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Research Article

Virtual Reality in Visual Field Tests for Early Diagnosis of Glaucoma

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Abstract

Introduction

The Advanced Vision Analyzer (AVA; Elisar) vision technology) is a new portable and lightweight virtual reality perimeter with optics that allows visual field analysis under test conditions compatible with standard automated perimetry with eye tracking and a cloud-based storage system that allows data backup. This work aims to update knowledge aimed at the use of the advanced vision analyzer (AVA; Elisar vision technology) to contribute to the early diagnosis of glaucoma by the graduate in Optometry and Optics.

Methods: For the development of this work, the dialectic method was used as a guiding method, which made it possible to explain and understand the development of the visual field and its essential features. From the theoretical level, analysis-synthesis and induction-deduction were used to interpret documentary information, as well as to obtain the trends that have characterized diagnostic tests of virtual reality visual field. From the empirical level, documentary review was used to present this technology, virtual reality visual field test : advanced vision analyzer (AVA; Elisar Vision technology) .

Conclusions: The AVA equipment is a device that allows to contribute to the early diagnosis of glaucoma. The virtual reality visual field test: Elisar advanced vision analyzer It is carried out through the joint effort of the licensed Optometrist and Optics graduate and the patient. All users must receive appropriate training for the use of the device individually. Professional development was provided to the licensed Optometrist and Optics graduate, in accordance with the AVA instructions for use in a Training that was given to these professionals

Keywords: glaucoma, virtual reality visual field, advanced vision analyzer (AVA)

Introduction

Glaucoma is a chronic and progressive optic neuropathy of multifactorial origin, in which intraocular pressure is the main risk factor. It is characterized by a typical pattern of optic nerve damage and bilateral asymmetric visual field loss. [1].Intraocular pressure is considered the only potentially modifiable causal factor for the purpose of preventing blindness from glaucoma. [2].This disease is the leading cause of irreversible blindness in the world, determined with a prevalence of 76 million people between 40 and 80 years of age with glaucoma in 2020, with a projection of an increase of 111.8 million in 2040. [3].

Cuba has a population of 11,333,483 inhabitants, in the current context of fluctuations in the survival capacity of the Cuban population and the accelerated aging process that is taking place today, where life expectancy at birth reaches 78 years for both sexes . It constitutes the largest percentage of inhabitants over 60 years of age in Latin America (18.2%) and 48.5% of them are 40 years of age or older, which makes it an aging population particularly predisposed to suffer from glaucoma. [4].

All these circumstances make this disease a challenge for the Cuban Health System, for this reason the realization of effective interventions that deal with the promotion and prevention of the disease by the licensed Optometrist and Optics, a professional who performs within his/her healthcare functions, health work in individuals over 40 years of age, ages with a higher risk of suffering from glaucoma, together with the active research in the areas of primary care that is currently carried out by the Ministry of Public Health in Cuba, will allow the identification of patients who present glaucoma in the population and who have no perception of the disease; which favors the early diagnosis of glaucoma.

The Advanced Vision Analyzer (AVA; Elisar) Vision Technology) is a new portable, lightweight virtual reality perimeter with optics that enables visual field analysis under test conditions compatible with standard automated perimetry with eye tracking and a cloud-based storage system that enables data backup. [5].

Elisar algorithm ; this equipment was donated to the Cuban Institute of Ophthalmology Ramón Pando Ferrer approximately one year ago, a leading center for scientific research in the field of Ophthalmology, where this advanced technology has already been put into practice through training for graduates in Optometry and Optics. In addition, scientific research is currently being carried out at this institution on this virtual reality visual field test to contribute to the early diagnosis of glaucoma.

This documentary review aims to update knowledge on the use of the virtual reality visual field test: advanced vision analyzer (AVA; Elisar vision technology).

Methods

For the development of this work, the dialectical method was used as a guiding method, which made it possible to explain and understand the development of the visual field and its essential features. From the theoretical level, analysis-synthesis and induction-deduction were used to interpret documentary information, as well as to obtain the trends that have characterized diagnostic tests of the virtual reality visual field. From the empirical level, documentary review was used to present this technology, virtual reality visual field test: advanced vision analyzer (AVA; Elisar). vision technology).

