52-Relationship of corneal thickness and measured intraocular pressure

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Recently, clinicians have begun to have an awareness that corneal thickness may influence the measurement of intraocular pressure (IOP). This is one case where the glaucomologists owe something to their refractive colleagues. This is because this relationship was first widely noted when measured IOP was observed to decrease following iatrogenic corneal thinning by photorefractive keratectomy (PRK). These observations have lead researchers to question one of the fundamental assumptions of Goldman applanation tonometry: that it is independent of corneal thickness.

Sunil Shah, MD, of Manchester, England, attempted to examine this relationship between corneal thickness and IOP in a non-refractive population. Dr. Shah, along with eleven co-authors from the same institution, examined patients with either no glaucoma (normals) primary open angle glaucoma (POAG), normal tension glaucoma (NTG), and ocular hypertension (OHT).

854 consecutive eyes observed by the first author were included in the study. In order to eliminate inter-observer bias, eyes observed by the other authors were eliminated from the final sample.

Corneal thickness was measured by ultrasonic pachymetry in 308 clinically normal eyes, 376 eyes with POAG, 54 eyes with NTG, and 242 eyes with OHT. Intraocular pressure was measured by Goldman applanation tonometry.
Mean corneal pachymetry was 555 um in normals, 551 um in POAG, and 577 um in OHT, versus only 515 um in NTG.

Mean corneal thickness was significantly less in NTG patients compared to patients with either POAG or OHT, as well as normals. Conversely, patients who had been classified with OHT had the largest mean corneal thickness of any group.

These results have two clear implications. First, some patients who have been classified with NTG may in fact have POAG, with spuriously “low” or “normal” measured IOPs, secondary to their thinner corneas, which require less force to applanate. Similarly, a subset of patients previously classified with OHT may, in fact, have truly normal pressures, and not be at risk for developing glaucoma--their “high” measured IOPs merely being a function of their thicker corneas. Only direct intraocular pressure measurement will be able to finally resolve these questions.

But for now, beware of those patients with a corneal thickness greater than 585 um without typical visual field or disc progression. These patients may carry an incorrect diagnosis of OHT, according to Dr. Shah. Such patients, in his opinion, actually have a very low risk of suffering visual loss, their “high” IOPs being purely the result of measurement error.

Conversely, it is those subset of patients classified with NTG who have a corneal thickness greater than 540 um that may truly have this disease, rather than falsely low pressures due to measurement error because of their thin corneas. This paper was discussed by Jacob T. Wilensky, MD, of Chicago, IL. Dr. Wilensky mentioned that the first report of spuriously high IOP due to a markedly thickened cornea was in 1978. Nevertheless, it took almost two decades for ophthalmologists to seriously question Goldman’s contention that central corneal thickness should have little effect on applanation readings.

Dr. Wilensky pointed out several weaknesses in methodology, in the study by Dr. Shah, for example, the lack of any data about glaucoma medications used, the lack of longitudinal follow-up, and the relatively high percentage of patients in the current study with abnormally thin or thick corneas compared to other studies. Dr. Wilensky also raised the question of whether scleral rigidity also affects applanation readings.

Dr. Wilensky then pointed out that, at least in studies of diurnal curves, it is the peak, rather than the mean IOP which is the greatest determinator of visual loss. This fact lead him to question how clinically significant is the relationship between corneal thickness and IOP.

It may be premature to require nomograms incorporating corneal thickness in the measurement of IOP. The need for further studies on this topic with larger numbers and longer longitudinal follow-up, however, cannot be debated.