Comparison of computer-assisted instruction and conventional method in visual field testing

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Introduction : *Standard automated perimetry is an acceptable method for glaucoma visual field testing. Correct interpretation depends on the reliability of the test, which can be reflected by reliability indices.*

Objective : *To compare computer-assisted instruction (visual field game) with conventional instruction (document) in subjects who were undergoing visual field test.*

Setting : *Out-patient Clinic, King Chulalongkorn Memorial Hospital*

Research Design : *A prospective, randomized study*

Patients : *Subjects who were newly exposed and to undergo visual field testing by standard automated perimetry from March 2005 to August 2005 were recruited*

Methods : *Thirty-five and 37 patients, aged between 40-75 years, were randomized either to receive a computer-assisted instruction or conventional instruction before taking a visual field test. The outcomes, scaled as reliability indices, fixation losses and false positive error rates, were measured.*

Results : *Fixation losses and false positive rate were higher in computer-assisted (mean $\pm$ SD), 0.23 $\pm$ 0.29 and 0.06 $\pm$ 0.11, compared to conventional method group, 0.15 $\pm$ 0.23 and 0.03 $\pm$ 0.05. Furthermore, false positive rate in conventional instruction group was shown statistically significantly lower than the computer-assisted one ($p<0.05$). The result is that the conventional method has higher reliability than the computer-assisted instruction.*

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Conclusions : *Computer-assisted instruction did not alter the reliability outcome of the visual field test by automated perimetry when compared to the conventional instruction. Regarding the computer-assisted method used in this study, some improvement will be needed if it is still believed useful.*

Keywords : *Standard automated perimetry, Computer-assisted instruction, Conventional instruction, Fixation losses, False positive rate.*

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หญิง สุพัฒนวงศ์, วิศนี ตันติเสวี. การศึกษาเปรียบเทียบระหว่างการใช้วิธีสอนโดยใช้คอมพิวเตอร์ ตัวช่วย และวิธีสอนดั้งเดิม ในการตรวจลานสายตาผู้ป่วย. จุฬาลงกรณ์เวชสาร 2550 พ.ค. – มิ.ย; 51(5): 263 – 71

บทนำ : *การตรวจลานสายตาด้วยคอมพิวเตอร์แบบมาตรฐานเป็นวิธีตรวจลานสายตาโรคต้อหินที่เป็นที่ยอมรับใช้กันทั่วไป การแปลผลที่ถูกต้องขึ้นกับ ความน่าเชื่อถือของการตรวจวัด ซึ่งแสดงออกผ่านทางดัชนีความน่าเชื่อถือ*

วัตถุประสงค์ : *เพื่อศึกษาการใช้วิธีการสอนผู้ป่วยที่จะรับการตรวจวัดลานสายตาโดยการใช้คอมพิวเตอร์ช่วย (เกมคอมพิวเตอร์) เปรียบเทียบกับวิธีการสอนแบบดั้งเดิม (ใช้เอกสาร) ต่อผลดัชนีความน่าเชื่อถือของการตรวจวัดลานสายตา*

สถานที่ที่ทำการศึกษา : *คลินิกผู้ป่วยนอก ฝ่ายจักษุวิทยา โรงพยาบาลจุฬาลงกรณ์*

รูปแบบการวิจัย : *การศึกษาแบบสุ่มและเป็นการศึกษาไปข้างหน้า*

ผู้ป่วยที่ได้ทำการศึกษา : *ผู้ป่วยที่จะรับการตรวจวัดลานสายตา ในช่วงระหว่างเดือนมีนาคม 2548 ถึง เดือนสิงหาคม 2548 และเป็นผู้ป่วยใหม่ ไม่เคยได้รับการตรวจวัดมาก่อน*

วิธีการศึกษา : *ผู้ป่วย 35 คน และ 37 คน ช่วงอายุระหว่าง 40 - 75 ปีถูกสุ่มเลือกให้ได้รับวิธีการสอนโดยการใช้คอมพิวเตอร์ช่วย และวิธีการสอนแบบดั้งเดิมตามลำดับก่อนที่จะรับการตรวจวัดลานสายตา ผลการศึกษาดูจากดัชนีความน่าเชื่อถือของการตรวจวัดลานสายตา คือ อัตราส่วนของการไม่จ้องมองที่เป้าจ้องมอง (Fixation losses) และอัตราส่วนของผลบวกเทียม (False positive rate)*

