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Lens wearers non-compliance—Is there an association with lens case contamination?

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ABSTRACT

Purpose: This study aims to investigate the association of compliance amongst lens wearers and lens case contamination as assessed by the microbial profile of lens cases.
Methods: Fifty-two asymptomatic lens wearers filled out questionnaires seeking demographic data and several aspects of compliance to lens wear. Subsequently, contamination profiles of the inside bottom and rim of their lens cases was obtained for bacteria, fungi and Acanthamoeba. The association of the self-reported responses in the questionnaire with contamination profile of the lens case was then analyzed.
Results: Based on compliance criteria, 21% of the participants were described as fully compliant lens wearers. Contamination of lens case was prevalent in 42% of the cases. Frequent non-compliant behaviours reported by study participants included, showering and sleeping with contact lenses, and irregular lens case replacement. In comparison to soft contact lens wearers prevalence of non-compliance and contamination amongst rigid gas permeable (RGP) lens wearers was significantly greater. There was a statistically significant correlation between bacterial contamination and current case age.
Conclusion: These results suggest that majority of lens wearers do not fully comply with recommendations for lens wear and case care. Crucially, none of the fully compliant patients had contaminated lens cases. However it would appear that several non-compliant behaviours significantly increase the risks of case contamination. These results suggest that greater efforts should be invested with lens wearers to ensure enhanced compliance as this is likely to reduce the possibility of case contamination.

1. Introduction

Whilst contact lenses provide an effective modality for vision correction [1,2] a number of complications are associated with their use [3–7]. The lens cases and lens solutions in which lenses are held, can become contaminated with various microorganisms. Once contaminated, lenses can become a medium for direct ocular transmission of microorganisms. This signifies the need for maintaining the hygiene of the lens care system.

For over 10 years, researchers have observed the relationship between contact lens complications and the patients' compliance with the recommended lens care guidelines [1,8]. Although patients have a responsibility to strictly follow recommended guidelines, they often do not, due to an insufficient understanding of contact lens care guidelines, lack of awareness regarding risks, or simply ignoring consciously the recommended guidelines [1,6,9,10]. This non-compliance is not aided by the inconsistent or inadequate contact lens and lens storage case hygiene recommendations by different advisory bodies (manufacturer, regulatory authority and physicians) [11] and a deficient evidence-based data to inform the optimal hygiene regimens [12].

Current estimates of lens wearers' non-compliance range from 40% to 91% [13]. Frequently mentioned non-compliant behaviours in lens wearers comprise poor hand hygiene, improper handling with lens care systems, sleeping and swimming with contact lenses and skipping recommended aftercare and replacement schedules [7,11,14,15]. However, inadequate lens case care is identified as the most common non-compliant behaviour among contact lens wearers. The lens storage case is the most frequently contaminated item in the lens care system [6,16], with its contamination observed in up to 80% of cases [17–19]. Consequently, contamination of lens storage cases has been identified as the major risk factor for keratitis, with up to four fold increase in risk for microbial keratitis among contact lens wearers if lens care system is not handled appropriately [12,20–24].

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The purpose of this study was to investigate the relationship between patient compliance and contact lens case contamination in greater detail. Compliance of asymptomatic contact lens wearers was assessed across several domains to analyze its association with the profiles of lens case contamination. We hypothesized that the level of compliance to contact lens system care will influence contamination status of the lens cases.

2. Methods

2.1. Subjects

We analyzed 52 randomly selected asymptomatic lens wearers who came for regular control contact lens examination to our outpatient clinic at the University Hospital Centre Zagreb. All patients at this clinic are routinely issued with written instructions for lens wear and care management. Therapeutic lens wearers were excluded from the study.

2.2. Study protocol

The study was performed in two parts:

2.2.1. Questionnaire

Firstly, patients were asked to complete a questionnaire to establish their demographic profile, contact lens wear pattern and contact lens case care compliance. Compliance assessment evaluated the accuracy with which wearers followed the instructions that they had been issued with. Patients were considered compliant only if their responses to the questionnaire suggested that they met all the compliance criteria outlined in Table 1.

2.2.2. Microbiological examination of lens cases

Secondly microbiological examination of lens cases was undertaken. The samples were obtained by swabbing. To perform the lens case contamination profile, cultures were obtained from two areas of the same lens case inside bottom and upper rim. These cultures were then analyzed for bacteria, fungi and Acanthamoeba.

