Smoking and Corneal Biomechanics

Dear Editor:

Changes in the biomechanical properties of the human cornea play an important role in the pathogenesis of corneal dystrophies such as pellucid marginal corneal degeneration and keratoconus. The latter primarily affects young people and is a leading cause of severe visual impairment. Keratoconus is characterized by weakened corneal biomechanics that leads to progressive bulging and thinning of the cornea.[1] Spoerl et al[2] have shown recently that the incidence of keratoconus is distinctly reduced in smokers suggesting that smoking improves the biomechanical properties of the cornea. This hypothesis is further supported by studies showing that cigarette smoke contains compounds that enhance corneal biomechanics: formaldehyde crosslinks the cornea and experimentally increase the tissue's resistance to collagenases.[3,4]

We investigated potential changes in the biomechanical properties of the cornea in chronic smokers and nonsmokers using the Ocular Response Analyzer (ORA), a device that utilizes a dynamic bidirectional applanation process to measure biomechanical parameters.[5] We conducted a prospective comparative case series study including 110 eyes (56 eyes from nonsmokers and 54 age-matched eyes from chronic smokers). The study was approved by the institutional review board of the canton of Zurich and adheres to the tenets of the Declaration of Helsinki. All subjects provided written informed consent to participate. Patient age ranged from 20 to 69 years (nonsmokers: mean age 44.7 years, median age 46.0 years; smokers: mean age 44.3 years, median age 43.0 years). Inclusion criteria for smokers were current smoking and a smoking history of at least 10 pack years. A pack year, as defined by the National Cancer Institute, was calculated by multiplying the number of packs of cigarettes smoked per day by the number of years the person has smoked (www.cancer.gov/Templates/db_alpha.aspx?CdrID=306510).

Nonsmokers were defined as those who had never smoked. Scheimpflug analysis was performed in all eyes to rule out corneal ectatic diseases. The main parameters for corneal rigidity, as measured by the ORA, are the Corneal Resistance factor (CRF) and Corneal Hysteresis (CH). In smokers, we observed statistically significant increases of CRF ($P<0.0001$, Student t-test) and CH ($P = 0.02$, Student t-test, see Table 1).

In conclusion, our results suggest that chronic smoking has a beneficial effect on corneal biomechanics. Obviously, we do not recommend tobacco smoking in patients suffering from keratoconus due to the associated health risks. However, the relationship between chronic smoking and corneal biomechanics observed here may help the clinician to better assess the speed by which keratoconus will probably progress.

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References

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Table 1. Ocular Response Analyzer Readings: Differences in Corneal Biomechanical Properties in Nonsmokers vs Smokers

	Nonsmokers (n = 56)	Smokers (n = 54)	*P* Value
CRF	10.6±2.0	11.6±2.0	0.000013211*
CH	10.2±2.0	10.7±2.1	0.02*

CH = corneal hysteresis; CRF = corneal resistance factor.
Statistical analysis was performed using Student *t*-test.
*$P<0.05$.