Original Article

# Contact Lens Use Advice–Risks and Outcomes: Are Patients Drowning in Information but Starved for Knowledge?

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## Abstract

**Objectives:** Microbial keratitis can cause significant visual morbidity and is a common reason for presentation to eye casualty clinics. Contact lens wear and poor contact lens hygiene significantly increase the risk of corneal infection. This study aimed to determine the level of contact lens hygiene awareness amongst contact lens wearers attending our service and determining whether contact lens type and hygiene attitude are related to severity of disease.

**Materials and Methods:** This prospective questionnaire-based study included 50 consecutive patients attending the eye casualty clinic of a tertiary referral center. Visual acuity was assessed at presentation and 2 weeks after diagnosis. Patients were divided into subgroups according to contact lens type (monthly, bi-weekly, daily, and extended day and night wear) and risk group (low, medium, and high) depending on their contact lens hygiene practices.

**Results:** Thirty-four women and 16 men were included in this study. Twenty-four patients used monthly disposable contact lenses, 16 used daily disposable contact lenses, 6 were using bi-weekly replacement lenses, and 4 patients were using extended wear (day and night) contact lenses. Twenty-five patients were diagnosed with corneal ulcer, 23 of which had some degree of poor contact lens hygiene. Best corrected visual acuity (BCVA) significantly improved after treatment. Mean BCVA was 0.24 LogMAR before treatment and 0.09 LogMAR after treatment ($p<0.05$).

**Conclusion:** Our study highlights the need to improve contact lens hygiene awareness and influence hygiene practices. Patients with the poorest contact lens hygiene had slower visual recovery and a higher prevalence of corneal ulcer. Contact lens hygiene advice needs to be clear and reinforced over time.

**Keywords:** Contact lenses, hygiene, corneal ulcer, infection

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## Introduction

Microbial keratitis is a frequent reason for presentations to eye casualty clinics, with an estimated 71,000 new cases per year in the United States and a prevalence of 1.1 per 10,000 in the Netherlands and 0.36 per 10,000 in Scotland.[1,2,3] Microbial keratitis can be mild, with no visual sequelae upon resolution, or it can cause a high degree of morbidity and significant visual loss in up to 14% of cases.[4] Contact lens (CL) wear is a recognized risk factor for infective keratitis and unlike other predisposing factors such as ocular surgery, ocular surface disease, and systemic disease, is modifiable in practice.[5,6,7,8,9,10]

CL wear in itself, irrespective of the CL replacement interval and material, is associated with an increased risk of corneal infection.[9,10] Severe infections that lead to visual loss are more often seen in patients wearing monthly replacement CL rather than in daily disposable CL.[10,11] Other similarly important risk factors implicated in infection are extended wear, overnight wear, poor lens disinfection, and poor CL hygiene.[7,8,9,10,11,12]

Poor CL hygiene is a known contributor to microbial keratitis.[7,8,9,10,11,12,13] In a study by Brewitt[13] 66% of complications observed in CL wearers were attributed to poor hygiene practices.

To assess levels of patient CL hygiene awareness and adherence, we conducted a prospective study examining the level of CL hygiene awareness in patients attending an eye casualty clinic and the effect of their CL hygiene practices on visual acuity (VA) and presenting pathology.

## Materials and Methods

We prospectively analyzed 50 consecutive patients with CL-related complaints presenting to the eye casualty of our tertiary center over a period of 2 months. Informed consent was obtained from all patients and the study adhered to the tenets of Helsinki (ethical approval number: 07/H0512/39).

After ophthalmic examination in eye casualty by a member of the corneal service, an independently validated questionnaire was used to identify the type and length of CL use, source of CL purchase (optician or internet), CL hygiene behavior, and CL hygiene advice received. Patients were specifically asked whether they showered, slept, or swam in their CLs and whether they recalled receiving advice regarding CL hygiene. The patients were examined on presentation and 2 weeks later by the corneal team and in the interim were assessed for response to treatment by the eye casualty team.

In tertiary centers, patients with CL-related problems are often referred after initiation of treatment by local ophthalmologists. In our cohort, empirical treatment was started or continued solely or in addition to our regimen and thus we did not discontinue previous treatment in order to take corneal cultures/scrapes.

Patients were subdivided into three groups on the basis of their CL risk behaviors. The high-risk group was defined as patients who engaged in all three components of risk behavior (slept, showered, and swam in CLs). The medium-risk group was defined as patients who engaged in two of the above risk behaviors, and those in the low-risk group reported engaging in only one of the risk behaviors.

