Evaluation of axial length of the eye in patients with diabetes mellitus

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Setting : 2nd University Ophthalmology Clinic of the National and Kapodistrian University of Athens, PGN "Attikon"

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Introduction

Diabetes mellitus is a chronic disease, characterized by elevated blood sugar levels (hyperglycemia), which are secondarily due to a lack or abnormal insulin resistance.[1]

The incidence of diabetes increases significantly with age.[2] It is the most common endocrine disease and is divided into two types:

a) Type I or insulin dependent, diagnosed in people under the age of 30 (between 10 and 20 years) and occurs in approximately 15% of the total diabetic population. It has been found that this type is associated with greater risk of developing proliferative diabetic retinopathy.

b) Type II or non-insulin dependent, diagnosed at older ages, between 50 and 70 years, and affects the remaining 85% of cases. This type rarely causes the development of productive diabetic retinopathy, but due to its frequency it affects the largest percentage of diabetic patients with ocular complications.

It is worth mentioning that diabetes is considered the most common cause of legal blindness, in people between the ages of 20 and 65, regardless of its type, mainly due to microvascular complications, mainly related to diabetic retinopathy and diabetic macular edema.

Diabetic retinopathy is a serious complication of diabetes mellitus, which presents with characteristic findings in the retina due to biochemical and structural lesions of the retina in response to chronic hyperglycemia, leading to microvascular and leakage.[1,3]

During the early onset of diabetic retinopathy, retinal vessels are disrupted by endothelial cells, thickening of their basement membrane, and a reduction in the number of pericytes resulting in rupture of the inner retina and the development of retinal edema (mainly in the macular area).

In more advanced cases, areas of capillary obstruction develop resulting in retinal ischemia, which leads to overproduction of growth angiogenic factors, such as vascular endothelial growth factor (VEGF), resulting in the development of retinal neovascularization.[1]

Diabetic retinopathy is distinguished into non-productive diabetes (NPDR) and productive diabetes mellitus (PDR), with retinal neovascularization to signal the transition from the non-proliferative diabetic retinopathy (NPDR) to the proliferative diabetic retinopathy (PDR).[1] In NPDR, the lesions are the result of either increased vascular permeability, or obstruction of capillaries and / or arterioles (retinal ischemia) and are located mainly intravaginally.

Clinical signs of NPDR are microaneurysms, retinal hemorrhages, cotton-shaped lesions, capillary lesions and diabetic macular edema, resulting in decreased vision. In addition, depending on its severity and retinal lesions, NPDR is divided into mild, moderate, severe and very severe.

On the other hand, the PDR is characterized by the development of neovascularization, which may start from the retina and extend into the vitreous. In this case, the presence of neovascularization can lead to intravitreal hemorrhage and the development of fibrous connective tissue, which can lead to attractive retinal detachment with concomitant loss of vision.

In recent years, a study effort has been made to determine the association between axial length of the eye and diabetic retinopathy. Studies on this subject are few and usually do not include a control group, but converge on the fact that there is an inverse relationship between axial length of the eye and productive diabetic retinopathy.[4-7]

Purpose

The aim of this study was to evaluate the axial length of the eye in adult patients with type II diabetes mellitus and its possible association with the development and severity of diabetic retinopathy.

Type of Study: Case-Control Study

Materials and Method:

Selection Criteria: Patients (aged 50 to 85 years) with type II diabetes regardless of stage of diabetic retinopathy (approximately 200 patients) and healthy adults of similar age (50 to 85 years) and sex (200 patients) to be used as controls.

Exclusion criteria: Patients with type I diabetes, patients under 50 years of age, patients with strabismus

Imaging and diagnosis tools:

The participants in the study will be ophthalmic cases that are presented and evaluated at the 2nd University Ophthalmology Clinic of the National and Kapodistrian University of Athens, PGN "Attikon" for the annual ophthalmological examination or cataract surgery, in order to measure the value of the eye.

A general history (if they have diabetes, duration and management of diabetes, demographics) and an ophthalmological history (refraction, treatment in case of diabetic retinopathy) will be taken first by the participating ophthalmologist who will be assisted by evaluation for participation in the protocol and its relationship is not a patient doctor. Then, from the history of patients will be divided into two categories: patients with diabetes (study group) or without diabetes (controls).

