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ORIGINAL PAPER

Comparison of Samfilcon A and Lotrafilcon B silicone hydrogel bandage contact lenses in reducing postoperative pain and accelerating re-epithelialization after photorefractive keratectomy

Erdem Yuksel · Kemal Ozulken · Mehmet Murat Uzel · Ayse Guzin Taslipinar Uzel · Semih Aydoğan

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Abstract

Purpose To compare the efficacy of Samfilcon A and Lotrafilcon B bandage contact lenses after photorefractive keratectomy (PRK).

Methods In this study, patients with bilateral PRK were assigned for the fitting of Lotrafilcon B lens and Samfilcon A lens. The patients were examined on the day of surgery and on postoperative days 1, 2 and 3. Slit biomicroscopy was performed to assess epithelial defect size in the postoperative examinations. The subjective evaluation of pain and visual symptoms was recorded on postoperative days 1, 2 and 3.

Results Analysis was made of 68 eyes of 34 patients who fulfilled the criteria and had PRK for correction of low to moderate myopia/astigmatism. On postoperative days 1 and 2, pain and epiphora scores were significantly lower in eyes with Samfilcon A lens ($p < 0.001$ for all), and on postoperative day 3, the differences were not significant ($p = 0.414$ and $p = 0.180$, respectively). There was no significant difference between the two lenses in respect of the levels of photophobia. The difference in epithelial defect size was statistically lower in eyes with Samfilcon A lens compared to Lotrafilcon B on day 1 (16.89 mm^2 vs. 21.07 mm^2; $p = 0.003$) and day 2 (1.49 mm^2 vs. 2.46 mm^2; $p < 0.001$). The difference was not significant on day 3. (0.05 mm^2 vs. 0.05 mm^2; $p = 1.000$).

Conclusions The Samfilcon A lens is superior to the Lotrafilcon B lens in reducing postoperative pain and accelerating re-epithelialization.

Keywords Photorefractive keratectomy · Bandage contact lens · Samfilcon A · Lotrafilcon B · Epithelial defect size

E. Yuksel (✉)
Ophthalmology Department, Faculty of Medicine, Kastamonu University, Alacaatlı Mah. Sinpas Incek Life Kon. 2/5, Kastamonu, Turkey
e-mail: drerdemyuksel@gmail.com

K. Ozulken
Ophthalmology Department, Tobb-Etu University Hospital, Ankara, Turkey

M. M. Uzel
Ophthalmology Department, Afyonkarahisar State Hospital, Afyonkarahisar, Turkey

A. G. Taslipinar Uzel
Ophthalmology Department, Afyonkarahisar Sandıklı State Hospital, Afyonkarahisar, Turkey

S. Aydoğan
Ophthalmology Department, World Eye Hospital, Ankara, Turkey

Introduction

Although laser in situ keratomileusis (LASIK) is the most commonly applied refractive procedure, photorefractive keratectomy (PRK) is a well-established

flapless procedure [1]. It is a more appropriate method for patients with a thin cornea and who are prone to trauma and have a high risk of flap dislocation [2]. The most important disadvantage of this procedure is postoperative pain and delayed visual rehabilitation [3]. Proper management of these symptoms not only enhances patient comfort but also prevents the development of complications such as corneal haze and infections [4, 5]. Local and systemic anti-inflammatory drugs and analgesics, cold balance salt solution application and bandage contact lenses (BCL) are applied in pain management after PRK [6–8]. As the anterior corneal surface is regenerated in 2-4 days [9], the use of bandage contact lens is recommended for 3–5 days [4, 5].