The patients' responses were compared against the CL leaflets frequently used by our optometry department (from CL manufacturers no. 7, David Thomas, Ultravision, Synergeyes, and Mark'ennovy).

### Statistical Analysis

The data was analyzed using statistical software SPSS version 19 (IBM, SPSS, Chicago, IL, USA). Sample normality was confirmed with the Shapiro-Wilk test. The association with VA data was analyzed using one-way analysis of variance (ANOVA) for CL type and risk behavior and t-test for diagnosis.

## Results

### Demographics and Contact Lens Types

The study included 50 consecutive patients (34 female, 16 male) who were regular CL wearers. The mean age was 38 years (range, 16 to 65 years). All patients had been using CLs for over a year. The patients most commonly used monthly replacement CLs (n=24; Table 1) and were in the medium-risk group (n=23; Figure 1). Forty-nine patients bought the CLs solely from a local optician. One patient bought their CLs over the internet but had previously purchased them from an optician. Patient demographics and contact lens types are detailed in Table 1.

Best corrected visual acuity (BCVA) showed marked improvement after treatment. Mean pre-treatment VA was 0.24 LogMAR and improved to 0.09 LogMAR after initiation of treatment. The difference between pre-treatment and 2-week follow-up BCVA in the cohort was statistically significant ($p<0.05$). When compared according to patient behavior (high risk, medium risk and low risk), we observed that VA improved significantly following treatment in the medium and low-risk groups ($p=0.017$ and 0.002, respectively). However, in the high-risk group, the improvement in VA was not statistically significant ($p=0.053$) (Figure 1).

In one-way ANOVA, there was no difference in VA before or after treatment according to CL type except for extended wear CLs, which were associated with significantly worse VA (Table 2 and Figures 2, 3).

### Contact Lens Hygiene Advice and Practices

Table 3 outlines the patients' recall of CL hygiene advice received and their corresponding CL hygiene practices. The majority of patients in the study (n=31) did not recall receiving

**Table 1. Patient demographics and contact lens types**

| **Gender** | | |
|---|---|---|
| **All** | **Male** | **Female** |
| 50 | 16 | 34 |
| **Age (years)** | | |
| | **Mean** | **Range** |
| | 38 | 16-65 |
| **Contact lens type** | | |
| | **n** | **Percentage** |
| Monthly replacement | 24 | 48% |
| Daily disposable | 16 | 32% |
| Bi-weekly replacement | 6 | 12% |
| Extended wear (day and night) | 4 | 8% |

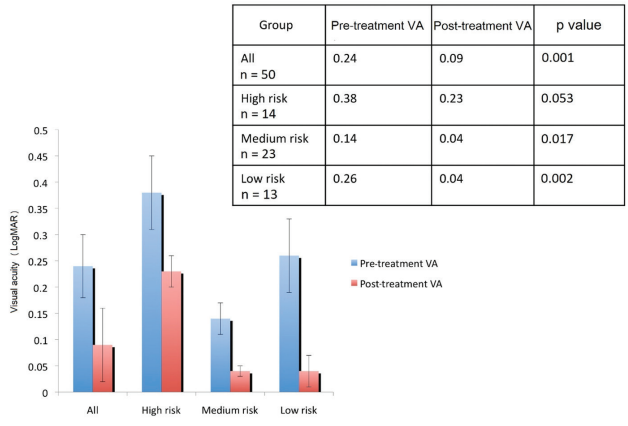


**Figure 1.** Best corrected visual acuity (BCVA) before and after treatment

any CL hygiene advice, and most patients were not aware that showering in CLs is not advised.

### Diagnosis

Twenty-five out of the 50 patients were diagnosed with a corneal ulcer, whereas the remaining 25 patients were diagnosed with less severe CL-related problems such as corneal abrasion and superficial punctate erosions. In the latter group, 2 of the patients presented with corneal infiltrates. Solely for the purpose of comparing visual acuity, these patients were grouped with the corneal ulcer patients under the label of microbial keratitis.

Of the 25 patients diagnosed with corneal ulcer, 12 (48%) used monthly disposable CLs and 8 (32%) used daily disposable CLs. All 4 patients wearing extended wear (day and night) CLs were diagnosed with corneal ulcer. Of these 25 cases, 11 patients (44%) were in the high-risk group. Two patients (8%) were in the low-risk group and the remaining 12 patients belonged to the medium-risk group (Figure 4).

Initial and final VA showed no statistical difference between patients with microbial keratitis (including the 25 cases with corneal ulcers and the 2 cases with corneal infiltrates due to the clinical appearance) and those with other minor adverse complications (Table 4a-b).

