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Role of contact lenses in relieving ocular allergy

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ABSTRACT

Purpose: To examine the potential barrier and lubricating effects of modern daily disposable contact lenses (DD) against airborne antigens.
Methods: Ten patients with skin prick and ocular conjunctival provocation confirmed allergic sensitivity to grass pollen were recruited (average age 27.4 ± 7.7 years). Each had their ocular symptoms (on a 0 none to 5 extreme scale) and appearance of bulbar and limbal conjunctival redness, palpebral conjunctival redness and roughness, and corneal and conjunctival fluorescein staining (CCLRU scale) graded before and five minutes after exposure to 400 grains grass pollen/m^3 for 2 min in a purpose-designed exposure chamber to simulate the conditions of a 'very high' pollen-count day. This was repeated on three occasions separated by >72 h wearing etafilcon A (sDD), nelfilcon A with enhanced lubricating agents (ELDD) and no contact lenses in random order out of the pollen season. Each sign and symptom was compared to baseline for each condition. The duration of the symptoms was also recorded (http://www.clinicaltrials.gov NCT01125540).
Results: Only symptoms of burning and stinging were significantly reduced in severity by ELDD (Chi-Sq = 7.6, $p = 0.02$), but overall symptoms were significantly reduced in duration ($F = 3.60$, $p = 0.05$). Bulbar hyperaemia, corneal and conjunctival staining, and palpebral conjunctival roughness were significantly reduced by DD wear ($p < 0.01$), with limbal and palpebral conjunctival redness further reduced in ELDD ($p < 0.05$).
Conclusion: Daily disposable contact lenses offer a barrier to airborne antigen which is enhanced by modern lenses with enhanced lubricating agents.

1. Introduction

Advice on the management of ocular allergy usually includes the cessation of soft contact lens wear in habitual wearers due to the potential of allergens to lodge in the contact lens material, causing prolonged antigen exposure to the ocular surface [1–6]. The prevalence of allergies has reached 30–50% in the USA, with 80–90% having some form of ocular involvement and 70% having conjunctival symptoms at least as severe as their rhinitis [7,8]. Ocular allergy is hence a common cause of soft contact lens wears drop-out [9,10] and wear is contraindicated in patients with more severe allergic conditions such as vernal conjunctivitis [4,5]. Conversely rigid lens material sclera contact lenses can be used to protect the ocular surface in medically managed advanced atopic keratoconjunctivitis [11] and soft hydrogel bandage lenses in eyes with vernal ulcers [5,12].

Seasonal allergies have long been known to be associated with giant papillary conjunctivitis [13], with regular replacement of soft contact lenses shown to reduce the severity [14]. By emphasising contact lens hygiene and changing the contact lens polymer and design, Donshik et al. [15] were able to keep about 80% of their giant papillary conjunctivitis sufferers in contact lenses without reactivating the condition.

The use of topical anti-allergy agents, particularly vasoconstrictor pharmaceuticals, should be avoided while the contact lenses are in the eye [4,5]. However, the soft contact lens matrix could in future be used to release pharmaceuticals in a controlled dose, such as antihistamines [16]. Instillation of olopatadine prior to contact lens wear allows greater comfort and longer duration of lens wear compared to a placebo in subjects with a history of allergic conjunctivitis during a conjunctival allergen challenge [17]. A similar effect has been shown for epinastine during the allergy season [18].

When soft contact lens wear is to be attempted by patients with ocular allergy, lens cleaning should be stressed or daily disposable lenses worn, and extended wear avoided [2,4,12]. There is evidence that some disposable soft contact lenses allow their wearers better comfort and reduced signs of ocular allergy than others [19]. However, the effect of contact lens wear compared to the uncovered eye has not been investigated and 'enhanced comfort' contact lenses were not available until more recently. Therefore this study

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used a controlled challenge of the ocular surface to airborne pollen in patients with known allergic sensitivity to compare the relative effects of wearing standard or 'enhanced comfort' soft daily disposable contact lenses.

2. Method

Ten experienced contact lens wearers with skin prick [20] and ocular conjunctival provocation [21] confirmed allergic sensitivity to grass pollen were recruited (average age 27.4 ± 7.7 years, 7 female). Exclusion criteria included asthma, any viral infection, currently taking any topical or systemic medication and pregnancy or lactating. The trials were conducted outside the pollen season and all subjects were symptom free at the start of each trial. The research complied with the Declaration of Helsinki and was approved by the Aston University Human Sciences Research Ethics Committee.

Each subject reported their ocular symptoms under the categories of discomfort/pain, burning and stinging, dry eyes, itchiness, blurred vision, photophobia and tearing on a 0 (none) to 5 (extreme) scale. The appearance of bulbar and limbal conjunctival redness, palpebral conjunctival redness and roughness, and corneal and conjunctival fluorescein staining were recorded using the CCLRU scale reference [22], graded before and five minutes after exposure to an average of 400 grains grass pollen/m^3 for 2 min in a purpose-designed exposure chamber to simulate the conditions of a 'very high' pollen-count day or short term peak as assessed by laser particle counter (measurements set at 6 s intervals). Short term peaks of 400 grains/m^3 over a few minutes to a few hours, are very common in the UK grass pollen season as evidenced by results from the National Pollen Monitoring network. Daily (24 h) averages of grass pollen counts also reach and exceed this level in the peak weeks. The pollen used was Dactylis glomerata supplied by Allergon Ltd. (Angelholm, Sweden). This is a common grass throughout the UK. A high level of cross reactivity has been demonstrated among UK grasses by ELISA [23]. Assessment of the anterior eye was conducted after 5 min once any early phase allergic reaction had commenced [24]. The subjectively reported duration of symptoms was elicited to encompass late phase reactions.

