Contact Lens Update
CLINICAL INSIGHTS BASED IN CURRENT RESEARCH

Corneal and conjunctival sensitivity in intolerant contact lens wearers

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Paul Murphy is a Professor at the School of Optometry and Vision Science, University of Waterloo.

What is the source of symptoms in patients who develop discomfort during contact lens wear? Is it the cornea, the eyelid, the bulbar conjunctiva? Early studies on contact lens wear that sought to answer this question assumed that the cornea was the cause, since it was known to be highly innervated with sensory nerve endings. Thus, studies published at that time principally investigated the effect of contact lenses on corneal sensation, with less consideration of responses from, or changes in, the sensitivity of the bulbar conjunctiva or palpebral conjunctival lid margin. These studies deduced, at least in early, low oxygen permeability materials, that adaptation to lens wear occurred through a combination of reduced oxygen supply and adaptation of the corneal nerves.[1,2]

With the advent of higher oxygen permeability materials, and the 'victory' of oxygen supply to the cornea, there was some debate as to whether this effect would be of benefit to the corneal nerves – or correspondingly result in an unwanted outcome of higher nerve function and increased sensitivity. It is hard to say if either of these effects occurred, but the advent of these lens materials did not prove to be the magic bullet everyone hoped for.[3,4] Instead, discomfort associated with wearing lenses became a more conscious problem for contact lens fitters and researchers, ultimately leading to the publication of the recent extensive TFOS report on contact lens discomfort.[5]

So, back to the first question: where do the symptoms of contact lens discomfort arise from? A paper by Stapleton et al.[6] attempts to address this important question, reporting on a study that assesses the function of the upper tarsal conjunctiva – an area already associated with contact lens wear discomfort through the observation of staining arising from lid wiper epitheliopathy.[6]

Stapleton F, Golebiowski B, Skotnitsky C, et al. Corneal and conjunctival sensitivity in intolerant contact lens wearers. J Optom 2015;8: 62-3.

The authors used a non-contact aesthesiometer – the CRCERT-Belmonte instrument.[7] This instrument aims a controlled air-pulse at the ocular surface to produce a variety of stimuli – mechanical (deformation of the surface by air-pressure), temperature (either heating or cooling of the airflow to transfer a thermal effect) and chemical (a slight acidic stimulus produced by using CO_2 gas, which dissolves in the tear film). The range of stimulus intensity is produced by varying the flow rate of the air-pulse from levels below any sensation to above this level, to find the threshold for sensation. For this study, only the mechanical stimulus was used, by heating the airflow such that it would match the ocular surface temperature (34°C) when it reached the eye, and the resulting airflow is thought to therefore have a negligible thermal effect, either of heating or cooling.

Subjects recruited were a mixture of experienced lens wearers and non-lens wearers. All of the nine lens wearers (two males and seven females) had self-reported discontinuation of daily lens wear due to discomfort. The ten non-lens wearers (two males and eight females) were approximately age-matched to the lens wearing group.

None of the subjects had a history of previous corneal or ocular pathology.

Since the authors had an interest in discovering contact lens-related sensory nerve changes at ocular surface locations that might be affected by contact lens wear, sensation thresholds were assessed for the central cornea, a location in the inferior cornea (2mm above the limbus), in the inferior bulbar conjunctiva (2mm below the limbus) and at the midpoint of the tarsal conjunctiva of the everted upper eyelid.

The researchers found that sensation thresholds were different between the four test locations, and that sensation was affected by contact lens wear. Sensation was highest in the cornea and lower in the conjunctiva, as per previous study findings.[7,8] Contact lens wear produced a reduction in sensation compared to non-lens wear at all test locations, except the central cornea.

This study is the first to report tarsal conjunctival sensitivity using the air-pulse stimulus, showing that it is of a similar sensitivity to the inferior bulbar conjunctiva and that it is lower than corneal sensitivity. In contact lens wearers, tarsal conjunctival sensitivity was found to be higher in those subjects who had reported discontinuation of lens wear. Sensitivity was also higher in the inferior bulbar conjunctiva, while sensitivity remained unchanged at the corneal locations.

These findings suggest that there are physiological differences between successful contact lens wearers without discomfort complaints, and those who are intolerant, and with non-lens wearers. While this study has a small cohort number, it does represent, for the first time, a possible link between ocular surface sensory nerve response and patient described discomfort symptoms. The results suggest that it is more likely that the conjunctiva plays a role in contact lens intolerance than corneal sensitivity, refuting those thoughts from several decades ago.

REFERENCES

1. Millodot M. A review of research on the sensitivity of the cornea. *Ophthal Physiol Opt* 1984;4: 305-18.
2. Murphy PJ, Patel S and Marshall J. The effect of long-term, daily contact lens wear on corneal sensitivity. *Cornea* 2001;20: 264-269.
3. Situ P, Simpson TL, Jones LW et al. Effects of silicone hydrogel contact lens wear on ocular surface sensitivity to tactile, pneumatic mechanical, and chemical stimulation. *Invest Ophthalmol Vis Sci* 2010;51: 6111-6117.
4. Lum E, Golebiowski B, Gunn R, et al. Corneal sensitivity with contact lenses of different mechanical properties. *Optom Vis Sci* 2013;90: 954-960.
5. Stapleton F, Marfurt CF, Golebiowski B, et al. The international workshop on contact lens discomfort: report of the subcommittee on neurobiology. *Invest Ophthalmol Vis Sci* 2013;54: TFOS71-TFOS97.
6. Stapleton F, Golebiowski B, Skotnitsky C, et al. Corneal and conjunctival sensitivity in intolerant contact lens wearers. *J Optom* 2015;8: 62-63.
7. Stapleton F, Tan ME, Papas EB, et al. Corneal and conjunctival sensitivity to air stimuli. *Br J Ophthalmol* 2004;88: 1547-1551.
8. Murphy PJ, Armstrong E and Woods LA. A comparison of corneal and conjunctival sensitivity to a thermally cooling stimulus. *Adv Exp Med Biol* 2002;506: 719-722.