Contact lens induced keratitis associated with contact lens wear

Irene Dejaco-Ruhswurm, Ursula Scholz, Georg Hanselmayer and Christian Skorpik

Department of Ophthalmology, University of Vienna Medical School, Vienna, Austria

ABSTRACT.

Purpose: **To evaluate clinical characteristics, risk factors, management and outcome of contact lens induced keratitis (CLIK) associated with contact lens wear.**

Methods: **The study comprised all consecutive patients presenting with contact lens related presumed microbial keratitis during a 12-month period at our department. Detailed demographic data, type of contact lens, duration of lens wear, wearing schedule and lens hygiene were derived from a self-administered questionnaire. Severity of ulcer, corneal scrapings, treatment and final outcome were evaluated.**

Results: **27 patients with CLIK, some of which may have been sterile peripheral infiltrates, due to contact lens wear were detected. In the majority of the cases patients had used disposable soft contact lenses (89%) and most of them had a daily wearing schedule (78%). 51.8% patients cleaned their lenses regularly. 6 (22%) applied no disinfection since their lenses were disposable on removal. In 3 of our cases with CLIK, penetrating keratoplasty had to be performed.**

Conclusion: **Disposable contact lenses seem to have been a predisposing factor for contact lens induced keratitis also when used on a daily wear schedule. Insufficient contact lens care products and/or manufacturing characteristics may be responsible for CLIK, which is also observed in otherwise compliant contact lens users. In 3 of our patients with CLIK keratoplasty became necessary, indicating that contact lens induced keratitis may result in severe corneal complications.**

Key words: disposable contact lenses – contact lens hygiene – soft contact lenses – contact lens induced keratitis (CLIK).

Acta Ophthalmol. Scand. 2001: 79: 479–483

In the past several years there has been a steady increase in the number of contact lens users. Although most of them enjoy safe and effective visual correction with contact lenses without any adverse events, a variety of complications associated with contact lens use are well recognized. Corneal abrasions, giant papillary conjunctivitis and toxic epithelial reactions to contact lens solutions are minor complications that cause temporary discontinuation of contact lens use. The most serious and sight-threatening complication is ulcerative keratitis. It is well established that extended wear of soft contact lenses, conventional as well as disposable ones, is associated with a higher risk of contact lens related keratitis (Mondino et al. 1986; Schein et al. 1989; Poggio et al. 1989; Maguen et al. 1991; Buehler et al. 1992; Matthews et al. 1992). As a consequence of these studies, extended wear of contact lenses, conventional as well as disposable ones, decreased because practitioners in many countries prefer a daily wear (DW) schedule. Accordingly, manufactures have defined that their disposable contact lenses may be applied either as single used lenses, which are disposed of when taken out of the eye after the recommended time, or as DW lenses, which are taken out and disinfected every night and are disposed after 2–4 weeks.

In Austria patients are instructed by ophthalmologists not to use any contact lenses on an extended wear basis. Ophthalmologists especially recommend the use of disposable contact lenses for DW only. In line with this assumption, at our department we have evaluated the clinical characteristics, risk factors, clinical management and outcome of contact lens induced keratitis associated with contact lens wear.

Methods

The study comprised all consecutive patients presenting with contact lens induced keratitis (CLIK) during a 12-month period (1998) at the University Eye Clinic, Vienna. Detailed information on the type of CL, duration of wear, schedule and lens hygiene was derived from a self-administered questionnaire. “Extended wear” was defined as a 24-hour use at least once per week, less frequent overnight wear was defined as “daily wear”. In accordance with the clinical aspects (the site of the major part of the keratitis), patients were assigned to one of two categories, namely central keratitis, presenting in a central, approximately 6 mm diameter zone of the cornea, and peripheral keratitis, manifesting within 2 mm of the limbus. Corneal scrapings with Gram’s stain microscopy and culture with antibiotic sensitivity

Table 1. Characteristics of contact lens wearers examined for contact lens induced keratitis (CLIK) were clinically divided into central CLIK and peripheral CLIK. Values are expressed in numbers (percentages).