Currently, silicone hydrogel lenses with high oxygen permeability are applied as a BCL after PRK [10, 11]. BCL reduces the pain by covering the corneal surface and accelerates the healing process [12]. After PRK, contact lenses with various properties such as Comfilcon A, Lotrafilcon A, Lotrafilcon B, Balafilcon A, Omafilcon A, Senofilcon A have been tried as BCL [10, 11, 13–16]. There is no clear conclusion about which lens is better after PRK to achieve comfort and to accelerate epithelization. Lotrafilcon B has the advantage of trimethylsiloxysilyl and other hydrophilic monomers to be able to phase independently, thereby producing a material that has two distinct phases: a water and gel phase allowing high oxygen permeability and high water and sodium permeability. Samfilcon A (Bausch and Lomb Incorporated) has the polyvinylpyrrolidone (PVP) wetting agent integrated in the polymer matrix through a novel manufacturing process that results in PVP tightly compacted at the surface. A PVP-rich surface can create an environment that attracts and retains water, resulting in a highly wettable, smooth surface and high permeability [17].

Lotrafilcon B has been studied in many studies and has proven to be beneficial in pain control and epithelialization [13–16]. The aim of this study was to compare Samfilcon A and Lotrafilcon B lenses in terms of epithelial healing and ocular comfort.

Patients and methods

This comparative clinical study enrolled 68 eyes of 34 patients with bilateral PRK applied for the correction of myopia at the Kecioren World Eye Hospital, Ankara. All patients provided written consent before enrollment. The research conformed to the tenets of the Declaration of Helsinki and followed a protocol approved by the Ethics Committee of TOBB University. Inclusion criteria were $\geq$ 18 years, myopia $\leq$ 6 D, astigmatism $\leq$ 2 D, refractive stability in the last 1 year, central corneal thickness of at least 480 mm and best-corrected visual acuity of $\geq$ 20/20. Previous refractive surgery, myopia greater than 8.00 diopters (D), anisometropia greater than 2.00 D, and ocular or systemic diseases that could affect epithelial healing were excluded from the study. All patients were asked to stop contact lens wear at least 3 weeks before the preoperative examination.

Surgical technique

The surgical procedure was performed under sterile conditions using topical anesthesia of proparacaine 0.5% eyedrops. The epithelium was removed with a blunt spatula with the assistance of 20% alcohol. Stromal ablation was performed with a 500 Hz Allegretto laser platform (WaveLight AG). At the end of the procedure, one eye of each patient, randomly determined by a coin flip, was fitted with a Lotrafilcon B bandage contact lens (Air Optix Hydraglyde) and the fellow eye, with a Samfilcon A bandage contact lens (Bausch and Lomb Ultra). The properties of the lenses are shown in Table 1. Patients were unaware of which type of bandage contact lens was in which eye. The same clinician evaluated the fit of the bandage contact lenses using slit-lamp biomicroscopy. The postoperative drug regimen was the same for both eyes, and tobramycin–dexamethasone was used until the bandage contact lens was removed. Patients were encouraged to use artificial tears every 30 min until the day of complete re-epithelialization.

Postoperative follow-up

All patients were examined on postoperative days 1, 2, 3 and 4. Each postoperative examination included slit-lamp biomicroscopy and assessment of uncorrected distance visual acuity measured using logMAR ETDRS charts at 4 m. Slit-lamp biomicroscopy was used to evaluate the integrity of the corneal media and objectively assess epithelial healing. An ophthalmologist blinded to the type of bandage contact lens in each eye performed the assessments. The epithelial

Table 1 Contact lens characteristics

Parameter	Air optix plus hydraglyde	Ultra
Manufacturer	Alcon (Ciba Vision)	Bausch & Lomb
Material	Lotrafilcon B	Samfilcon A
Dk/*t*	138	163
Water content (%)	33	46
Diameter (mm)	14.20	14.2
Back optic zone radius (mm)	8.60	8.5
Modulus	1	0.7

Dk/*t*, oxygen transmissibility coefficient

defect size was calculated from the remaining area of the epithelial defects using the following equation:

$$A = \pi\,[(a+b)/4]$$

where a is the shortest dimension of the defect and b is the longest dimension. This equation was used in previous studies to determine the size of the epithelial defect after PRK [10]. Each bandage contact lens was removed when there was no visible epithelial defect. After removal of the bandage contact lens, fluorescein was instilled to confirm that there was no epithelial defect. The day of epithelial healing was recorded in each case. Patients completed a visual analog scale at each examination to subjectively score the level of pain, photophobia and epiphora on a scale of 0 (none) to 10 (maximum). An examiner who was blind to the lens type recorded the subjective scores of pain and discomfort.