Samples for bacteriological analysis were incubated on "brain-heart" agar (BH agar) at $35 \pm 2\,^{\circ}C$ and analyzed after 24 and 48 h of incubation. Samples for fungi analysis were incubated in malt agar at $29 \pm 2\,^{\circ}C$ and analyzed every day during 7 days of incubation. Agars with the presence of microorganisms were cultivated on the rigid substrate and nutrients incubated in the appropriate atmosphere BH agar on chocolate and blood agar, and malt agar on Emmons agar. Increased colonies of bacteria were identified with standardized microbiological tests for gram positive and gram negative bacteria. Increased yeast colonies were identified with germination test, with subcultivation on corn agar Tween 80, Dalmau method, and on CHROMagar. Increased yeast colonies were identified on the basis of microscopic preparations stained with laktofenolom. For the Acanthamoeba isolation agar surfaces with *Escherichia coli* were incubated at room temperature of $37\,^{\circ}C$. Samples were microscopically analyzed daily through the subsequent 10 days. Contamination of the lens case implied the presence of bacteria or fungi inside and/or on the rim of the lens case.

The survey protocol was approved by the Ethical Committee of the Zagreb University Hospital Centre.

Table 1
Criteria for compliance.

Criteria	Compliance value
Daily lens wear	<12 h per day
Routine RGP lens replacement	<3 years
Soft lens replacement	Manufacturers guidelines
Current RGP lens age	<3 years
Current soft lens age	Within manufacturers suggested replacement period
Replacement of case solution	Daily
Typical case replacement	<3 months
Current case age	<3 months
Saline disinfection	None
Swimming with lenses	None
Showering with lenses	None
Sleeping with lenses	None

2.3. Statistical analysis

Statistical analysis was performed using The Statistical Package for the Social Sciences for Windows version 13.0 (SPSS Inc., Chicago, IL, USA). Descriptive statistics were used to describe the subjects' demographic and clinical data, using means and standard deviations for interval measures and frequencies and percentages for categorical variables. Kolmogorov–Smirnov goodness of fit test was used to test for the normality of data distribution ($p < 0.05$ was considered as a significant departure from normality). Where significant departures from normality were found, data were presented using range (min–max), median and interquartile range.

χ^2 test was used to compare differences in the distribution of categorical variables among the two contamination groups ("yes" and "no"), and groups according to the presence or absence of any microbacteria inside, on the lens case rim or both. Also, χ^2 test was also used to compare differences in gender distribution between the two groups according to compliance ("compliant" vs. "non compliant" group). To test differences in interval measures between the different compliance and contamination groups *t*-tests or Mann Whitney were used appropriately, for normally and not-normally distributed variables, respectively. In addition, binary logistic regression was used to predict the likelihood of contamination using sociodemographic and clinical factors. Bivariate Pearson or Spearman correlations (for normally and not-normally distributed variables, respectively) were used to compare the subjective evaluation of patients' hygiene habits and compliance as, defined by the above mentioned criteria. A *p*-value of less then 0.05 was considered to denote statistical significance.

3. Results

3.1. Demographic and clinical characteristics

Analysis was undertaken on data obtained from 52 patients, of whom 37 (71%) were females and 25 (48%) were soft contact lens wearers. The mean age and standard deviations (SD) of all patients was 28.44 years (SD 12.88).

Eleven patients (21%) were found to fulfilled all the compliance criteria. The mean number of years of contact lens wear was 9.52 years (SD 9.08). Range (min–max), median and interquartile range 25–75th for the lens wearing time per day were 4–18 h, with $M = 12$, and interquartile range of 10–15. Range (min–max), median and interquartile range 25–75th for lens solution replacement frequency were 1–30, $M = 1$, 25–75th = 1–2.5, respectively. Range (min–max) and interquartile range 25–75th for current lens case duration as well as for lens case replacement frequency were 0.08–10 years and 0.24–1.5, with medians of 0.5 and 1, respectively.

Contact lens disinfection solutions used for RGP lenses were: Boston ($N = 12$), total care ($N = 9$), Boston simplus ($N = 2$), Nitilens ($N = 1$), unknown ($N = 3$), and for soft contact lenses: Renu Multiplus Multi-purpose Solution ($N = 8$), AMO Complete Multi-purpose Solution ($N = 7$), Optifree Replenish Multi-purpose disinfecting solution ($N = 4$), Solo Care Aqua Multi-purpose solution ($N = 2$), Oxsysept ($N = 2$), AO Sept Plus ($N = 2$).

Patients' contact lens wear related non-compliant behaviours are outlined in Table 2.