	All cases of CLIK (n=27)	Central CLIK (n=10)	Peripheral CLIK (n=17)
Mean age (±SD)	28.8 (±9.5)	25.6 (±7.6)	30.7 (±10.2)
Sex (females/males)	13/14	3/7	10/7
Contact lens type:			
Non-disposable soft CL	2 (7.4)	1 (10.0)	1 (5.9)
Disposable soft CL	24 (88.9)	9 (90.0)	15 (88.2)
Rigid gas-permeable	1 (3.7)	0	1 (5.9)
Wearing schedule:			
Daily wear	21 (77.8)	7 (70.0)	14 (82.3)
Extended wear (disposable SCL only)	6 (22.2)	3 (30.0)	3 (17.7)
Contact lens disinfection:			
H_2O_2-systems	2 (7.4)	1 (10.0)	1 (5.9)
Other chemical agents (all-in-one solutions)	19 (70.4)	6 (60.0)	13 (76.4)
None (Disposal on removal)	6 (22.2)	3 (30.0)	3 (17.7)
Disinfection frequency:			
Daily	14 (51.9)	6 (60.0)	8 (47.0)
Irregular	7 (25.9)	1 (10.0)	6 (35.3)
None (Disposal on removal)	6 (22.2)	3 (30.0)	3 (17.7)

Table 2. Isolated microorganisms of corneal scrapings. Values are expressed in numbers (percentages).

	Central CLIK (n=10)	Peripheral CLIK (n=17)
Isolated microorganisms:		
Pseudomonas	5 (50.0)	4 (23.5)
CNS	2 (20.0)	0
α Haem strep	1 (10.0)	4 (23.5)
Acanthamoeba	1 (10.0)	0
No growth	1 (10.0)	5 (29.5)
No culture	0	4 (23.5)

CNS=coagulase negative staphylococci, α Haem strep=α haemolytic streptococci.

Table 3. Management and outcome for central and peripheral CLIK. Values are expressed in numbers (percentages).

	Central CLIK (n=10)	Peripheral CLIK (n=17)
Management		
Local antibiotics only	5 (50)	13 (76.5)
Additional systemic antibiotics	5 (50)	4 (23.5)
Surgical treatment (PKP)	3 (30)	0
Outcome (last follow-up)		
Visual acuity (±SD)	0.76 (±0.3)	0.91 (±0.2)

PKP=penetrating keratoplasty, SD=standard deviation.

tests were performed for all but 4 patients. Initially, therapy management comprised an empirical first line broad-spectrum antimicrobial treatment with topical gentamicin and ofloxacin or ciprofloxacin. In case of severe anterior segment inflammation with hypopyon, an additional systemic broad-spectrum antimicrobial substance with meropenem or vancomycin was administered. Additional microbiological tests (e.g. Acanthamoeba) were only performed if the disease was progressive and treatment considered a failure. With positive microbial culture findings, treatment was modified accordingly.

Final visual outcome at the last follow-up was evaluated. A Students t-test was applied to compare the visual results of the two clinical categories. A p-value of <0.05 was considered statistically significant.

Using the data of one marketing research institute in Austria (GFK Fessel), the distribution of the different contact lens types among Austrian contact lens users as well as the number of persons wearing contact lenses in Austria were assessed.

Results

27 patients with contact lens induced keratitis (CLIK) due to contact lens wear have been found. Of these, 10 patients had a central ulcerative keratitis and 17 a peripheral one.

The mean age of all patients was 28.8±9.5 years, 13 were female and 14 male. 2 (7%) patients used non-disposable soft contact lenses, 24 (89%) disposable ones and one (4%) wore a rigid gas-permeable lens. The type used by the 24 disposable soft contact lens wearers was Etafilcon A – 1 Day in one case (4%), Etafilcon A – Acuvue in 9 cases (38%), Etafilcon A – Surevue in 2 cases (8%) and Viflicon – Focus in 12 cases (50%). 21 (78%) of the total number of patients had a daily wearing schedule and 6 (22%) used their contact lenses on extended wear. Mean wearing time per day was 15.2±4.1 hours. Patients used their contact lenses at a mean of 6.4±1.0 days per week. For lens disinfection hydrogen peroxide systems were applied in 2 (7%) cases and other chemical systems (all-in-one solutions) in 19 (70%) cases. 14 (52%) patients disinfected daily, 7 (26%) stated that they disinfected irregularly. 6 (22%) applied no disinfecting agent because their lenses were disposable on removal. Three patients, all of them with central keratitis, admitted that they did not dispose the contact lenses at the recommended time. Table 1 gives detailed information on the type of contact lens, duration of wear, schedule and lens hygiene for all patients, both with central CLIK and peripheral CLIK.

Table 2 shows the isolated microorgan-

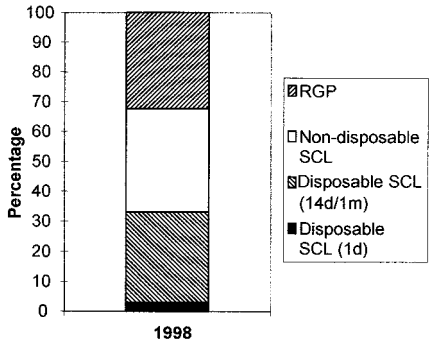

Fig. 1. Contact lens wearers in Austria, 1998 (RGP=rigid gas-permeable lenses, SCL=soft contact lenses).

isms that were found in the central and the peripheral CLIK cases.

