Contact Lens and Anterior Eye 39 (2016) 266–269

Contents lists available at ScienceDirect

Contact Lens and Anterior Eye

journal homepage: www.elsevier.com/locate/clae

Effect of overnight orthokeratology on conjunctival goblet cells

Gonzalo Carracedo[a,*], Alba Martin-Gil[b], Begoña Fonseca[b], Jesús Pintor[b]

[a] Department of Optics II (Optometry and Vision), Faculty of Optics and Optometry, Universidad Complutense de Madrid, Madrid, Spain
[b] Department of Biochemistry and Molecular Biology IV, Faculty of Optics and Optometry, Universidad Complutense de Madrid, Madrid, Spain

ARTICLE INFO

Article history:
Received 18 July 2015
Received in revised form 6 April 2016
Accepted 6 April 2016

Keywords:
Discomfort
Orthokeratology
Silicone hydrogel contact lens
Goblet cell density

ABSTRACT

Objective: To evaluate the differences between goblet cell density (GCD) and symptomatology after one month of orthokeratology lens wear.
Methods: A pilot, short-term study was conducted. Twenty-two subjects (29.7 ± 7.0 years old) participated voluntarily in the study. Subjects were divided into two groups: habitual silicone hydrogel contact lens wearers (SiHCLW) and new contact lens wearers (NCLW). Schirmer test, tear break up time (TBUT), Ocular Surface Disease Index (OSDI) questionnaire and conjunctival impression cytology. GCD, mucin cloud height (MCH) and cell layer thickness (CLT) were measured. All measurements were performed before orthokeratology fitting and one month after fitting to assess the evolution of the changes throughout this time.
Results: No differences in tear volume and TBUT between groups were found ($p > 0.05$). However, the OSDI score was statistically better after one month of orthokeratology lens wear than the baseline for the SiHCLW group ($p = 0.03$). Regarding the goblet cell analysis, no differences were found in CLT and MCH from the baseline visit to the one month visit for the SiHCLW compared with NCLW groups ($p > 0.05$). At baseline, the GCD in the SiHCLW group were statistically lower than NCLW group ($p < 0.001$). There was a significant increase in GCD after orthokeratology fitting from 121 ± 140 cell/mm^2 to 254 ± 130 cell/mm^2 ($p < 0.001$) in the SiHCLW group.
Conclusion: Orthokeratology improves the dry eye subject symptoms and GCD after one month of wearing in SiHCLW. These results suggest that orthokeratology could be considered a good alternative for silicone hydrogel contact lens discomfort and dryness.

1. Introduction

Contact lens wearing can influence tear stability, most commonly causing ocular discomfort and dryness at the end of the day [1]. More than half of CL wearers self-report dry eye symptoms [2]. Some of these wearers reduce their lens wearing time and some eventually drop out of contact lens use. Over 15% of lens wearing drop out is attributed to dryness and nearly 30% to ocular discomfort [3,4]. The majority of these symptoms disappear after stopping wearing contact lens [5].

There is only one study published comparing dryness symptoms between daily wearing of contact lenses and orthokeratology contact lenses, performed with a specific dry eye symptoms questionnaire [6]. In this study, the authors found that orthokeratology wearers have statistically less discomfort than daily wear gas permeable contact lens wearers. Lipson et al. compared the quality of life between orthokeratology contact lens wear and soft contact lens daily wear [7]. Both, symptoms and dependence of correction, were worse in the soft contact lenses group than the orthokeratology group. The gas permeable contact lens for orthokeratology is worn on an overnight wear basis since no lenses are worn during the day to disturb the ocular surface. The closed-eye-only wearing versus the open-eye waking hours wearing is one possible reason for this difference.

Impression cytology is considered an adequate test for dry eye syndrome by the Diagnostic Methodology Subcommittee of Report of National Eye Institute, Industry-Sponsored Dry Eye Workshop (DEWS) [8,9]. It evaluates goblet cell density (GCD) which is important to maintain the integrity of the ocular surface due to the mucins these cells produce [10]. Moreover, some authors found an association between GCD and subjects' symptoms of dry eye [11–13]. A new technique for the analysis of impression cytology by laser confocal microscopy allows 3D imaging that can analyse cell density, cell layer thickness (CLT) and mucin cloud height (MCH). This technique provides more meaningful and objective details for diagnosis [14].

* Corresponding author at: Faculty of Optics, Department Optics II (optometry and Vision), C/Arcos del Jalon 118, 28037 Madrid, Spain.
E-mail address: jgcarrac@ucm.es (G. Carracedo).

http://dx.doi.org/10.1016/j.clae.2016.04.001
1367-0484/

A previous study has reported the effect of orthokeratology lens wearing on GCD but not in their mucin production, measured as CLT and MCH [15]. Therefore, the objective of this study is to evaluate the differences in GCD and symptomatology after one month of orthokeratology lens wearing.

2. Methods

A pilot, non-randomized, open-label, prospective study was conducted. In this study, 22 subjects (10 men and 12 women) with a mean age of 29.7 ± 7.0 years (range 22–39) were recruited and enrolled in the Optometry Clinic of the Faculty of Optics and Optometry in the University Complutense of Madrid (Spain). Subjects diagnosed with dry eye syndrome or subjects under treatment for dry eye syndrome were excluded. All subjects took part voluntarily in the study and were free to withdraw without being questioned. The study observed the renewed and revised rules of Helsinki Declaration [16]. Moreover, the study was approved by the Ethics Committee (CEIC) of the University Complutense of Madrid.