The keywords used were: glaucoma, virtual reality visual field, advanced vision analyzer (AVA); the databases of Scielo , Pudmed and Google Scholar were used. 25 results were found, in English and Spanish, of which 10 were used because they were the most up-to-date and pertinent. This work takes into account the experience of the authors in the use of the equipment over a period of approximately one year, which was taken into account when carrying out the Training for graduates in Optometry and Optics.

Results

The visual field is the area that is visible to a subject when looking in a fixed direction. Currently, there are automatic methods for both qualitative and quantitative measurement of the visual field. For a normal person, the spatial extension of the monocular visual field is more than 90° away from the nose (or temporally), 60° towards the nose (or nasally) and 50° towards above (or superiorly) and about 70° downwards (or inferiorly). [6].

The purpose of visual field testing is to provide critical information leading to the Early diagnosis, evaluation and monitoring of the progress of eye diseases, especially he glaucoma. [7].

Visual field testing can lead to early detection and treatment of eye diseases. In the case of glaucoma, visual field testing plays a key role in identifying visual field defects and evaluating the effectiveness of the therapy used to control the disease. 7, and requires patients to stare at the machine for long periods. [6,7].

Experts say virtual reality perimetry can improve some of these problems. These devices gained additional attention during the pandemic, when the need for portable remote monitoring tools became more apparent than ever. [8].

The Advanced Vision Analyzer (AVA; Elisar) Vision Technology), is a new portable, lightweight virtual reality perimeter with optics that enables visual field analysis under test conditions compatible with standard automated perimetry with eye tracking and a cloud-based storage system that enables data backup. The AVA incorporates a custom Elisar standard algorithm . [9].

The AVA can be used in both adults and children over ten years of age who need a Diagnostic evaluation. The patient may sit upright or partially reclined. position for performing the test. The test should not be administered in a fully reclined position. [9].

through active screening; although the device is designed to operate without the need for an external power supply during testing, the external power supply is required to charge the device for continuous operation.

Some of the features that distinguish Elisar AVA from other automatic perimeters are : [8].

• **Portability:** The AVA is a VR-based head-mounted device that brings enhanced functionality, intelligence, and convenience to automated perimetry. The AVA comes with a backpack that can be easily carried.

• **Gaze tracking:** The virtual reality-based head-worn device (HMD) eye tracking system is used to monitor the patient's visual fixation throughout the test.

• **No eye occlusion required:** The AVA uses a binocular optical system that separates the stimuli presented to each eye. As a result, there is no need to occlude the eye that is not being tested.

• **No darkroom required:** The AVA does not require a darkroom for visual field testing due to its head-mounted design.

Figure 1: Components of the device, the Elisar Advanced Vision Analyzer . Source: AVA 2022 User Manual.

Elisar 's Advanced Vision Analyzer consists of:

- Head-mounted device (HMD)
- Patient Response Button (PRB)
- Detachable Part Test Controller (TC)

Head-Mounted Device (HMD) – This head-mounted device that the patient wears to perform the test, consists of a series of visual stimuli , which are presented to them on a display built into the device. The patient responds to the presented stimuli by clicking the patient response button. It has a built-in eye tracker that is used to record and monitor the patient's gaze throughout the test. It is battery operated which must be charged from an external power source. when necessary. [9].

Patient Response Button (PRB): This is a wearable device that connects to the head-mounted device via a cable. The patient clicks the Patient Response Button to respond to the stimuli presented. The Patient Response Button is powered by the HMD. This Patient Response Button (PRB) is considered a detachable part of the device. Patient Response Button Dimensions: 120 x 30 mm x 100 mm; Cable Length: 1000 mm.