### Content of Contact Lens Leaflets

Advice on showering and swimming in CLs was absent in 3 of the 5 leaflets. Three out of the 5 leaflets contained advice about sleeping in CLs and mentioned a recommended time limit of daily wear. All leaflets mentioned hand washing. Three leaflets were particularly difficult to read and extract information from.

## Discussion

The role of CL wear, particularly when associated with poor CL hygiene is a well-studied and recognized risk factor for infective keratitis.[9,10] Despite this, conveying the importance of good CL hygiene to CL wearers continues to be a challenge, and CL-related keratitis remains an important cause of visual morbidity.[9,10,11] Visual outcome is determined by numerous factors, including virulence of the organism, severity of keratitis at the time of presentation, and promptness to initiate appropriate treatment.[4] There is a spectrum of causative organisms and trends vary between climates. In Europe, *Pseudomonas aeruginosa* is the most commonly identified pathogen amongst CL wearers, followed by gram-positive organisms.[14,15] Although *Acanthamoeba* is an important pathogen of severe CL keratitis, cases of Acanthamoeba keratitis remain rare. *P. aeruginosa* is able to adhere to and colonize CL materials during CL wear, can survive in CL storage cases, and has resistance to CL disinfectants.[16] *Acanthamoeba* are free-living cyst-forming ubiquitous protozoa found in air, dust, soil, and fresh water. They are highly resistant to disinfection with chlorine and are thus not eradicated from tap water.[16,17,18] For this reason, showering with, swimming with, and washing CLs in fresh water are regarded as risk behaviors.

In addition to the heightened risk of infective keratitis associated with CL wear, factors such as wearing CLs for long periods, overnight CL use, and poor hygiene play a major role in further increasing the risk.[4,5,6,7,8,9,13] In our study, 62% of patients were unaware of CL hygiene recommendations. Patients in the high-risk group had a higher prevalence of corneal ulcer and worse VA at presentation that did not improve significantly at 2-week follow-up, whereas in the medium and low-risk groups, vision had recovered significantly at 2-week follow-up (Figure 1). This high-risk group had greater visual morbidity as a result of their keratitis, which was also slower to resolve.

Dividing the patient cohort into two groups according to diagnosis (microbial keratitis vs. less severe non-infective keratitis pathology) revealed no difference in final visual outcome. There were also no statistically significant differences in presenting or final BCVA between daily, bi-weekly and monthly CL users. However, both presenting and final BCVA were significantly worse in extended wear CL users.

The patients' low level of hygiene compliance along with the low recall rates of information provided by their opticians when buying their CLs suggest that patient education and understanding of the potential risks associated with CL wear need to be improved. Among the patients who did recall

**Table 2. Extended wear contact lenses exhibited worse outcome than all other types of contact lenses for both initial and final visual acuity (VA)**

| Multiple comparisons | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Scheffe** | | | | | | | |
| **Dependent variable** | | | **Mean difference (I-J)** | **Std. error** | **p-value** | **95% confidence interval** | |
| | | | | | | **Lower bound** | **Upper bound** |
| Initial VA | Extended | Monthly | 0.85750* | 0.20061 | 0.001 | 0.2754 | 1.4396 |
| | | Bi-Weekly | 0.90833* | 0.23977 | 0.006 | 0.2126 | 1.6041 |
| | | Daily | 1.07500* | 0,20765 | 0.000 | 0.4724 | 1.6776 |
| Final VA | Extended | Monthly | 0.68792* | 0.21842 | 0.028 | 0.0541 | 1.3217 |
| | | Bi-Weekly | 0.74833 | 0.26106 | 0.050 | -0.0092 | 1.5059 |
| | | Daily | 0.68313* | 0.22608 | 0.038 | 0.0271 | 1.3392 |