All enrolled subjects were fitted with Paragon CRT100® lenses for orthokeratology (Paragon Vision Sciences, Mesa, AZ) according to manufacturer guidelines. When lenses were prescribed, instructions about the wearing schedule, application, removal, and care system were given to the subjects. The care system prescribed was a multipurpose solution for RGP lenses (Menicare Plus, Menicon, Japan). Subjects were divided in two groups: habitual silicone hydrogel contact lens wearers (SiHCLW) and neophyte contact lens wearers (NCLW). All measurements were performed in the morning, between 8:00 am to 10:00 am and one hour before removing the lenses, before (pre) orthokeratology fitting and one month after fitting to assess the evolution of the changes during the study.

The Schirmer I test with closed eyes (without anaesthesia), tear break up time (TBUT), OSDI questionnaire and impression cytology were performed. The tear collection was always performed following Van Bijsterveld criteria [17]. After Schirmer I test, fluorescein was applied to evaluate TBUT. In order to assure repeatability of the staining procedure, a solution was prepared: 10% sodium fluorescein (Colircusí Fluoresceina; Alconcusí, Barcelona, Spain) diluted in saline (NaCl 0.9%). For each application, a micropipette with 5 μl of diluted fluorescein solution was applied in the inferior conjunctival sac. Twenty seconds later, TBUT was analyzed using a stopwatch and subjects were asked to blink twice and keep their eye open. TBUT measure was repeated three times. In order to identify dry eye symptoms, the subjects completed the OSDI questionnaire. The questionnaire, evaluated by different studies [18] is composed of 12 questions, each with five possible responses with a score between 0 and 4 (0 = none of the time, 1 = some of the time, 2 = half of the time, 3 = most of the time, 4 = all of the time). This questionnaire is used to grade the degree of dry eye symptoms to help in differentiating dry eye syndrome subjects from healthy subjects. The final score is between 0 and 100, where 100 represents the highest symptomatology of dry eye.

To perform impression cytology on the bulbar conjunctiva, a device equipped with a paper filter (polyethersulfone membrane) known as Eyeprim™ (OPIA Technologies SAS, Paris, France) was used. This device, which has a membrane surface of 69 mm^2, is placed in contact with the temporal bulbar conjunctiva of the subjects on a region of approximately 1.5–2.0 mm from the filter edge to the corneal limbus with gentle contact for approximately 2 s.

All impression cytology samples were preserved in 96% ethanol, processed with periodic acid Shiff (PAS) reagent, dehydrated through an ethanol series to xylol, and mounted on coverslips for microscopic observation. Microscopic observation was accomplished using a laser scanning confocal microscope (LCM) (Zeiss LSM Pascal; Carl Zeiss, Jena, Germany), following the protocol described by Peral and Pintor [14]. Samples were viewed at magnifications of 20× for Cell Density evaluation and 40× for CLT and MCH. This LCM is able to scan samples on the Z-axis at 0.25 μm intervals between photograms, and was used to determine CLT, MCH, and GCD. The field size for the confocal images was 450 × 450 μm and then the multiplication factor used to obtain GCD estimation was 4.938. Ten microscope fields were analyzed to count goblet cells. Five cells for each field were evaluated to calculate MCH and CLT [14].

2.1. Statistical analysis

The statistical analysis was performed with SPSS software (version 15.0, SPSS Inc., Chicago, IL, USA). The results obtained and statistically analysed were expressed with mean ± standard deviation (SD). Normality of samples was analysed with the Shapiro-Wilk test, resulting in no normality due to the heterogeneity of the sample. This was followed by a non-parametric statistical test to compare the different results. To compare the visits, the non-parametric test of Wilcoxon for paired samples was applied; and to compare the groups, the non-parametric test of *U* Mann-Whitney was used. Statistical significance was defined as $p < 0.05$.

3. Results

Twelve subjects were recruited in SiHCLW group and 10 subjects in the NCLW group. All subjects included in SiHCLW group reported at least one year and no more than two years of Silicone Hydrogel (Si-Hi) contact lens wearing in daily wear modality. The mean spherical refraction was −2.30 ± 1.04 D (−0.75 to −4.50 D), the mean cylinder was −1.05 ± 0.68 D (−0.25 to −2.50 D) and the mean flat keratometry value was 42.85 ± 1.45 D (40.5–45.5 D) for the enrolled cohort. No statistically significant differences were found between groups ($p > 0.05$).

Table 1
Comparisons between baseline and 1 month of orthokeratology lens wear.

Parameter	Habitual Si-Hi contact lens wearers (SiHCLW) n = 12			Neophytes contact lens wearers (NCLW) n = 10		
	Baseline Mean (SD)	Post 1 month Mean (SD)	p-value	Baseline Mean (SD)	Post 1 month Mean (SD)	p-value
Schirmer I test (mm)	16 (13.5)	15.8 (10.8)	0.76	18.1 (12.5)	18.2 (13.9)	0.89
TBUT (s)	4.1 (1.9)	4.6 (1.5)	0.26	4.9 (3.2)	4.6 (2.7)	0.27
OSDI (Score)	13 (12.2)	5.8 (3.6)	0.03*	11.9 (9.8)	9.6 (7.6)	0.50
GCD (cells/mm^2)	121 (140)	254 (130)	<0.01*	240 (177)	208 (142)	0.68
CLT (μm)	4.0 (1.2)	4.1 (0.5)	0.86	4.2 (0.6)	4.6 (0.6)	0.08
MCH (μm)	1.4 (0.6)	1.4 (0.6)	0.98	1.5 (0.3)	1.4 (0.7)	0.50

Wilcoxon for paired samples. For details see material and methods.
* p value <0.05 compared with baseline visit.