In all patients, the axial length of the eye will be measured using the IOL Master (Carl Zeiss Meditec AG, Germany). The IOL Master is an optical device of contactless biometrics, which can accurately measure the axial length of the eye, ie the distance from the apex of the cornea to the darkened retinal epithelium, based on the phenomenon of partial coherence interferometry.[8,9]

This technology is characterized by systematic consistency and reliability, as well as extremely high accuracy within the limit of ± 0.02 mm.[9]

The IOLMaster is the first device with these features to be widely used in clinical ophthalmology. Calibrated internal algorithm approximates the distance to the vitreous interface, for the equivalent of the A-scan ultrasonic immersion technique axial length.

Consideringthe fact that the axial length measurements with A-scan ultrasound (using a standard 10-MHz converter) have a standard resolution of 0.10 mm to 0.12 mm, the axial length measurements through the IOLMaster show a fivefold increase to be precise. IOLMaster is the most effective because it allows the measurements to be taken with complete confidence in the accuracy of the results.

In addition, because the device is non-contact, there is no need for anesthesia of the eye, nor is there a potential risk of spreading possible infections to the eye in question.[8] The measurement is easy, painless and without contact.

Calculation of axial length:

In order to calculate the axial length of the examination eye , the device's diode laser (LD) initially produces infrared light of wavelength λ = 780 nm of short coherence, of the order of 160 μm (which roughly coincides with the axial resolution of the system). This means that the contribution will be achieved only if the delays along the path of the interferometer are harmonized within the coherence period of the light source. The above property makes partial coherence interferometry the most suitable method for describing graded or uneven surfaces. After being separated into two coaxial rays CB1 and CB2 by the beam splitter BS1, the light is reflected into the eye by the mirrors M1 and M2. The distance that separates the two rays will be equal to twice the displacement of the mirror M1 (d). Both coaxial - 60 - rays entering the eye, leading to have reflections in both the corneal surface (C), and the pigment epithelium of the retina (R). The difference in frequencies between the coaxial rays exiting the eye (after passing through a second BS2 beam splitter) is detected by the photodetector (PHD). During the measurement, the M1 mirror moves at a constant speed, causing a change in the frequency of the reflected coaxial light detected on the photodetector due to Doppler effect. The displacement d of the retina M1 can be determined with great precision and correlated with the reflected signals detected in the photodetector, thus allowing accurate measurements of the axial length (AL) of the eye (Figure 1) .[10-11]

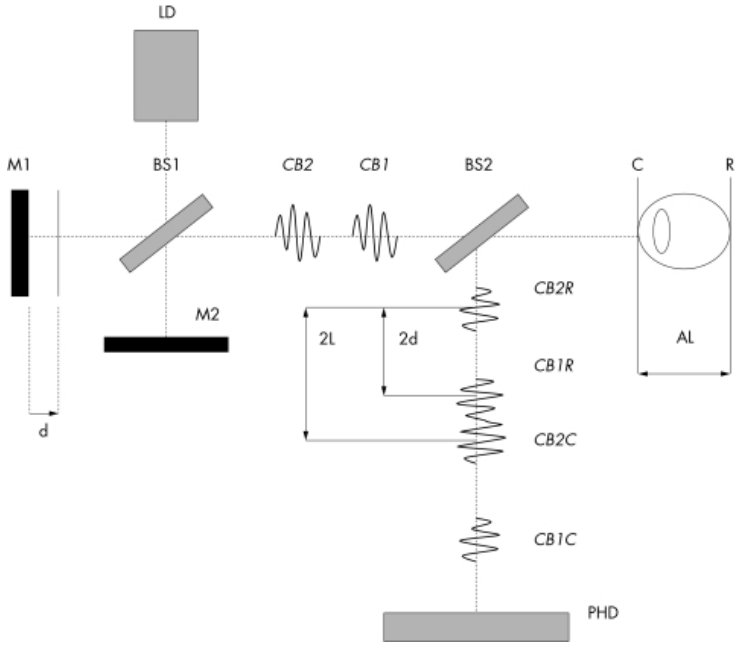

Figure 1: Operating principal of IOLMaster.
Source: A new non-contact optical device for ocular biometry, Br J Ophthalmol. 2002 Apr; 86(4): 458–462. doi: 10.1136/bjo.86.4.458

To determine the axial length of the eye, it is necessary to take at least five measurements (Signal to Noise Ratio - SNR> 2.0) from which the average value is calculated.

During the examination with the IOL-Master the patient is placed in the special socket of the machine, touching the chin and the forehead, as in most ophthalmological machines (Figure 2). The patient looks at a bright target and accordingly keeps his eyes open or opens and closes according to the examiner's instructions. The measurement process takes less than 5 minutes.