Therapy with antibiotics was only topical in 18 (67%) patients, additional systemic therapy was necessary in 9 (33%) cases. Management schedule of the two groups (central and peripheral) are presented in Table 3. The regimen for *Acanthamoeba* keratitis was a combination of chlorhexidine and propamidine.

In three out of the 10 (30%) cases with central CLIK, penetrating keratoplasty was performed. Isolated microorganisms in the keratoplasty cases were Pseudomonas (n=1), *Acanthamoeba* (n=1) and in one case not identified.

At the last follow-up 10.7±5.6 months after the first visit to our department, visual outcome was evaluated. At that time the 3 keratoplasty patients had already been surgically treated. Best corrected visual acuity in the patients with central CLIK was 0.76±0.3 and 0.91±0.3 in the patients with peripheral CLIK (p=0.12) (Table 3).

The distribution of the different contact lens types on the Austrian market is presented in Fig. 1.

Discussion

In Austria approximately 4.5 million patient wear glasses, of these 450 000 persons use contact lenses (GFK Fessel, 1999). The most serious and sight-threatening complication associated with contact lens use is ulcerative keratitis. Disposable contact lenses were introduced in the expectation that their use would decrease the risks of severe contact lens-related complications (Nilsson 1997). Nevertheless, in our study disposable soft contact lenses seem to be a risk factor for developing contact lens induced keratitis. 89% of our patients with keratitis used this type of contact lens. Our conclusion is supported by the fact that according to a marketing institute in Austria only 33.2% of all contact lens wearers use disposable lenses, leading to the assumption that the wearers of disposable contact lenses in our cases with contact lens induced keratitis are over-represented. However, since the inquiries of a marketing institute are distributed to a fairly limited part of the population, this hypothesis should be taken with caution. Another potential limitation of our study is the use of a possibly unrepresentative hospital population.

Our results are in concordance with the results of others (Buehler et al. 1992; Matthews et al. 1992; Cohen et al. 1996; Radford et al. 1998), also describing an increased risk of contact lens induced keratitis among daily wear disposable soft contact lens users. However, whether daily wear of disposable contact lenses harbours an increased risk of corneal complications as compared to conventional contact lens users is still matter of debate since others (Nilsson & Montan 1994; Poggio & Abelson 1993) did not find such an association.

Extended wear of soft contact lenses increases the risk of corneal ulcers dramatically (Schein et al. 1989; Poggio et al. 1989; Buehler et al. 1992; Matthews et al. 1992). As already mentioned, in Austria patients are instructed by ophthalmologists not to wear any contact lenses on an extended wear schedule. Nevertheless, we had 6 users of contact lenses on extended wear in our group. This may be due to inadequate compliance among those patients or due to the interesting fact that all but one of these 6 patients did not have their contact lens fitting done by an ophthalmologist. They had their contact lenses fitted at an optician and therefore may not have had sufficient information on lens wear and care. In the future, the lack of regular professional checks of contact lens fitting and integrity after the initial fitting may be an increasing problem due to the possibility of buying lenses via the Internet where ophthalmologic examinations are not a prerequisite.

We also had 3 patients with central microbial keratitis who did not adhere to the advised disposal time for their contact lenses. There are certainly cost issues for the user whenever he/she extends the recommended wearing time; this is also a major problem with disposable contact lenses. Thus, lens practitioners should carefully advise patients as to the proper lens care and replacement regimen and explain the consequences of improper handling and extended wear. However,

Fig. 2. Peripheral contact lens induced keratitis.

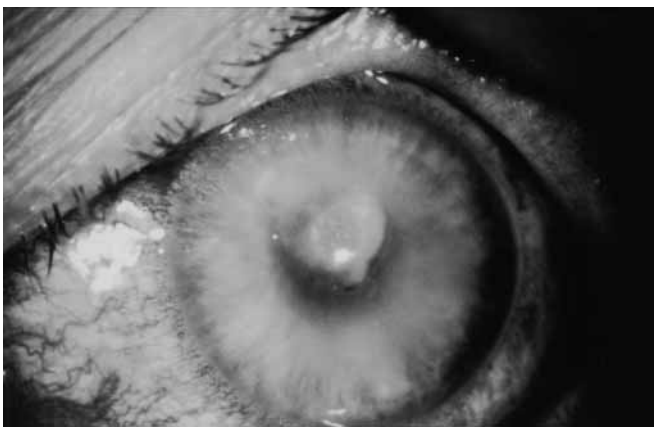

Fig. 3. Central contact lens induced keratitis.

long daily hours (mean 15.2 hours per day) and frequent contact lens use (mean 6.4 days per week) as observed in our patients may also contributed to CLIK.