Test Controller (TC): It is a touchscreen handheld device that connects via network (Wi -Fi) to the head-mounted device. It is used by the device operators to set up and monitor the test during its progression. During the test, the HMD transmits details of the patient's response and live feed of the patient's pupil to the TC via wireless data link. The TC device is powered by a battery that can be charged from an external power source via a micro-USB port. Charging adapter details: micro-USB 2.0 5V, 1A and TC dimensions: 191 x 100 x 8.8 mm. [9].

Discussion

He advanced vision analyzer (AVA) is a novel virtual reality automated helmet perimeter that allows visual field testing in patients with suspected visual field impairment and therefore requires guidelines to be followed by the graduate in Optometry and Optics to perform a correct procedure and thus contribute to the early diagnosis of glaucoma. The AVA has four basic components: a headset or head-mounted device (HMD), a patient response (PR) button, a tablet and a back-end server. [10].

fitted for correction of refractive errors, and the test can be performed without the need to close one eye.

The Goldmann size III stimulus is presented and the patient presses the (PR) button when the stimulus is displayed, after which the response is recorded and saved. The 30-2, 24-2 and 10-2 strategies are built into the device, which houses three types of algorithms: full threshold, standard Elisar and fast Elisar . The AVA has its own normative database built into the device. [8,9].

The eye tracking system tracks eye movements while performing the visual field test, providing a qualitative assessment and helping to verify fixation loss. [8].False positive and false negative detection tests are built into the device; these tests are stringent and help validate the reliability of the visual field test. [8,10].Because AVA is a portable device, it has the potential to be an integral part of telemedicine by allowing visual field testing to be performed even in remote areas of the world. A great improvement in the level of medical care can therefore be achieved. Patient data can be stored in the back- end cloud server and reports can be retrieved when needed. [8].Patients with neck or spine deformities or neurological disorders who are unable to attend the clinic can perform the visual field test comfortably at home.

The AVA has made indelible improvements in the assessment of visual fields and has a far-reaching impact that can improve people's lives with proper diagnosis, which eventually translates into accurate and timely treatment. [10].

Procedures to consider when determining the Virtual Reality Field of View (AVA)

1-Turn on the headset or head-mounted device (HMD) and the tablet.

2-Pair the HMD with the tablet.

3-Sit the patient comfortably.

4-Create a suitable environment.

5-Psychological preparation, giving clear instructions about the test to the patient; if the patient has hearing problems, face him/her while the test procedure is explained.

6-Enter patient number and details.

7-Place the HMD on the patient's head and adjust properly.

8-Select the test to be performed according to the patient's visual impairment and medical indication.

9-Several light points will appear on the HMD like small lightning bolts or flashes, in different areas and with different intensities, and the patient must press a button each time the light flashes, the same as the Octopus.

10-Keep the patient motivated throughout the exam.

11-Emphasize that it is absolutely normal that many of the stimuli cannot be seen, but it is important that you see them immediately and press the button.

12-You will be able to blink normally during the test.

13-You can take a break if you feel like you need to rest for a moment.

14-Perform the same procedure on the other eye (always remember that it does not require occlusion but the examination is performed on each eye separately) 15-At the end of the test, the tablet contains the results of the tests that are automatically saved once the test is finished, where a map of the sensitivity in the points explored in the visual field is observed and an analysis of how the patient performed the test is also attached: false negatives, false positives and loss of fixation.

Conclusions

The AVA device is a device that helps to diagnose glaucoma early. The virtual reality visual field test: Elisar advanced vision analyzer It is carried out through the joint effort of the graduate in Optometry and Optics and the patient.

Success, measured in terms of obtaining reliable results, is achieved by taking the necessary steps and precautions to help the patient perform the test.All users must receive appropriate training for the use of the device individually. Professional development was provided to the graduate in Optometry and Optics, in accordance with the instructions for use of AVA in a Training that was given to these professionals.

Recommendations

In order to use this equipment, we must take into account the procedures incorporated in this work and continue with the professional development of graduates in Optometry and Optics in the use of this equipment from other institutions so that when they must perform using this advanced technology, they can manipulate it and use it effectively to contribute to the diagnosis of glaucoma.

Conflictos de intereses: No existen

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