PRACTICE ADVICE: HOW TO BEST USE YOUR TONOMETER

The following document provides information about measurement of intraocular pressure in optometric practice. This guide is not a substitute for legal responsibilities and optometrists must ensure that they comply with State and Federal Law and Common Law responsibilities.

Intraocular pressure (IOP) is routinely measured in optometric practice. A number of instruments are used for the measurement of IOP and it is important that these instruments are calibrated regularly as described in the manufacturer’s instructions and that appropriate disinfection procedures are followed.

It is recommended that the record of IOP values is accompanied by the time, date and method of measurement and any repeat measurements taken. Any central corneal thickness measurement should also be recorded. If an adjustment to the measured IOP is made due to thick or thin CCT measurement, then the actual measured IOP should also be recorded as well as any variation.

IOP should be measured regularly for patients with:

- Risk factors for glaucoma or a known diagnosis of glaucoma;
  (Although the incidence of glaucoma in patients under the age of 40 is low, optometrists have a responsibility to detect glaucoma whenever it is present. The optometrist must not rely on the IOP alone to determine the presence or absence of glaucoma and must be sure to assess the optic nerve, retinal nerve fibre and other relevant clinical parameters carefully. Thorough assessment of the optic disc requires pupil dilation which should be preceded by tonometry. Visual fields should be assessed prior to Optical Coherence Tomography (OCT) which may be performed (or referral made for performance) where there is any degree of suspicion in the appearance of the optic nerve head. Tonometry is recommended as part of any initial consultation or subsequent full examination unless the procedure is contra-indicated or cannot be performed.)

- symptoms associated with glaucoma (e.g. symptoms of angle closure glaucoma)
- ocular fundus signs associated with glaucoma
- anterior segment signs associated with glaucoma (e.g. narrow angle on Van Herrick or Gonioscopy);
- visual field changes suggesting glaucoma;
- the use of topical corticosteroids
- previous retinal vein occlusion;
- recent monocular refractive changes;
- suspected anterior uveitis;
- diabetes;
- a recent or past history of trauma;
- previous intraocular surgery
- family history of glaucoma.
Measurement of IOP is subject to variability due to:

- normal diurnal variation (as much as 6.8 mmHg in patients with ocular hypertension)
- calibration of tonometers (this assumes a constant value for corneal thickness and rigidity - a thin cornea may be underestimated by up to 5.9 mmHg and a thick cornea overestimated by up to 6.8 mmHg)
- instrument errors
- rounding off errors
- clinician bias
- errors due to corneal astigmatism or to excess or deficient fluid on the cornea

Measurement of IOP should precede pupillary dilation and gonioscopy.

Relative contra-indications for contact tonometry are:

- presence of corneal or conjunctival infections (non-contact tonometry is an option when there are infections);
- significant central corneal epithelial defects;
- significant epithelial basement membrane dystrophy;
- known sensitivity to local anaesthetics;
- suspected perforation of the globe;
- recent corneal surgery
- contact lens wear eg. if the patient has to wear contact lenses directly after their eye examination and has no other correction on that day, tonometry requiring anaesthesia should be rescheduled as soon as possible as the patient should not wear a contact lens on an anaesthetised cornea. Alternatively the patient can wait for 10-15 minutes until the anaesthetic has worn off and then reinsert the lenses.

Note: in some cases non-contact tonometry may be suitable.

**Measurement of IOP in infants, toddlers and pre-school children**

Unless clinically indicated due to presence of signs or symptoms, measurement of IOP in infants and toddlers may not be considered a part of a routine examination. The optometrist must consider whether other signs suggestive of glaucoma exist eg. corneal oedema, increased corneal diameter or a rapid increase in myopia. If these signs are present and the optometrist is unable to perform tonometry, the patient should be referred to an ophthalmologist. Baseline measures of older children may be valuable as a basis for comparison in future examinations.

Non-contact and applanation tonometers are suitable for use with school-age children.

**Correction of IOP with Central Corneal Thickness**

It is important that practitioners factor into their assessment and analysis of a patient’s IOPs the central corneal thickness measured when determining if a patient requires treatment or referral for
Practitioners are encouraged to be familiar with the correction of IOP based on the patient’s central corneal thickness.  

Cleaning/disinfection of tonometers

It is recommended that practitioners have at least two tonometer probes, so that one can be cleaned whilst the other is available for use.