ผลการศึกษา : *ในกลุ่มผู้ป่วยที่ได้รับวิธีการสอนโดยการใช้คอมพิวเตอร์ช่วยมี ค่าเฉลี่ย ± ค่าเบี่ยงเบนมาตรฐาน ของอัตราส่วนการไม่จ้องมองที่เป้าจ้องมอง และ อัตราส่วนผลบวกเทียม (0.23 ± 0.29 และ 0.06 ± 0.11) สูงกว่ากลุ่มผู้ป่วยที่ได้รับวิธีการสอนแบบดั้งเดิม (0.15 ± 0.23 และ 0.03 ± 0.05) นอกจากนี้อัตราส่วนผลบวกเทียมในกลุ่มผู้ป่วยที่ได้รับวิธีการสอนแบบดั้งเดิมยังต่ำกว่ากลุ่มผู้ป่วยที่ได้ได้รับวิธีการสอนโดยการใช้คอมพิวเตอร์ช่วยอย่างมีนัยสำคัญทางสถิติ ($p<0.05$) จากการศึกษานี้ดูเหมือนว่าวิธีการสอนแบบดั้งเดิม จะให้ความน่าเชื่อถือของการตรวจวัดลานสายตาได้มากกว่า*

วิจารณ์และสรุป : *วิธีการสอนการตรวจวัดลานสายตาโดยการใช้คอมพิวเตอร์ช่วย ไม่ได้เปลี่ยนแปลงดัชนีความน่าเชื่อถือไปจากวิธีการสอนแบบดั้งเดิม เมื่อพิจารณาวิธีการสอนโดยการใช้คอมพิวเตอร์ที่ใช้ในการศึกษานี้ ควรมีการพัฒนาปรับปรุงวิธีการให้ดีขึ้น หากเชื่อว่าการนำคอมพิวเตอร์มาใช้ยังเป็นประโยชน์อยู่*

คำสำคัญ : *การตรวจลานสายตาด้วยคอมพิวเตอร์แบบมาตรฐาน, วิธีการสอนการตรวจวัดลานสายตาโดยการใช้คอมพิวเตอร์ช่วย, วิธีการสอนการตรวจวัดลานสายตาแบบดั้งเดิม, อัตราส่วนของการไม่จ้องมองที่เป้าจ้องมอง อัตราส่วนของผลบวกเทียม.*

Preservation of the patient's visual function and quality of life is the ultimate goal of glaucoma management. Visual field is an important function in which will be deteriorating over time if glaucoma progresses. It can be measured in a variety of way. Standard Automated Perimetry (SAP) or white on white perimetry is still acceptable world-wide on indicating patients with glaucoma field damage, though other tests such as Short Wavelength Automated Perimetry (SWAP) or Frequency Doubling Perimetry (FDP) has been claimed indicating several years earlier glaucoma detection than SAP does.[1,2] However, particularly in the detection of glaucoma progression, SAP is still useful. To interpret visual field results correctly, reliability of each test is essential. Untrained subjects need time to learn their new visual field tests and tend to improve their performance in subsequent examinations, learning the effect was found between the first test and the others.[3-5]

Usually, subjects who were about to undergo the visual field evaluation, verbal instruction and demonstration would be given prior to the beginning of the test. In spite of this, many test results were not reliable and subjects needed to repeat testing. Due to this problem, computer-assisted instruction (visual field game) was therefore created in order to get subjects more accustomed to how to do the visual field. As a result, this would reduce the number of unreliable tests and indirectly reduce time and human resource wasting upon repeating measurements.

The purpose of our study was to compare computer- assisted instruction (visual field game) with conventional instruction (document) in visual field test (Humphrey Automated Perimetry).

Patients and Methods

This study was a prospective, randomized trial. Patients who were undergoing visual field testing by Humphrey Automated Perimetry, 24-2 SITA standard at Outpatient Clinic at King Chulalongkorn Memorial Hospital from March 2005 to August 2005 were recruited. Informed consent was obtained from all subjects. The study was approved by the ethics committee of the Faculty of Medicine, Chulalongkorn University.

