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Abstract

This manuscript is a guide to using the Goldmann Applanation Tonometry Eye (GATE). This device permits the student to learn applanation tonometry without the anxiety of using human subjects. Detailed instructions accompanied by photographs are presented. A brief theoretical discussion of Goldmann applanation tonometry is included.

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**GOLDMANN APPLANATION TONOMETRY EYE
PROCEDURES MANUAL**

By

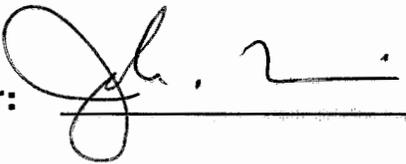
JOHN W. COLVIN

A thesis submitted to the faculty of the
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Pacific University
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Adviser:

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Signature Page

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BIOGRAPHY

John W. Colvin received his Bachelor of Science degrees from Colorado State University (Fort Collins, Colorado) in Microbiology and Biology. Following this education, he was a Research Microbiologist for the Environmental Protection Agency in Fairbanks, Alaska investigating bacterial growth dynamics following infusion of crude oil into subarctic river water. Results of this study were presented to the Alaska Conference on Polar Studies which was internationally attended by arctic researchers.

For eight years, as head chemist for the City of Loveland in Colorado, his activities included supervision of the laboratories and representation for the City in state and local water quality issues. During this time, he was also an instructor for the Colorado Department of Health teaching water and wastewater treatment theory and mathematics for which he received the Award for Outstanding Teaching Service given by the Department of Health.

While in optometry school at Pacific University, he has joined many optometric organizations including the AOA, Contact Lens Section, Low Vision Section, Colorado Optometric Association, and COVD. In addition, he has been accepted into the BSK organization. His preceptorship was at Fitzsimon's Army Hospital in Aurora, Colorado followed by a preceptorship at a private optometric clinic in the same city.

He is married to Susan and has three children: Bennett, Grant, and Matthew.

ABSTRACT

This manuscript is a guide to using the Goldmann Applanation Tonometry Eye (GATE). This device permits the student to learn applanation tonometry without the anxiety of using human subjects. Detailed instructions accompanied by photographs are presented. A brief theoretical discussion of Goldmann applanation tonometry is included.

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I wish to extend my sincere thanks to Dr. Lee Ann Remington for her suggestions and willingness to accept another thesis student. Gratitude is expressed to Dr. Nada Lingel for her many useful suggestions and slides. My wife, Susan, and kids (Bennett, Grant, and Matthew) are thanked for providing the important balance between profession and life.

This manuscript is primarily a guide to using the Goldmann Applanation Tonometry Eye (GATE). Procedures discussed here do not supplant didactic or clinical instruction an individual receives in formal training for human eye applanation tonometry. The GATE does provide the student with a means of practicing his/her first attempts at applanation tonometry under conditions far less anxious than if using human subjects.

The GATE is constructed of a plastic body, posterior 1-way air valve, and anterior membrane. The membrane, cut from a latex balloon, simulates the human cornea for training purposes. After spraying the membrane with the * fluorescein solution, visualization of the ghost rings and applanation mires is fairly effective with the GATE. The GATE is secured to a wooden support bar that is attached to the slit lamp.

Utilizing the GATE requires 6 steps:

- (1) Secure the membrane with an O-ring.
- (2) Inflate the GATE.
- (3) Attach the wooden GATE support to the slit lamp.
- (4) Secure the GATE to the wooden support.
- (5) Apply the fluorescein solution with the spray bottle.
- (6) Perform applanation tonometry.

*The fluorescein solution was formulated using Crystal Clear[®] lens cleaner in which approximately 20 FUL-GLO[®] fluorescein strips were rinsed several times.

Secure the membranes

Stretch one latex membrane over the open end of the GATE body. While maintaining tension, roll an O-ring over the membrane and down about 1/2". Roll a second O-ring over the membrane to further secure the membrane. If necessary, tug at the loose edges of the membrane to smooth it out so that folds and wrinkles are not present.

Inflate the GATE

Insert the ball inflating needle into the 1-way valve and inflate with the air pump. This may take some practice and trial and error to find an acceptable amount of inflation. Care must be exercised not to overinflate so as to force the membrane out from under the O-rings.

Secure the GATE to the wooden support

Place the GATE in the the center of the support and stretch a rubber band over it.

Attach wooden GATE support to the slit lamp

The wooden GATE support is attached to the patient side of the slit lamp chin rest support arms with heavy duty rubber bands. A rubber band is stretched from each end hook, around a chin rest support arm, and back to the end hook.

Spray the GATE membranes with the fluorescein solution

The membrane is sprayed with a fluorescein-detergent solution just prior to performing applanation tonometry. Use only enough spray to achieve adequate coverage. Do not wait too long before tonometry or the solution film will dry.

Clinicians are frequently surprised that applanation tonometry can be performed without fluorescein, but unfortunately it has been demonstrated that this technique underestimates IOP by an average of 5.62mm Hg (Roper 1980).

Perform applanation tonometry

1. Set up the slit lamp with a bright, wide cobalt beam. The illumination arm is positioned at approximately 45° . Set magnification at about 15X. Position the Goldmann probe facing forward. Adjust the probe measurement dial to about 10mm Hg.
2. Looking outside of the instrument, align the probe at the apex of the membrane using the vertical control of the slit lamp.
3. Observing through the oculars, advance the probe toward the GATE.
4. Notice, if you are properly lined up, blue 'ghost' rings (Figure 1) will come into view and may be used to improve alignment by centering these rings before coming into contact with the eye.
5. Yellow mires suddenly come into view when the probe touches the eye or 'tear film' of the eye. Appropriate alignment of the mires has occurred when they have just overlapped (Figure 2). If the mires are widely overlapped (Figure 3), the measuring dial on the tonometer housing must be turned down as the pressure in the eye is less than the apposition force of the probe. Conversely, if the mires are separated from each other (Figure 4) the dial must be turned up to increase the applanating force. If the probe is not centered properly (Figure 5), it is necessary to move it toward the larger of the mires.
6. Withdraw the probe straight back after aligning the mires.

