SHORT COMMUNICATIONS & CASE REPORTS

Orthokeratology associated microbial keratitis

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PURPOSE. *To report the clinical course, microbiologic findings, treatment, and outcomes of overnight orthokeratology associated microbial keratitis.*
METHODS. *Four cases of overnight orthokeratology associated microbial keratitis are reported.*
RESULTS. *Four patients aged 14–23 years (mean 18 years) who had central or paracentral corneal ulcers were included. Visual acuity at presentation ranged from 20/30 to hand motion. In all cases Pseudomonas aeruginosa was cultured from corneal scrapings or storage solution. In all patients the infection resolved with intensive topical antimicrobial treatment. Final best-corrected visual acuity ranged from 20/25 to 20/200 according to the location, size, and density of the corneal scar, which complicated all cases.*
CONCLUSIONS. *Infectious keratitis is a significant, visual threatening complication of overnight orthokeratology. Eye care practitioners should be aware of this complication and educate their patients of the importance of lens hygiene and prompt medical care when symptoms or signs of keratitis appear. (Eur J Ophthalmol 2009; 19: 133-6)*

KEY WORDS. *Orthokeratology, Microbial keratitis*

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INTRODUCTION

Orthokeratology (OKL) is a method designed to temporarily reduce myopia by flattening the corneal curvature. The procedure was first described in the 1960s (1). Several investigations in the 1970s and 1980s using flattening polymethyl methacrylate (PMMA) lenses, with a base curve of the lens flatter than the central corneal curve, showed unpredictable and inconsistent results (2-5). However, the recent introduction of reverse geometry contact lens designs and new rigid gas-permeable (RGP) materials with high oxygen transmission has shown more promising outcomes for OKL with overnight wearing of gas permeable lenses (6, 7). The reverse geometry contact lens has a flat central curvature with a steep secondary curve which improves the centration and stability of the lens (8). Recent studies suggest that this treatment modality is primarily effective through central epithelial thinning and midperipheral epithelial and stromal thickening (9). However, concerns exist regarding the possible harm of overnight lens wear and lens shape on corneal physiology. Complications reported with OKL include corneal edema, abrasions, scarring, keratoconic changes, and induced astigmatism (3, 6). A serious vision-threatening complication is infectious keratitis, which has also been reported in the literature (9-19).

In this series, four cases of OKL-related corneal ulcers in adults and adolescents are described. We review the clinical and microbiologic features and outcome of overnight OKL-associated microbial keratitis.

Case reports

Case 1

A 23-year-old man was referred to our medical center from another hospital.

He had used OKL contact lenses for 1 year to treat myopia of –2.00 diopters (D) in both eyes. The lenses were worn 6–8 hours every night and cleaned with a multipur-

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pose solution. Before admission he received treatment with topical antibiotics for a corneal ulcer in his left eye (LE) with no improvement. Conjunctival cultures were negative (corneal cultures were not taken).

At presentation, visual acuity in the LE was hand motion only. A central corneal ulcer was observed with clouding of the surrounding corneal stroma due to severe infiltration, and the corneal periphery was edematous. There was a 1 mm hypopyon in the anterior chamber (AC). Cultures were obtained from the conjunctiva, corneal scraping, and storage solution. Treatment was initiated with topical application of Cefamezin (133 mg/cc) and Garamycin (14 mg/cc) hourly and cycloplegia. The patient was also treated with intravenous Tazocin (4.5 g x3/d) and vancomycin (2 g x2/d) which was later switched to Meronem (1 g x3/d) because of an allergic reaction. A Gram staining smear and cultures from the conjunctiva and cornea did not reveal any pathogens, but *Pseudomonas aeruginosa* resistant to Cefamezin was grown from the storage solution culture. Topical Cefamezin was stopped and ciprofloxacin was added with a satisfactory response.

The corneal ulcer healed leaving a 5 x 4.5 mm central corneal scar. Best-corrected visual acuity (BCVA) recovered at 3 months follow-up to 20/200 with –1.75 D.

Case 2

An 18-year-old woman was referred by her optometrist with a red painful right eye (RE) and suspected corneal infiltrates. She had used OKLs for 3 months to treat myopia of –2.00 D in both eyes. The lenses were fitted by the optometrist, worn 6–8 hours every night, and cleaned with a multipurpose solution.