Inclusion criteria were

1. Subjects who was new to visual field test, and never experienced any visual field test before
2. Age 40 -75 years old
3. Visual acuity of the studied eye was equal to or better than 20/100

Exclusion criteria were

1. Expected advanced visual field loss
2. Poor communication
3. Subjects who had systemic diseases that might affect visual field performance, e.g., Parkinsonism, hyper -or hypo- thyroidism etc.;
4. Subjects who were light sensitive, e.g. migraine.

Collected baseline characteristics were as follows:

1. Gender,
2. Age,
3. Visual acuity (VA),
4. Refractive error, and
5. Ocular diseases.

The subjects were randomized by blocks of four into either using computer-assisted instruction or conventional instruction (document) before performing visual field. Outcome was focused on reliability indices: fixation losses rate and false positive rate. High false negative rate may be found in advanced field loss cases. Therefore, this parameter was not included as an outcome measurement.

Computer-assisted instruction was created by PowerPoint program. It contained text, verbal explanation, photos of perimeter and subject preparation. Simulation of fixation target, appearance and disappearance of light stimuli on an illuminating background was also demonstrated and subjects were allowed to test themselves by tapping on the computer mouse to visualize how stimuli proceeded as it would appear on the bowl of perimeter. Subjects would not get themselves acquainted with the real perimeter before entering the process of real visual field test.

The conventional or paper documentation was listed in text format regarding what and how to do. Subjects had to read and understand the sequence by themselves but they were allowed to see for a few seconds the demonstration from the real parameter as it had been usually done before entering the process of real visual field test.

Mann-Whitney was statistical method used to analyze the results.

Results

A total of 72 patients were recruited into the study. Thirty-five were randomized into computer-assisted instruction group whereas the other thirty-seven were in conventional instruction group. Right eye was usually the first eye tested, and hence right eye visual field was chosen to represent the result. In one-eyed subject, only that eye visual field was recorded. Baseline characteristics of the patients were shown in table 1. Fixation losses rate and false positive rate were recorded and shown in table 2.

Outline of the study

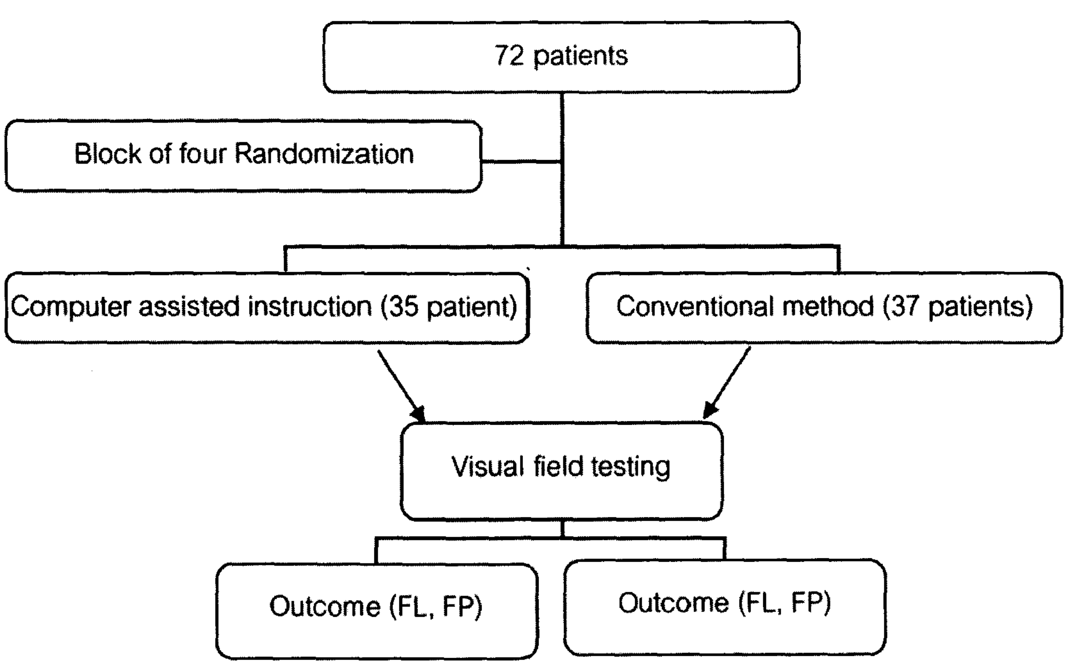

Table1. Baseline characteristics.