We did not find any differences in the risk of contracting contact lens induced keratitis among the manufacturers of the disposable contact lenses, but our study also did not have the statistical power to prove this.

Experimental studies have indicated that infectious keratitis might be related to lower lens oxygen permeability (Ren et al. 1999; Latkovic & Nilsson 1997). However, the reasons that may be responsible for the higher prevalence of contact lens induced keratitis in wearers of disposable contact lenses are a matter of debate. It is known that fitting parameters available for disposable lenses are limited as compared to conventional ones (Maguen at al. 1989); as a consequence in some cases this may lead to a tighter lens fit.

Only 26% of our patients admitted irregular disinfection of their contact lenses. In these cases improper lens hygiene may have been the cause for corneal infection, but the majority of our patients (52%) stated that they cleaned their contact lenses regularly. Contact lens cleaning systems used by our patients were H_2O_2-systems and all-in-one solutions. Chlorine-based solutions, as were widely used in the United Kingdom and reported to be ineffective (Lowe et al. 1992), are not applied in Austria. Low efficacy of some generally used contact lens care products (Kramer et al. 1992) may be responsible for contact lens induced keratitis as observed in otherwise compliant contact lens users. Hydrogen peroxide systems with a brief exposure time, for example, are not effective against *Acanthamobia* since these microorganisms need 2 hours of exposure time (Silvany et al. 1990). Moreover, popular chemical systems containing polyaminpropylbiguanide, the disinfecting agent our patient with *Acanthamobia* keratitis used, are known to be ineffective against this infection (Silvany et al. 1990). Thus, in the future better disinfection systems will be needed. Further, contact lens cases are recognized to be a potential source of microorganisms, since they are often not cleaned properly (Gray et al. 1995), however, contact lens case contamination was not evaluated in our study.

Interestingly enough, 6 (22%) of the 27 patients with CLIK were culture-negative. All but one of them had peripheral ulcers and these patients probably had sterile corneal infiltrates. This phenomenon, especially in association with soft contact lens wear and concurrent poor contact lens hygiene, has been reported previously (Stein et al. 1988; Bates et al. 1989; Donshik et al. 1995). These infiltrates are suggested to be due to immunological or toxic reactions to contact lens material or to the contact lens disinfecting systems used (Binder et al. 1981). Also, Gram-negative bacteria that adhere to the contact lenses may be associated with these corneal infiltrates (Holden et al. 1996). However, 8 (47.0%) out of 17 patients with peripheral ulcers were culture-positive, leading us to the conclusion that microbial keratitis may not be excluded in patients with peripheral keratitis.

The clinical outcome of patients with peripheral contact lens induced keratitis with a mean visual acuity of 0.9, though statistically not significant, was better than of those with central CLIK (0.8; $p=0.12$). Penetrating keratoplasty had to be performed only in patients with central CLIK, leading to lifelong visual disturbances in otherwise healthy young persons.

In the future it is hoped that the introduction of a cost-competitive one-day disposable lens, obviating the need for disinfection, with improved oxygen transmissibility will lower the incidence of severe corneal complications and diminish the attraction of overnight wear.

In conclusion, we found that disposable contact lenses seem to have been a predisposing factor for contact lens induced keratitis, also when used on daily wearing basis. Insufficient contact lens care products and/or contact lens properties may be responsible for ulcerative keratitis observed in otherwise compliant users. In 3 of our 10 central CLIK patients keratoplasty became necessary, indicating that contact lens induced keratitis may result in severe corneal complications. However, with the expanding population of disposable contact lens users, it will be necessary to perform further studies in order to know more about the risk factors in this group.

References

Bates AK, Morris RJ, Stapelton F, Minassian DC & Dart JKG (1989): Sterile corneal infiltrates in contact lens wearers. Eye 3: 803–810.

Binder PS, Rasmussen DM & Gordon A (1981): Keratoconjunctivitis and soft contact lens solutions. Arch Ophthalmol 99: 87–90.

Buehler PO, Schein OD, Stanler JF, Verdier DD & Katz J (1992): The increased risk of ulcerative keratitis among disposable soft contact lens users. Arch Ophthalmol 110: 1555–1558.