The cleaning/disinfection process should involve:

1. Initial wiping with an alcohol swab or cleaning with mild soap, followed by
2. Rinsing under tap water for 10 to 20 seconds, followed by
3. Soaking for 5 minutes in 3% H₂O₂ or 70% isopropyl alcohol or 1:10 dilution of sodium hypochlorite, followed by
4. Rinsing with water and allowing to dry. If there is not time for air-drying the probe could be rinsed with preserved saline, but it should be dried immediately after this with a lint free tissue (eg. kim wipe) straight from the box, as preserved saline can still become contaminated. Do not use contact lens solution to rinse tonometer probes, as these solutions usually contain lubricants, buffers and so on, which may deposit on the surface of the probe.

Notes:

- Following tonometry, debris is present on tonometer probes and washing or wiping of tonometer probes has been shown to be important in its removal. A five-minute soak in hydrogen peroxide or 70% isopropyl alcohol followed by a cold water wash resulted in the greatest reduction of hepatitis C virus RNA that had been placed on Goldmann tonometer tips and allowed to air dry. Another study found that tonometer prisms soaked for 5-minute in 3% hydrogen peroxide (or 70% isopropyl alcohol or a 1:10 dilution of sodium hypochlorite) were adequately disinfected against most ocular pathogens, except Acanthamoeba.

- Solutions that are toxic to the ocular epithelium must be rinsed from the tonometer probe with water or preserved saline prior to use of the tonometer probe on the eye.

- Where there is evidence of eye infection, non-contact tonometry should be used or tonometry delayed until the condition has resolved.

- Where there is a risk of CJD infection, it is recommended that either non-contact or puff tonometers or tonometers with a disposable plastic cover that is discarded immediately after use are employed. Information on heat and sterilisation methods for tonometers that have come into direct contact with the cornea of a high-risk CJD patient can be found at Australian Government Department of Health and Ageing website.

Non-contact tonometry

- Although non-contact tonometers are not intended to make contact with the cornea or the tears, they may cause “micro-aerosol formation” and may occasionally contact the eye. Concerns regarding such splashback from non-contact tonometers may be addressed by wiping the front surface with an alcohol swab and allowing it to dry between patients.

Disposable prism tonometry

The difference between IOP with disposable prism tonometry and Goldmann reusable prism tonometry has been measured as 0.1 mmHg (SD 1) and 0.29 mmHg (SD 0.54), indicating that the disposable prism is a “reliable, effective, and safe alternative” for screening and for monitoring of
Disposable prisms remove the need for chemical disinfection and remove the risk of cross-infection. Another disposable item, the disposable silicon shield was reported to measure on average 2.09 mmHg (SD 1.23) higher than the Goldman. The Tonosafe disposable prism head averaged 0.14 ± 1.73 mmHg higher than Goldman tonometry and was 0.15 ± 2.40 mmHg higher in eyes with IOP > 21 mmHg.

Alternative devices for IOP measurement

Applanation Tonometry
- Goldmann
- Perkins

Non-contact Tonometry
- Puff Tonometry
- Ocular Response Analyser

Indentation Tonometry
- Tonopen

Rebound Tonometry
- ICare

Clinical Tip: In instances where the reading of a particular tonometer may not reflect other clinical signs, (e.g. high IOPs in the absence of any other ocular disease or manifestation of pathology), it may be prudent to use an alternative device to check the initial reading of the intraocular pressures.

Calibration of applanation tonometer

Ideally, applanation tonometers should be calibrated to check for errors on a monthly basis or more frequently as described in the manufacturer’s instructions. For non-contact tonometers, calibration can only be undertaken by the manufacturer and is recommended annually.

Patient evaluation of IOP

There are a number of methods of tonometry to allow patients to monitor their own IOP but these still tend to be experimental. The value of such instrumentation is dependent on the accuracy of the instrument and the ability of the patient to use it.

- Pressure phosphene tonometry is described as “portable and relatively inexpensive” and does not require topical anaesthesia or direct contact with the eye. It has been reported as reading an average of 0.25mmHg lower and 2.43mmHg higher than Goldman tonometry but another study suggested that the force to generate a phosphene may not accurately reflect IOP.

- The Proview eye pressure monitor has been reported to have significantly lower values compared to Goldman tonometry.
• With repeated measures the reliability of the Ocuton S self-applanation tonometer was reported to increase, but only one in two patients was able to obtain reliable results.18

References
15. Chew GS, Sanderson GF, Molteno AC. The pressure phosphene tonometer-a clinical evaluation. Eye 2004 Jun 11