVFA detected 62 participants with glaucoma. 25 males representing 35.2% and 20 females representing 32.3% had altitudinal scotoma. 9 males (12.7%) and 8 female participants (12.9%) showed arcuate scotoma with percentage within gender while 9 people (12.7%) had other visual defects not related to glaucoma eg ring scotoma and junction scotoma.

This result is also in line with a similar study conducted by He., *et al*. 2016. As compared to the previous results the study reveals the perimetric outcomes from perimetry software Melbourne Rapid Fields (MRF) run on an Apple iPad tablet and those from the Humphrey Field Analyzer (HFA) among glaucomatous patients [6].

MRF showed a high level of concordance in its outcomes with HFA although the MRF tended to give a less negative MD (1.4 dB bias) compared with the HFA. The perimetry results from the MRF have a strong correlation to the HFA outcomes. Portable tablet perimetry may allow accurate assessment of visual field when standard perimetry machines are unavailable or unsuitable [6].

Another cross sectional study also revealed that Medmont automated perimeter (MAP), when compared to Humphrey field analyzer (HFA), Medmont and Humphrey perimeters correlated well (Landers., *et al*. 2013).

The results of this study disagrees with the study which was done in Australia, in a community based cross-sectional study conducted on 50 glaucoma participants, which aimed at comparing Rapid Matrix Fields (RMF) to HVFA (Fredette, 2015). Their study found that the visual field outcomes between the two machines were not similar. The results of this study may differ from the results of the current study because they recruited glaucomatous people and also they compared different equipment from equipment used in the current study while this study focuses on both glaucomatous and non-glaucomatous participants [8-17].

Conclusion

The "Visual Fields Easy" application is as sensitive as HVFA to measure the visual field and detect the visual field defects.

The application is not intended to replace standard automated perimetry machines.

The "Visual Fields Easy" application may have a role in detecting, documenting and monitoring visual field defects in low resource settings where visual field tests are not available.

Recommendations

Further studies need to be done in people with other diseases to detect correlation of visual fields between Visual Fields Easy" application to Humphreys Visual Field Analyser.

Similar studies in patients with neurological problems need to be carried out.

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