

Tonometer through the eyelid diaton: accuracy and quick IOP reading.

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Introduction

Glaucoma is the pathology that mainly stems from intraocular pressure (IOP) rise and leads to intense damage of the visual nerve and loss of vision. It is the second most common cause of blindness worldwide. Nearly 4.5 million people are believed to have become blind due to the run of glaucoma and this number is going to exceed 10 million by 2020.

Glaucoma detection is based on IOP measurement, examination of the visual nerve (correlation “delve - mount”), of the visual field and measurement of the anterior chamber angle.

IOP measuring is the most widely spread way to detect glaucoma from the above-mentioned ones since the percentage of patients suffering from glaucoma whose IOP exceeds 23 mm Hg is really high though there is still a group of patients who have normal IOP. Moreover, very high IOP does not mean that the patient is really suffering from glaucoma, but indicates a very high risk that he is prone to this disease. Therefore, it is necessary to make all diagnostic examinations to confirm the presence of pathology.

There are two types of tonometers suitable for IOP measuring. The first group is invasive tonometers measuring IOP on the cornea. The Goldman tonometer (GAT), Perkins and Icare belong to this group. The second group is contact free tonometers - pneumatic tonometers that measure IOP with the help of the air jet, and the tonometer measuring IOP through the eyelid – diaton.

PROS & CONS OF IOP MEASURING ON THE CORNEA

Tonometry based on cornea measurements, has a number of advantages and disadvantages. The main advantages are as follows:

- a. Cornea is more accessible for tonometry in an open eye than sclera.
- b. There are no other intermediate structures (conjunctiva, eyelid ...) between tonometer and cornea.
- c. Individual differences in thickness and curvature of cornea are less significant compared to other ocular structures.

On the other hand, it has several drawbacks:

- a. Cornea is a tissue with high sensitivity, since the tissue is much innervated. This means that anesthesia is needed for contact tonometry.
- b. Cornea is spherical only in the central zone; it becomes more flat and thick toward the periphery. These differences between the central and peripheral zones may significantly affect the measurement of IOP.

c. When making corneal tonometry it is difficult to prevent the increase in muscle spheroidal and palpebral tone, which causes increase in IOP.

d. When working with contact tonometers the tools should be very carefully sterilized.

e. Corneal tonometry is contraindicated in corneal edema, nystagmus, conjunctivitis, corneal erosion, keratitis and corneal ulcers.

TONOMETER THROUGH THE EYELID: DIATON

Diaton, the tonometer for measuring IOP through the eyelid, was developed by engineers and ophthalmologists; the purpose of the development: the device must be easy-to-operate and portable. It should have sufficient accuracy and quickly measure the intraocular pressure, be useful in diagnosing and monitoring the effectiveness of glaucoma treatment. The main feature of this tonometer: measurement is performed through eyelid, so, the direct contact with the cornea or (conjunctiva) of the mucous membranes is avoided, anesthesia is not required and there is no risk of infection during the measurement of intraocular pressure.

The measuring principle of the tonometer is based on the force analysis that is necessary for the rod movement when pressure is applied to the elastic surface of the eye. The main obstacle: to avoid influence of individual peculiarities of the eye during the IOP measuring procedure.

Technical designers solved this problem in the following way: pressure is applied on the section of 1,5 mm diameter so that the section under the pressure acts as hard surface and allows the rod to conduct the measurement without contact to the eyelid and without pain.

There are different research works, published in peer review tonometry magazines, which were held with the help of the tonometer through the eyelid. In 2005 Sandear et al have found sufficient correspondence between the Goldmann tonometer and the tonometer through the eyelid. They have come to conclusion that the tonometer through the eyelid is a good screening tool. In 2006 Doherty et al 6 stated 0,8 correlation between the reading of the Goldmann tonometer and the tonometer through the eyelid. Moreover, the patients have given their preferences to the tonometry through the eyelid but not to the Goldmann tonometry. On the other hand, as it usually happens to air-puff tonometers or contact free tonometers there is some dissonance with the Goldmann tonometer. This fact is usually explained with the differences in the methodology of measurements used in different research works 8.

IOP DETERMINATION WITH DIFFERENT TONOMETERS AFTER TRASLASIK

Doctor Isabel Cacho, specialist in optics and optometry at Balear Institute of ophthalmology together with Lenticon Laboratories have done a clinical trial of IOP changing after refractive corneal surgery LASIK. IOP is measured before and after refractive corneal surgery LASIK by means of three types of tonometers: contact corneal tonometry based on Goldmann system (Perkins), air-puff contact free tonometry and tonometry through the eyelid (diaton). The purpose of the trial is to estimate the influence of corneal thinning caused by refractive surgery.

Source: IOP screening after LASIK (IBO; Palma de Majorca)

This clinical trial is being continued but preliminary results (25 patients) present very interesting information. While carrying out the clinical trial it was observed that the divergence of IOP readings measured with through the eyelid tonometer is not significant 0,54 mm Hg decrease after surgery. In case of Perkins tonometry IOP decrease was more essential with the difference before and after - 2,48 mm Hg. IOP difference before and after surgery measured with contact free tonometer is more than 5 mm Hg as long as this tonometer is less accurate. On the other hand, the difference between the results before and after surgery of Perkins and diaton is 0,5 mm Hg, and with contact free tonometer the difference is 1,30 mm Hg.

After that the changing of corneal thickness in the central zone and in the peripheral upper part after surgery was studied as well. The observed corneal thinning in the central part is 140 micron which is statistically significant and in the upper part the changing is not prominent - 15 micron.

These data prove that corneal thickness greatly influences the IOP results measured with contact free tonometer. However, after surgery corneal thinning does not influence the results while measuring IOP with the help of through the eyelid tonometer.

CONCLUSION.

Through the eyelid tonometer diaton is a suitable screening tool for IOP measuring in patients with keratokonus, cornea pathologies, or in patients after refractive cornea surgery in order to see cornea thickness influence or some other cornea pathologies influence on IOP measuring result. Moreover, this device is easy, portable, does not require anesthetics, it can be used by a doctor to measure IOP in children, in people with limited mobility, in general, it can be used in each person who needs his IOP to be measured.

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