Cohen EJ, Fulton JC, Hoffman CJ, Rapuano CJ & Laibson PR (1996): Trends in contact lens-associated corneal ulcers. Cornea 15: 566–570.

Donshik PC, Suchecki JK & Ehlers WH (1995): Peripheral corneal infiltrates associated with contact lens wear. Trans Am Ophthalmol Soc 93: 49–60.

Holden BA, La Hood D, Grant T, Newton-Howes J, Baleriola-Lucas C, Willcox MD & Sweeney DF (1996): CLARE (contact lens associated red eye) due to Gram negative bacteria. CLAO J 22: 47–52.

Gray TB, Cursons RT, Sherwan JF & Rose PR (1995): Acanthamoeba, bacterial, and fungal contamination of contact lens storage cases. Br J Ophthalmol 79: 601–605.

Kramer A, Wernet M, Rudolph P, Werner HP, Adam C & Jülich WD (1992): Fitting soft contact lenses: A neglected infection hazard. Hyg Med 20: 278–291.

Latkovic S & Nilsson SE (1997): The effect of high and low Dk/L soft contact lenses on the glycocalyx layer of the corneal epithelium and on the membrane associated receptors for lectins. CLAO J 23 (3): 185–191.

Lowe R, Vallas V & Brennan NA (1992): Comparative efficacy of contact lens disinfection solutions. CLAO J 18 (1): 34–40.

Maguen E, Tsai JC, Martinez M, Rosner I, Cot PC, Macy JI & Nesburn AB (1991): A retrospective study of disposable extended wear lenses in 100 patients. Ophthalmology 98: 1685–1689.

Matthews TD, Frazer DG, Minassian DC, Radford CF & Dart JKG (1992): Risks of keratitis and patterns of use with disposable contact lenses. Arch Ophthalmol 110: 1559–1562.

Mondino BJ, Weissman BA, Farb MD & Pettit TH (1986): Corneal ulcers associated with daily-wear and extended-wear contact lenses. Am J Ophthalmol 102: 58–65.

Nilsson SEG & Montan PG (1994): The hospitalized cases of contact lens induced keratitis in Sweden and their relation to lens type and wear schedule: Results of a three-year retrospective study. CLAO J 20 (2): 97–101.

Nilsson SEG & Montan PG (1994): The annualized incidence of contact lens induced keratitis in Sweden and its relation to lens type and wear schedule: Results of a 3-month prospective study. CLAO J 20 (4): 225–230.

Nilsson SEG (1997): Ten years of disposable contact lenses – A review of benefits and risks. Contact Lens and Anterior Eye. 20 (4): 119–128.

Poggio EC & Abelson MB (1993): Complications and symptoms with disposable daily

wear contact lenses and conventional soft daily wear contact lenses. CLAO J 19 (2): 95–102.
Poggio EC, Glynn RJ, Schein OD, Seddon JM, Shannon MJ, Scarding VA & Kenyon KR (1989): The incidence of ulcerative keratitis among users of daily-wear and extended-wear soft contact lenses. N Engl J Med 321: 779–783.
Radford CF, Minassian DC & Dart JK (1998): Disposable contact lens use as a risk factor for microbial keratitis. Br J Ophthalmol 82: 1272–1275.
Ren DH, Petroll WM, Jester JV, Ho-Fan J & Cavanagh HD (1999): The relationship between contact lens oxygen permeability and binding of pseudomonas aeruginosa to human corneal epithelial cells after overnight and extended wear. CLAO J 25 (2): 80–100.
Schein OD, Glynn RJ, Poggio EC, Seddon JM & Kenyon KR (1989): The relative risk of ulcerative keratitis among users of daily-wear and extended-wear soft contact lenses. N Engl J Med 321: 773–778.
Silvany RE, Dougherty JM, McCulley JP, Wood TS, Bowman RW & Moore MB (1990): The effect of currently available contact lens disinfection systems on Acanthamoeba castellani and Acanthamoeba polyphaga. Ophthalmology 97: 286–290.
Stein RM, Clinch TE, Cohen EJ, Genvert GI, Arentsen JJ & Laibson PR (1988): Infected vs sterile corneal infiltrates in contact lens wearers. Am J Ophthalmol 105: 632–636.

Received on January 28th, 2001.
Accepted on June 15th, 2001.

Correspondence:
Dr. Irene Dejaco-Ruhswurm
Department of Ophthalmology
University of Vienna
Medical School
Allgemeines Krankenhaus
Waehringer-Guertel 18–20
1090 Vienna
Austria
Tel: +43 1 40400 7931
Fax: +43 1 40400 7942
e-mail: irene.ruhswurm@univie.ac.at