Statistical analysis

SPSS software version 20.0 (SPSS Inc., Chicago, IL) was used for statistical analysis. The independent T test was used to compare nonparametric data. A value of $p < 0.05$ was considered statistically significant in all the tests. The results of a priori power analysis via PASS 11 (Power and Sample Size Calculation Software, Version 11) showed the need to enroll at least 30 eyes in each group. Therefore, 34 eyes were included in each group and the power of the study was found to be 84.7%.

Results

The 34 patients comprised 14 males (41%) and 20 females (59%) with a mean age of 23.8 years (range 18–43 years). Preoperative refractive error, corneal curvature and corneal thickness details showed no statistically significant difference (Table 2).

Postoperative details including corneal epithelial defect size, subjective levels of pain, epiphora and the photophobia scores of Lotrafilcon B and Samfilcon A on the control days are presented in Tables 3 and 4. On the first and second postoperative day, pain and epiphora scores were significantly lower in eyes with Samfilcon A lens ($p < 0.001$ for all), and on the third postoperative day, the differences were not significant ($p = 0.414$ and $p = 0.180$, respectively). There was no significant difference between the two lenses in respect of the levels of photophobia. The mean epithelial defect size immediately after surgery was 47.0 mm^2 in both groups. The difference in epithelial defect size was statistically less in eyes with Samfilcon A lens compared to Lotrafilcon B at 1 day (16.89 mm^2 vs. 21.07 mm^2; $p = 0.003$) and 2 days (1.49 mm^2 vs. 2.46 mm^2; $p < 0.001$). The difference was not significant on day 3. (0.05 mm^2 vs. 0.05 mm^2; $p = 1.000$). On postoperative day 3, re-epithelialization was complete in 33 eyes (97.0%) in the Samfilcon A group and 33 eyes (97%) in the Lotrafilcon B group. The difference between the groups was not statistically significant ($p = 1.00$).

Discussion

According to the results of this study, re-epithelialization occurred more quickly with Samfilcon A on postoperative days 1 and 2 than with Lotrafilcon B lens. The pain and epiphora were also lower with the Samfilcon A lens. On postoperative day 3, there was no difference between the two lenses in terms of epithelial defect, pain, epiphora and photophobia. On the third postoperative day, re-epithelialization was completed in 97% of the patients. To the best of our

Table 2 Preoperative patient data

Parameter	Lotrafilcon B (mean ± SD)	Samfilcon A (mean ± SD)	*p value
Spherical equivalent (D)	− 3.80 ± 1.94	− 3.74 ± 1.73	1.000
Corneal curvature (D)	43.84 ± 1.59	43.93 ± 1.59	0.91
Corneal thickness (μm)	519.12 ± 27.98	521.26 ± 28.63	0.83

SD standard deviation, *D* diopter

*Independent samples *T* test

Table 3 Postoperative outcomes of two different lenses

	Lotrafilcon B	Samfilcon A	*p value
Epithelial defect area (mm^2)			
1st day	21.07 ± 5.73	16.89 ± 5.34	0.003
2nd day	2.46 ± 2.11	1.49 ± 2.18	< 0.001
3rd day	0.05 ± 0.18	0.05 ± 0.18	1.000

*Independent samples *T* test

Table 4 Postoperative subjective scores of pain, epiphora and the photophobia*

	Lotrafilcon B	Samfilcon A	†p value
Pain scores			
1st day	7.12 ± 1.57	4.88 ± 1.29	< 0.001
2nd day	4.79 ± 1.87	3.21 ± 1.49	< 0.001
3rd day	0.32 ± 0.63	0.26 ± 0.56	0.414
Epiphora scores			
1st day	6.82 ± 2.02	5.94 ± 1.89	0.006
2nd day	4.44 ± 1.82	3.79 ± 1.73	0.001
3rd day	0.24 ± 0.74	0.09 ± 0.28	0.180
Photophobia scores			
1st day	6.97 ± 1.81	7.24 ± 1.63	0.102
2nd day	4.88 ± 1.83	5.00 ± 1.77	0.194
3rd day	0.32 ± 0.72	0.29 ± 0.67	0.655

