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Tobacco Smoking and Its Impact on Corneal Biomechanics

In their excellent study, Sahin et al.[1] investigated the effect of diabetes mellitus on various corneal biomechanical parameters, as measured by the Ocular Response Analyzer (ORA; Reichert, Inc., Depew, NY). The rationale of their study is very interesting. To my surprise, the authors showed a decrease in corneal hysteresis (CH) rather than the expected increase. Several factors suggest that diabetes mellitus would actually enhance corneal biomechanics by an increase in the cross-linking rate: First, an earlier retrospective study showed a lower incidence of keratoconus in diabetic patients, suggesting that corneal biomechanics are enhanced in diabetic corneas.[2] Second, the nonenzymatic glycosylation of proteins (Maillard reaction) that is prominent in diabetes mellitus, results in the formation of advanced glycosylation end products (AGEs). AGEs induce cross-links between connective tissue collagen and increase tissue rigidity, especially in the presence of glucose.[3,4]

Similar to diabetes, tobacco smoking represents a source of AGEs, and moreover, by-products of cigarette smoke, such as nitrogen oxides, nitrite, and formaldehyde, induce cross-links between collagen fibers.[5–7] A recent epidemiologic study showed that the incidence of keratoconus in smokers is considerably lower than in the nonsmoking population,[6] and we have recently performed a prospective comparative case series to investigate the effect of chronic tobacco smoking on corneal biomechanics using the ORA. Our results showed that chronic smoking increases corneal rigidity in a statistically significant manner.[8]

The study by Sahin et al.[1] shows the opposite and was performed in Turkey. From 1990 to 1999, Turkey had the second highest growth rate in cigarette consumption in the world, and in 1999, Turkey accounted for 2.2% of the total world cigarette consumption.[8,9] Therefore, accounting for the smoking status of the participants in this study would be essential for the outcome and might have significantly altered the results. The authors could not be aware of the influence chronic tobacco smoking might have on their results, because at the time of publication of their study our paper, now published, was in press.[8]

I therefore suggest that Sahin et al.[1] determine the smoking status of their patients and perform the statistical analysis in light of their findings.

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Lack of Statistical Power and Refractive Outcomes

We read with great interest the article by Raymond et al.[1] on a randomized controlled study comparing refractive outcomes after cataract surgery using applanation ultrasound (US) or partial coherence laser interferometry with the IOLMaster (Carl Zeiss Meditec, Dublin, CA). The purpose of the study was to assess whether these methods of measurement of axial length have a difference in precision of refractive outcomes. There are two aspects of the design of this study that compromise its conclusions.

The authors state that the trial was powered to detect a difference of 0.24 D in mean absolute error (MAE), without explaining the reasons or providing any evidence of why a difference of <0.24 D is not clinically significant. We can only assume that a level of 0.24 D was selected because of evidence supporting that a change of 0.25 D in spherical equivalent has an impact on unaided visual acuity.[2] A level of 0.24 D in MAE can actually have a big impact on refractive outcomes. For example, Olsen[3] discovered a difference at 0.23 D in MAE between applanation US and IOLMaster biometry (0.65 D vs. 0.43 D). This result translated to improved refractive outcomes from 45.5% and 77.3% for applanation US to 62.5% and 92.4% for IOLMaster for deviations of ± 0.5 and ± 1.0 D from the expected outcome ($P < 0.00001$).[3] According to the criteria set for the study by Raymond et al.,[1] this level of improvement in refractive outcomes is not clinically significant. There have been no clinical studies validating a specific level of clinical significance for MAE in the setting of refractive outcomes after cataract surgery.

MAE is a measure of the spread (precision) of a distribution assuming a mean numerical error (MNE) of 0. When the MNE is not 0, the MAE is increased, and it no longer quantifies spread (precision) alone but is also affected by inaccuracy. The authors' decision not to use optimized IOL constants but to use those recommended by the manufacturer (118.9 for IOLMaster and 118.7 for applanation US) could have introduced systematic errors from high MNEs and further compromised the