Research studies traditionally test ocular sensitivity to pollen with the conjunctival provocation test, applying pollen in solution to the ocular surface. This does not represent the usual airborne exposure to pollen, so an airborne ocular challenge was developed for this study. The exposure chamber box of volume 0.019 m^3 had a face mark attached to a detachable side, with laser cut apertures in the box for the eyes and nose apertures. The mask formed a seal with the face preventing the escape of the antigen from the sealed chamber. The antigen was blown into the chamber through a 0.5 mm diameter *DirectHaler* tube at 40 l/min for 7 s attached to a Sidewinder electric pump (model 62056, Bestway, Shanghai, China). A fan was located in the base of the box directed towards the eye to keep the antigen airborne.

The assessment of signs and symptoms before and after exposure to pollen was repeated on three occasions separated by >72 h wearing etafilcon A (sDD), nelfilcon A with enhanced lubricating agents (ELDD) and no contact lenses in random order determined by computer generated numbers. The contact lenses were inserted at least 30 min before the pollen exposure to allow them to settle. The investigator and patient were masked as to the type of contact lens worn.

Etafilcon A, an ionic contact lens material, is a co-polymer of 2-hydroxyethyl methacrylate and methacrylic acid cross-linked with 1,1,1-trimethylol propane trimethacrylate and ethylene glycol dimethacrylate (1 day Acuvue, Johnson and Johnson Vision Care). It consists of 42% etafilcon A and 58% water by weight

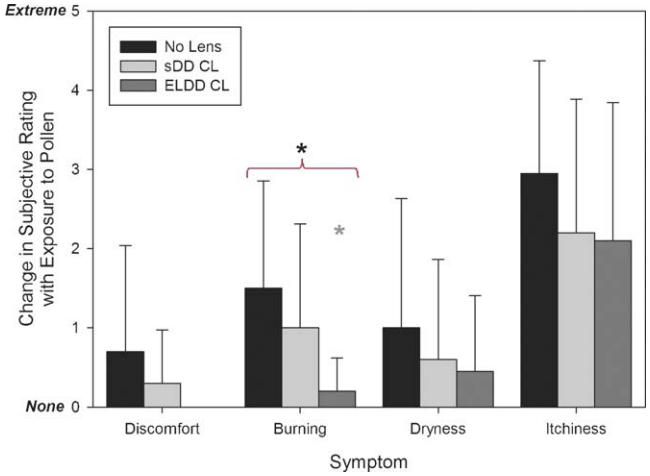

Fig. 1. Increase in ocular symptoms with exposure to airborne grass pollen with no lens, sDD contact lenses and ELDD contact lenses. No blurred vision, photophobia or tearing occurred. $N = 10$. Error bars = 1 S.D. Black stars indicate the overall level of significance between the three conditions with grey stars denoting significance compared to no lens wear $^*p < 0.05$.

when immersed in buffered saline solution. The nelficon A contact lens material (Focus DAILIES with AquaComfort) contains approximately 1.5% polyvinyl alcohol (PVA) and is created by polymerising partially acetalized PVA with N-formylmethyl acrylamide. This polymer forms 31% of the finished contact lens and is 'functionalised' as PVA is bound in the matrix as a functional part of the lens (70% water content). Incorporated non-functionalised PVA (extra, non-bound PVA making up 2% of the macromer formulation weight), remains free in the lens matrix after lens formation. This wetting agent, approximately 0.6% (w/v) of the finished lens, is then released slowly into the tear film assisted by the mechanical effect of blinking [25–28]. AquaRelease™ moisturising has been enhanced by the addition of hydroxypropylmethylcellulose and polyethylene glycol (which binds to PVA, prolonging its release) in DAILIES AquaComfort Plus contact lenses (Ciba Vision) [29].

Each sign and symptom was compared to baseline for each condition. Non-parametric comparison of the symptoms score on an ordinal scale and repeated measure analysis of variance were applied to the signs. Ten subjects allowed a 30% change to be detected and met the recommended degrees of freedom for an ANOVA [30,31].

3. Results

Only the severity of burning and stinging symptoms was significantly reduced by ELDD contact lenses (Chi-Sq = 7.6, $p = 0.02$; Fig. 1), but overall symptoms were significantly reduced in duration to ELDD (66 ± 73 min) and sDD (79 ± 83 min) compared to when no lenses were worn (135 ± 142 min no lenses; $F = 3.60$, $p = 0.05$). Baseline signs and symptoms were similar before each pollen exposure. No blurred vision, photophobia or tearing symptoms changed with exposure to grass pollen for any of the treatment options.

Bulbar hyperaemia, corneal and conjunctival staining, and palpebral conjunctival roughness were significantly reduced by DD wear ($F = p < 0.01$; Fig. 2), with limbal and palpebral conjunctival redness further reduced in ELDD ($p < 0.05$).

4. Discussion

In this study of the immediate effects of exposure to pollen in allergic individuals, contact lenses played a significant role in the protection of the ocular surface. Although only symptoms of burn-