7. Always disinfect the probe appropriately, e.g. alcohol wiping, before using on human subjects.

Additional notes:

- *Move the slit lamp controls around to get a feel for how the mires can be centered. If you see mires but the adjusting dial does not change their position, then you may need to move the probe forward just slightly with the joy stick to achieve contact with the membrane.
- *If the mires are underlapped and you can't get overlapping then the GATE has too much pressure in it. It must be reinflated with less pressure.
- *The GATE is not intended to be a calibrating device for standardizing applanating devices.

Observation of Mires

Figure 1. Ghost rings seen just before contacting the membrane.



Figure 2. Yellow mires correctly overlapped for measurement of IOP.



Figure 3. Mires overapplanated--applanation pressure must be reduced to achieve correct overlapping.



Figure 4. Mires underapplanated--applanation pressure must be increased.



Figure 5. Mires off-center--move probe in direction of most extensive mire to achieve correct centering.



Theoretical considerations of Goldmann applanation tonometry

Most tonometers require the use of a force applied to the eye and the simultaneous measurement of the deformation produced (Chandler and Grant 1979). The principle of Goldmann applanation tonometry employs a standard deformation and the force needed is quantified. Its utility is based on a modification of the Imbert-Fick Law. The basic law states that an external force (W) against a sphere equals the pressure in the sphere (P_t) times the area flattened (applanated) by the external force (A) (Figure 6).

$$W = P_t \times A$$

This formula is correct if the sphere conforms to the following criteria: It is (1) exactly spherical, (2) completely flexible, (3) infinitely thin, and (4) dry. Of course, the human cornea (or any other cornea) fails to meet those criteria, therefore it is necessary to modify the formula. Additional considerations must include the fact that the cornea is wet and therefore has an inherent surface tension (S) which tends to pull the applanating surface onto the cornea. The rigidity (B) of the cornea requires that a force bend it. Since the cornea has a measurable thickness (approximately 0.55mm) an applanating force will result in a larger outer area of flattening (A) than the inner flattened area (A_1) (Figure 7). It has been shown that central corneal thickness has a positive correlation to IOP. Thick corneas translate to higher applanation measurements (Ehlers and Bramsen 1975). Goldmann applanation tonometry may thus be described by a modification of the Imbert-Fick Law:

$$W + S = P_t A_1 + B$$

Imbert-Fick Law

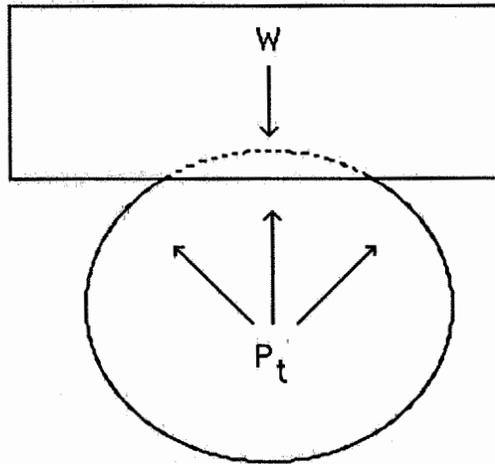


Figure 6

Forces Affecting Applanation Tonometry

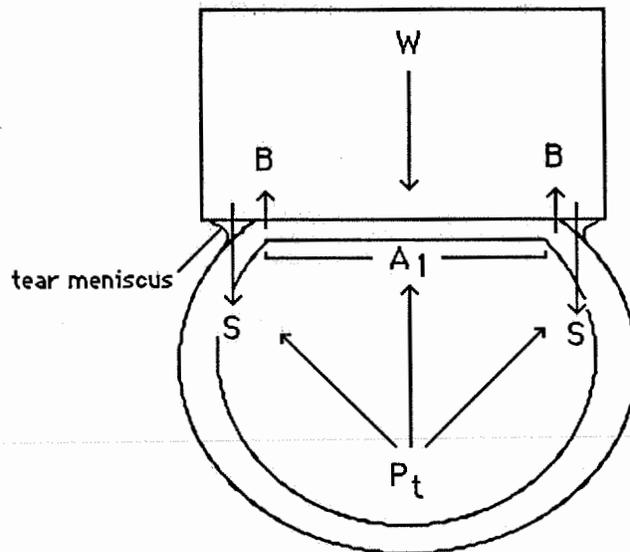


Figure 7

A study of the excised human cornea mounted on a chamber connected to a manometer reservoir confirmed that applanation tonometry is represented by the modified Imbert-Fick Law provided that the diameter of the external applanated area is 3.06mm (Gloster and Perkins, 1963).

BIBLIOGRAPHY

- Chandler, P. A., Grant, W. M. Glaucoma, 2nd Ed., Lea and Febiger, 1979.
- Ehlers, N. and Bramsen, T. Acta Ophthalmology, supp., Vol. 125, 32, 1975.
- Gloster, J. and Perkins, E. S., Experimental Eye Research, Vol. 2, 274, 1963.
- Gloster, J. Tonometry and Tonography. Little, Brown, and Co. Vol. 5, No. 4, Dec. 1965.
- Roper, D. L., American Journal of Ophthalmology, 90, 668-671, Nov. 1980.