*Postoperative subjective scores were assessed according to "*a visual analogue scale*"

†Independent samples *T* test

knowledge, this is the first study in the literature to have tested the Samfilcon A lens after surface ablation refractive surgery.

After surface ablation refractive surgery, contact lenses are used for epithelial healing and postoperative comfort [9–15]. Many studies have investigated which lens is the most effective. Some molecular properties of contact lenses, such as modulus, surface smoothness, size and base curvature, may be effective in reducing pain and re-epithelialization. In a few studies, it has been observed that epithelial healing is faster in lenses where oxygen permeability is higher [11–14]. In a study by Plaka et al. [11], re-epithelialization with the Asmofilcon A lens was reported to be faster than with the Lotrafilcon B lens. The oxygen permeability of Asmofilcon A lens is higher than that of the Lotrafilcon B lens. Another study also showed that the Comfilcon A lens, which has higher oxygen permeability, provided faster re-epithelialization [14]. In the current study, re-epithelialization was faster in the Samfilcon A lens with higher oxygen permeability. In this respect, it can be considered that re-epithelialization is related to oxygen permeability. The mechanism of pain improvement in BCLs is not clear, but lenses with a lower base curve (BC) may provide more comfort and less pain after the surgery because of a tighter fit and less movement during blinking [18]. Although the lower BC of the Samfilcon A lens may have been effective in reducing postoperative pain, no significant differences were detected between the two lenses fitted in respect of post-blink lens movement, centralization or corneal coverage (all assessed using biomicroscopy). In addition, the surface properties may have provided these benefits. PVP on the surface makes the lens highly wettable and provides a smooth surface, making the patients more comfortable [17]. Water content can also make a difference. In particular, the Samfilcon A lens with a higher water content may have resulted in less pain in patients. In a study by Eliacik et al. [14], the Comfilcon A lens with a higher water content was reported to provide more patient comfort. Taylor et al. [16] showed that greater patient comfort was achieved with the Senofilcon A lens, which has a higher water content. Another reason

could be that the modulus of the Samphilcon A lens is low, and this could have resulted in greater patient comfort.

Many studies in the literature have investigated the effect of Lotrafilcon B lens after PRK [10, 11, 13–15]. In a study by Mohammadpour et al. [13], the patients fitted with the Lotrafilcon B lens reported less foreign body sensation compared to those with Comfilcon A lens on the first postoperative day. In contrast, Eliacik et al. [14]. reported less pain felt by patients fitted with the Comfilcon A compared to those fitted with the Lotrafilcon B. In another study by Mohammadpour [15], in comparison with Balafilcon A lens, the patients who used the Lotrafilcon B lens had lower pain scores. Grentzelos et al. [10] compared Lotrafilcon B and Lotrafilcon A lenses. After 3 days, there were no differences in corneal re-epithelialization or subjective measurements after PRK between the two types of silicone hydrogel bandage contact lenses. In a study by Plaka et al. [11], Lotrafilcon B showed delayed re-epithelialization compared with the Asmofilcon lens. Previous studies have indicated that differences in pain of 30% or more tend to be clinically significant [19]. In the current study, the difference in postoperative pain scores between the groups was greater than 30%.

In conclusion, Samfilcon A and Lotrafilcon B contact lenses were successful in achieving re-epithelialization, both can be used effectively as a bandage after refractive surgery. Nevertheless, the use of Samfilcon A contact lens after PRK surgery has more positive effects on patient comfort and epithelial healing than Lotrafilcon B contact lens, especially in the first 2 days after surgery.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed consent Informed consent was obtained from all individual participants included in the study.

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