Baseline characteristics	Computer-assisted instruction group (N=35)	Conventional method group (N=37)
Gender:		
Male	13 (37 %)	11(30 %)
Female	22 (63 %)	26 (70 %)
Age (mean ± SD):	61.7 ± 7.9	58.35 ± 9.86
Range	(42-75)	(42-75)
40-65 yrs	26 (74 %)	27 (73 %)
66-75 yrs	9 (26 %)	10 (27 %)
VA:		
20/20-20/40	26 (74 %)	30 (81 %)
20/50-20/70	8 (23 %)	6 (16 %)
20/100	1 (3 %)	1 (3 %)
Refractive error (spherical equivalence):		
> +2.00	5 (15 %)	2 (6 %)
plano - +2.00	19 (54 %)	22 (60 %)
-2.00 - -0.01	7 (19 %)	4 (11 %)
< -2.00	4 (12 %)	9 (23 %)
Ocular diseases:		
glaucoma and enlarged cupping	16 (46 %)	19 (51%)
others..........	19 (54 %)	18 (49 %)

Table 2. Outcome of the 2 groups.

Outcome	Computer-assisted instruction group	Conventional instruction group
Fixation losses rate (mean ± SD)	0.23 ± 0.29	0.15 ± 0.23
False positive rate* (mean ± SD)	0.06 ± 0.11*	0.03 ± 0.05*

P < 0.05

Discussion

There have been studies on learning effect in visual field testing. Elliot B et al. reported that there was a learning effect between the first and second automated visual field examinations in glaucoma suspect patients who, in their study, had experience with manual perimetry. A significant improvement was found in short-term fluctuation, total losses and number of disturbed points of the second examination when compared to the first one.[3] Nonetheless, in their previous study in clinically stable glaucoma patients, they found no apparent effect of patient experience with manual perimetry on mean sensitivity, total losses or number of disturbed test locations on automated perimetry.[4]

Heijl A et al. performed a study in normal subjects and they found that sensitivity increased with perimetric training and improvement in sensitivity was more pronounced at peripheral field rather than central field. "Untrained" fields characteristically showed concentric contraction with numerous points of low sensitivity peripherally.[5] This might indicate initial single-printout was not good enough as a baseline and needed to be repeated.

Another study from Heijl A and Bengtsson B about learning effect on automated perimetry in patients with glaucoma showed similar results. Baseline for follow-up glaucoma visual field should be taken more than once.[6]

For example, in an attempt to get the first test to be reliable enough for interpretation, what needs to be considered is the method to train the inexperienced before they enter the real visual field test. In fact, no specific pattern of such training or explanation has ever been described. The usual mode of explanation or training was human one to one teaching. We decided to create a computer program to guide our subjects and then to compare this program to the conventional method we usually used. Outcome was measured in terms of fixation losses and false positive rate as mentioned above.

However, the results were in favor of the conventional method of instruction. Not only both outcomes were less than computer-assisted method, but false positive rate in the conventional group was lower with statistical significance than it was in computer-assisted group. This implies that computer-assisted instruction was not better than the conventional method regarding introduction of subjects to the visual field test. Our subjects might seemingly follow the conventional instruction easier or they did not get familiar with computer use. On the other hand, computer-assisted instruction might not be suitable and needed future improvement. This study, despite non-satisfactory result, would alert us to improve the helping tools for instruction in order to get more reliable visual field outcome, particularly in the first sessions, which would result in reducing our time and human resource on repeating visual field test.

Conclusion

Computer-assisted instruction did not alter the reliability outcome of visual field test by automated perimetry when compared to the conventional instruction. Familiarity to computer might be a limitation or the computer program was not effective enough to work. Regarding the computer-assisted method employed in this study, it certainly needs some improvement if it is still believed useful.

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