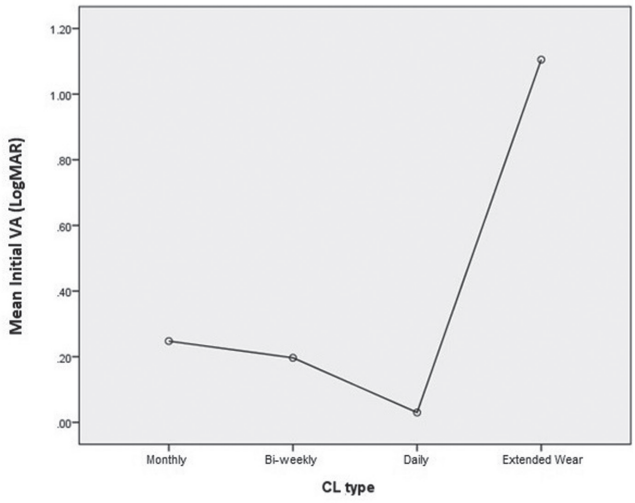


**Figure 2.** Plot of mean initial LogMAR visual acuity (VA) according to contact lens (CL) type

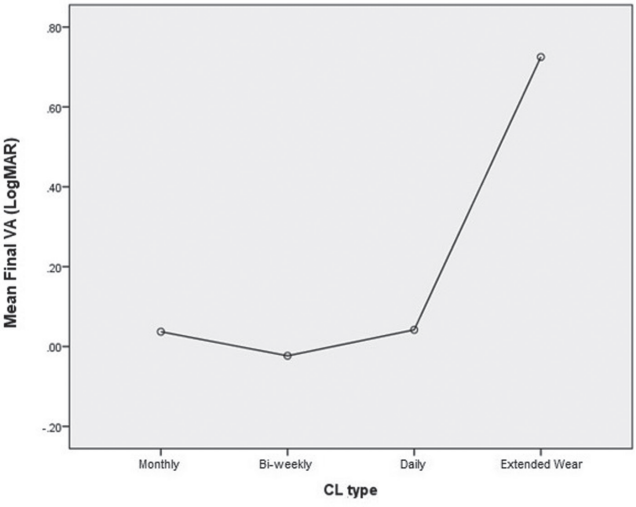


**Figure 3.** Plot of mean final LogMAR visual acuity (VA) according to contact lens (CL) type

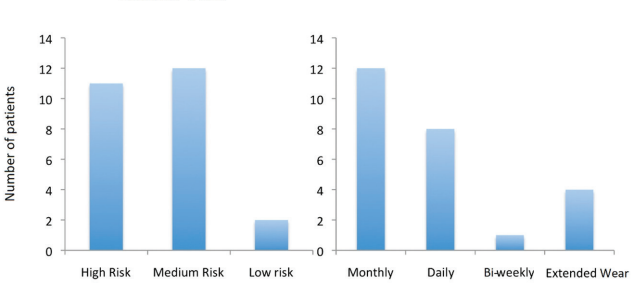


**Figure 4.** Distribution of corneal ulcer diagnoses according to risk behavior category and contact lens (CL) type

**Table 3. Patient recall of contact lens (CL) hygiene advice and risk behavior**

| Advice recall | n | % |
|---|---|---|
| No advice recalled | 31 | 62% |
| Some advice recalled:<br>Avoid sleeping in CL<br>Avoid swimming in CL<br>Avoid showering in CL | 7<br>6<br>1<br>0 | 12% |
| All advice recalled | 12 | 24% |
| Risk behavior | | |
| Sleeping in CL | 16 | 32% |
| Showering in CL | 33 | 66% |
| Swimming in CL | 27 | 54% |
| Patients who recalled all CL hygiene advice (n=12) | | |
| No risk behaviors (good CL hygiene) | 7 | |
| Sleeping in CL (moderate CL hygiene) | 1 | |
| Showering in CL (moderate CL hygiene) | 1 | |
| All risk behaviors (poor CL hygiene) | 3 | |

receiving CL hygiene advice, there was 58% compliance with the advice given. This highlights that patient education can influence CL practices and there is clearly potential to increase compliance with further education. In our study there was a strong link between poor CL hygiene and increased visual morbidity, where patients with the poorest CL hygiene had worse presenting vision and a slower visual recovery.

An interesting finding from this study was that a large proportion of patients (48%) wore monthly CLs (removed daily, replaced monthly), demonstrating the commercial prevalence of monthly CLs. Daily disposable CLs have not been found to reduce the risk of infective keratitis, but studies have indicated that patients are less likely to incur severe visual loss, thus suggesting less severe keratitis.[10,11] In our study, a higher proportion of monthly CL wearers were diagnosed with corneal ulcer than those who wore daily CL, suggesting a link between the severity of corneal infection and the type of CL used, consistent with the literature.

Of the patients presenting with corneal ulcer, 92% had poor CL hygiene practice to some degree (44% were in the high-risk and 48% in the medium-risk behavior group). All patients using extended wear CLs (day and night wear, replaced monthly) presented with a corneal ulcer rather than an epithelial defect or other diagnosis. Patients wearing extended wear CLs also had poor CL hygiene (sleeping and showering in CL), a finding that supports previous literature linking poor CL hygiene and extended CL wear to corneal infection.