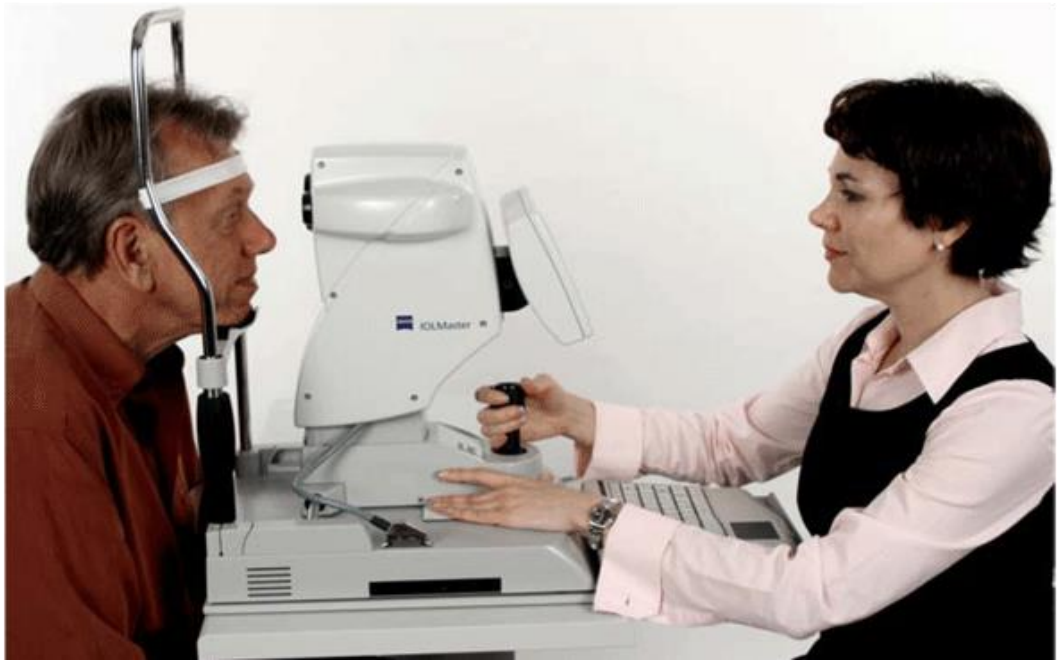

Figure 2: Examination of a patient in the IOL-Master

Source:https://www.reviewofophthalmology.com/article/iolmaster-evolves-new-technology-better-data

Before examining each patient, the areas where he places his head (more specifically forehead and chin) will be disinfected with ethyl alcohol.

Details entered in the machine:

Name - Surname - Year of Birth – Gender

Data used in the survey:

The minimum data from the individual and ophthalmological history of the participants that are related to the research only and which are: name (coded), date of birth, sex and whether they suffer from diabetes or not.

All patients will be screened by the participating ophthalmologist assistant professor to evaluate possible pathological or non-pathological findings and classify diabetic patients according to the stage of diabetic retinopathy.

The axial length of the eye will then be compared between the patients with diabetes and the control group to assess whether the axial length of the eye is related to the presence of diabetes. In addition, multivariate analysis will be used to study the effect of axial length on the stage of diabetic retinopathy, taking into account other data from patients' history (duration and regulation of diabetes, demographics).

Data Storage:

As part of the research we will collect the following research data: name (coded), date of birth, sex and whether patients have diabetes or not. These data are necessary in order to separate the two groups (patients-control group) needed to carry out the research. We will collect the information they give us and record it in digital files.

The information that the patients will give us will be coded in such a way that it will not be possible to reveal their identity to third parties. Also, their identity will not be revealed in possible publications, presentations or scientific reports that will emerge from this study.

All electronic files (including all types of electronic files used, such as databases and spreadsheets) that contain identifiable information will be password protected per patient. Any computer has such files will also have password protection to prevent access by unauthorized users. Only members of the research team will have access to passwords.

The research data and not the personal data as well as your characteristics (age, other diseases) that will be given to us will be stored in the way mentioned above until the completion of this research. The results of this research will be used in scientific publications and in conference papers.

The study will be conducted under the principles of good clinical practice in the Declaration of Helsinki.

Complaints Management Policy:

For any complaints or grievances regarding the conduct of the investigation, the participants will be able to report to the Head of the Investigation - Chandrinos Aristidis tel. 210-5395639, email: achand@uniwa.gr and to PhD candidate Mouzaka Aikaterini tel. Assistant 6958619735 and email: amouzaka@uniwa.gr.

In any case to the Personal Data Protection Authority (complaints@dpa.gr)

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Image Sources

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