INTRODUCTION

In the early 1800s, Sir William Bowman, an English ophthalmologist, recognized the relationship between “hardness” of the eye and the structural optic nerve changes that we now identify as glaucomatous optic neuropathy.

Since that discovery, a great emphasis was placed on obtaining accurate measurements of intraocular pressure (IOP).

However, biomechanical properties of the anterior segment, such as hydration, elasticity, hysteresis and rigidity, have substantial and widely variable influence on IOP measurement.

So, achieving accurate estimates of intraocular pressure remains difficult ***(Michael Sullivan, 2008)*.**

Early efforts to monitor IOP primarily involved indentation techniques, which essentially measured how easily the globe was compressed; these techniques were highly dependent on rigidity of the ocular tissue.

Thus, they typically overestimated true IOP in eyes with more rigid corneas and underestimated true IOP in eyes with softer corneas**.**

Later on Maklakoff tonometer was replaced by Schoitz tonometer, which was developed in 1905. Schoitz tonometer is an indentation tonometer ***(Schoitz, 1905)*.**

Schiotz tonometry, the best known form of indention tonometry, was first used to estimate IOP in the early 1900s.

In the late 1940s, Jonas Stein Friedenwald, M.D., who was building on the work of Hjalmar Schiotz, developed a method to improve Schiotz IOP estimates by accounting for corneal rigidity. ***(Friedenwald, 1949)***

Goldmann applanation tonometry was discovered in the mid-1950s.and quickly became the preferred method to measure intraocular pressure, primarily because it is far less affected by ocular rigidity than Schiotz tonometry ***(Broman et al, 2007).***

However, Goldmann assumed that there was minimal variation in corneal biomechanical properties, including central corneal thickness (CCT), between individual patients. Since then, research has shown that individuals demonstrate wide variations in corneal biomechanical properties ***(Singh et al, 2001).***

It has been estimated that a measurement error of between 0.11 and 0.71mmHg occurs per 10 mm deviation from the average CCT of 550 mm ***(Herndon, 2006)***.

Although GAT may be less prone to biomechanical influence than Schiotz tonometry, it is clearly affected by ocular biomechanical influences as well ***(Doughty and Zaman, 2000).***

The GAT despite being the most reliable tonometer, there are numerous sources of errors that may influence its validity, so other new tonometers begin to appear to avoid these errors ***(Stuckey, 2004).***

Several studies have been performed in the past to determine the rigidity (elasticity) of the cornea. It argued that intraocular pressure(IOP) measured by the applanation tonometer does not always give a true reading***(Liu J and Roberts,2005)*** Recent studies have demonstrated the importance of central corneal thickness (CCT) measurements as a measure of ocular rigidity,i.e. IOP values deviated when CCT, curvature or biomechanical properties varied from normal value***(Brandt et al,2005)***.

We set out to compare the GAT with a relatively new instrument that is designed to produce IOP readings less dependent on CCT; the ocular response analyzer (ORA; Reichert, Buffalo, NYFsoftware version 1.10)

Ocular Response Analyzer is designed to improve the accuracy of IOP by using corneal biomechanical data to calculate a biomechanically adjusted estimate of intraocular pressure. Using a precisely metered, progressively escalating pulse of air, the Ocular Response Analyzer acquires corneal biomechanical data by quantifying the differential inward and outward corneal response to an air pulse over a time span of approximately 20 milliseconds ***(Reichert web site)***

The corneal hysteresis phenomenon is a result of viscoelastic dampening in the cornea due to the combined effect of the corneal thickness and rigidity. In other words, the tissue's ability to absorb and dissipate energy. Studies have shown that subjects whose corneas exhibit low corneal hysteresis, which can be thought of as having a "soft" cornea, are probable candidates for a variety of ocular diseases and complications ***(Brandt et al, 2005).***

It has been shown that the elastic and viscoelastic properties of the cornea are related, making possible the use of the hysteresis measurement to arrive at a more accurate measurement of IOP less influenced by corneal properties such as central corneal thickness (CCT) and does not appear to drop artificially post-LASIK.., present a complete characterization of the cornea's biomechanical state, which has potential uses in screening refractive surgery candidates and predicting/controlling outcomes.

Once the air pulse induces the desired indentation/applanation, it symmetrically reverses, which allows the cornea to resume its original shape. Because a time lag is necessary to activate the reversal of the air pulse, the cornea actually indents mildly beyond the intended applanation point. This action permits the detection of a second applanation point, as the cornea returns from its overapplanated state. Using the first applanation pressure point (P1) and the second applanation pressure point (P2), the Ocular Response Analyzer generates two separate IOP output parameters.

- Goldmann-correlated IOP(IOPg)

The average of the inward (P1) and outward (P2) applanation pressures. This parameter is closely correlated with GAT-IOP ***(Pepose et al, 2007).***

- Corneal-compensated IOP(IOPcc)

It is derived from both IOP and corneal biomechanical data.

Several published clinical studies have reported that IOPcc is unrelated to central corneal thickness ***(Medeiros et al, 2006).***

- Corneal Hysteresis and Corneal Resistance Factor

The ORA supplies two additional parameters that reflect biomechanical properties of the cornea and demonstrate inter-individual variation: corneal hysteresis (CH) and corneal resistance factor (CRF).

During the Ocular Response Analyzer measurement process, the cornea absorbs some energy from the initial air pulse, which causes the second applanation pressure measurement to be lower than the initial measurement. The difference between the two pressures is CH ***(Johnson et al, 2007).***

It is an indicator of viscous damping in the cornea during inward and outward applanation pressure events that is the ability of the tissue to absorb and dissipate energy. ***(Netto, 2005).***

This thesis study is to evaluate the clinical applications of the ORA measurements in different fields as in glaucoma, refractive surgery and Keratoconus.