The guidelines on CL hygiene advice are a contentious topic, particularly as CL wear is often commenced outside of the hospital setting, but infections or problems associated with CLs often are seen by an ophthalmologist in eye casualty. Although the Royal College of Optometrists provides guidance on CL use, our study suggests that CL hygiene advice needs to

| Table 4a. No statistical difference in visual acuity (VA) before or after treatment according to diagnosis | | | | | |
|---|---|---|---|---|---|
| **Group statistics** | | | | | |
| **Diagnosis** | | **No. of patients** | **Mean** | **Std. deviation** | **Std. error mean** |
| Initial VA | Microbial keratitis | 27 | 0.2704 | 0.59716 | 0.11492 |
| | Others | 23 | 0.2052 | 0.18263 | 0.03808 |
| Final VA | Microbial keratitis | 27 | 0.1207 | 0.58927 | 0.11340 |
| | Others | 23 | 0.0461 | 0.10003 | 0.02086 |

| Table 4b. No statistical difference in visual acuity (VA) before or after treatment according to diagnosis | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | **Levene's test for equality of variances** | | **t-test for equality of means** | | | | | | |
| | | **F** | **Sig.** | **t** | **df** | **p-value** | **Mean difference** | **Std. error difference** | **95% confidence interval of the difference** | |
| | | | | | | | | | **Lower** | **Upper** |
| Initial VA | Equal variances assumed | 2.558 | 0.116 | 0.503 | 48 | 0.617 | 0.06515 | 0.12955 | -0.19532 | 0.32563 |
| Final VA | Equal variances assumed | 2.181 | 0.146 | 0.599 | 48 | 0.552 | 0.07465 | 0.12455 | -0.17577 | 0.32508 |

be given priority and reinforced over time, as it appears to be inadequate to provide this information only once during the CL sale transaction. Another cause of concern is the possibility of purchasing CLs over the internet. Although not a popular option in our patient cohort, internet purchases pose a threat to patient education, as this domain is difficult to regulate and guidelines are difficult to enforce. This option may be preferred because it is convenient and frequently cheaper than acquiring CLs through local opticians or an ophthalmic practitioner. However, during this speedy transaction consumers could easily overlook the CL hygiene information that is normally given during a face-to-face consultation. As the COVID pandemic still looms and travel/retail restrictions exist at the time of writing, internet retailers would ideally make sure that patients purchasing CLs online read all the important hygiene information in short, simple, and user-friendly sites.

### Study Limitations

A limitation of this study is that the results are based on 50 consecutive patients that presented as an emergency to an eye casualty clinic within a period of 2 months and thus there was no control group. Our study helps to identify and elucidate the problem of continuing patient education and the feeling of complacence some people develop after a long period of CL use. Although even the strictest adherence to CL manufacturers' guidelines would not completely eliminate all corneal infections in all CL users, improvement in patient adherence to CL hygiene recommendations appears to be associated with improved visual outcome in case of a successfully treated infection. This message alone should be a great incentive for CL hygiene adherence and could be used by CL practitioners and in patient information leaflets and websites.

## Conclusion

It seems clear that there is a need to improve patient CL hygiene awareness. It appears that internet purchases have yet to soar in popularity, suggesting that opticians remain at the center of patient education. It may be beneficial for ophthalmologists to liaise more closely with opticians to reinforce the recommendations of CL hygiene and make them aware of the emergency services available. Additionally, CL wearers should be made aware of the risks associated with CLs and encouraged to reduce those risks with good CL hygiene. CL information materials should offer advice on the importance of CL hygiene, avoidance of sleeping in CLs, and when to seek medical assistance. As poor CL hygiene is an important and well-established risk factor for the development of infective keratitis, it is essential that careful CL hygiene is stressed in information leaflets and by CL fitters and vendors. Perhaps more stringent guidelines are needed, but firstly we need to re-think the way CL hygiene advice is given and reinforced.

### Ethics

**Ethics Committee Approval:** The study adhered to the tenets of Helsinki (ethical approval number: 07/H0512/39).

**Informed Consent:** Informed consent was obtained from all patients.

**Peer-review:** Externally peer reviewed.

### Authorship Contributions

Concept: M.T., I.A., C.M., S.K.S., D.A., P.H., Design: M.T., I.A., C.M., S.K.S., D.A., P.H., Data Collection or Processing: M.T., I.A., C.M., S.K.S., D.A., P.H., Analysis or Interpretation: M.T., I.A., C.M., S.K.S., D.A., P.H., Literature Search: M.T., I.A., C.M., S.K.S., D.A., P.H., Writing: M.T., I.A., C.M., S.K.S., D.A., P.H.

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