Abstract

Purpose:

To test whether verteporfin with a nonthermal laser increases corneal mechanical stiffness and resistance to enzymatic degradation ex vivo.

Methods:

Thirty human corneas (n = 5 per group) were treated with verteporfin alone (V), irradiated with nonthermal laser therapy (689 nm) alone (NTL), or received combined treatment of verteporfin with nonthermal laser therapy for 1 sequence (V+NTL1) or 6 sequences (V+NTL6) of 1 minute of NTL exposure. Positive controls were pretreated with 0.1% riboflavin/20% dextran every 3 to 5 minutes for 30 minutes and irradiated with ultraviolet light type A (λ = 370 nm, irradiance = 3 mW/cm) for 30 minutes using the Dresden protocol (R+UVA). Untreated corneas were used as negative controls. The corneal biomechanical properties were measured with enzymatic digestion, compression, creep, and tensile strength testing.

Results:

V+NTL6- and R+UVA-treated corneas acquired higher rigidity and more pronounced curvature than untreated corneas. The stress-strain tests showed that V+NTL6 and R+UVA corneas became significantly stiffer than controls ($P < 0.005$). The V+NTL6 group seemed to be slightly stiffer than the R+UVA group, although the differences were not statistically significant. V+NTL6 corneas were found to have a significantly lower absolute creep rate (-1.87 vs. -3.46, $P < 0.05$) and significantly higher maximum stress values (7.67 vs. 3.02 $P < 0.05$) compared with untreated corneas.

Conclusions:

Verteporfin-NTL (V+NTL6) increases corneal mechanical stiffness and resistance to enzymatic collagenase degradation. Although a clinical study is needed, our results suggest that V+NTL6 induces corneal cross-linking and corneal biomechanical changes that are similar to those induced by standard corneal collagen cross-linking.

First Author: : S.Alageel SAUDI ARABIA
Co Author(s): : J. Ciolino A. Kozak *USA*

Massachusetts Eye and Ear Infirmary .Boston. MA. USA.

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