At presentation, visual acuity in her RE was 20/30 with a correction of –2.00 D. A 2 x 2 mm paracentral corneal ulcer with a 1 mm hypopyon were noted in the RE. After obtaining corneal scrapings, treatment was started with topical Cefamezin (133 mg/cc) and Garamycin (14 mg/cc) hourly and cycloplegia. She was further treated with intravenous Fortum (1 g x3/d). Nevertheless, visual acuity dropped to 2 meter finger count as a result of diffuse corneal infiltration and edema. Corneal scraping revealed *P aeruginosa* and *Klebsiella*, resistant to Cefamezin and Garamycin. Topical treatment with Cefamezin and Garamycin were stopped, and ciprofloxacin was added with satisfactory response. The corneal ulcer healed, leaving a 1.2 x 1 mm faint paracentral scar. Her final BCVA with a correction of –2.75 –1.25 x170º was 20/25.

Case 3

A 16-year-old boy was referred with photophobia, decreased vision, and progressive pain in his LE. He had been previously fitted with OKLs to treat moderate myopia. For initial evaluation, he was instructed to wear the contact lenses during the day for 8–10 hours. One evening he fell asleep wearing his OKLs. The following day he had progressive pain, photophobia, and decreased vision. At presentation, his visual acuity was 20/40 in the LE. A large central corneal ulcer surrounded by epithelial edema and hazy stroma was seen. Furthermore, cells and flare (+2) were noted in the anterior chamber. Corneal scrapings and the contact lenses were sent for cultures and were positive for *P aeruginosa*. He was treated with topical vancomycin (50 mg/mL) and ceftazidime (50 mg/mL) hourly. A slow improvement was noted with gradual resolution of the keratitis. Treatment was modified to ofloxacin with fluorometholone added later in a tapered regimen.

At 6-month follow-up examination, his BCVA was 20/50 with a residual central corneal scar.

Case 4

A 14-year-old girl presented with a 4-day red painful eye. She had been using OKLs for a year and a half due to myopia. She claimed she had cleaned the lenses properly.

Upon admission her BCVA was 20/50. Biomicroscopic examination revealed a midperipheral 2.7 mm diameter corneal ulcer with moderate inflammation in the anterior chamber. Corneal cultures were positive for *P aeruginosa*. She was successfully treated with fortified ceftazidime (50 mg/mL) and Garamycin (14 mg/mL) hourly.

After the epithelial defect healed, 0.1% dexamethasone phosphate eyedrops were added four times a day. Two months later, her BCVA was 20/25, with a small superficial stromal residual scar.

DISCUSSION

OKL has gained increased popularity for the treatment of myopia. However, despite its clinical success, there is a growing number of reports of microbial keratitis in association with their use.

In 2001, Chen et al (10) were the first to report a case of *Serratia marcescens* corneal infection in an overnight OKL

wearer. Since then, several case reports and series have been reported in the literature. Most of these cases come from Asia (20) due to the widespread use of OKLs. This is due to the high prevalence of myopia in this region (21, 22) and the as yet unconfirmed hope that overnight OKLs may provide some degree of myopic control. The predominant patient group wearing overnight OKLs and experiencing microbial keratitis in East Asia are children aged 9–15 (23). In our series the patients were older, aged 14–23, as the use of OKLs in children is less frequent in our country. There is however an ongoing local study of OKL in children with favorable 1-year follow-up results.

Overnight wear of OKLs seems to have a principal role in the pathogenesis of infectious keratitis as in all types of contact lens users (24, 25). Several studies have shown that overnight contact lens wear, including of high oxygen transmissibility rigid gas permeable lenses, impairs the epithelial barrier because of the reduced oxygen transmission through the contact lens (26). In addition, a lack of eye movements, which helps spread lysozymes over the corneal surface and disrupt bacterial glycocalyx, can render the eye more susceptible to bacterial infection (27, 28). OKLs may exert compressive forces on the cornea, affecting the redistribution of an already compromised corneal epithelium. Thus, their inherent effect on epithelial thinning, local corneal trauma, and ulceration may predispose the cornea to infection.

Review of the literature reveals that *P aeruginosa* is the most frequently isolated pathogen, isolated in more than 50% of cases of microbial keratitis associated with OKLs (20) and in 100% of cases in our series. This is not surprising, as *P aeruginosa* is the most common pathogen in contact lens–related corneal ulcers (24-26). Araki-Sasaki et al (19) described the characteristics of *Pseudomonas* corneal infections related to OKLs. They showed reduced susceptibility of *P aeruginosa* to antibiotics, and glycocalyx slime formation under hypoxic conditions. The second most frequently isolated pathogen was *Acanthamoeba*, with up to 30% of reported cases attributable to this pathogen (20). An even higher rate of *Acanthamoeba* (8 of 16 cases) was reported in a case series in the Chinese literature. Accordingly, *Acanthamoeba* should be taken into consideration in a patient with atypical keratitis after OKLs. However, the main risk factors for *Acanthamoeba* keratitis are contamination from water sources such as tap water, spas, and swimming pools (29, 30). These risk factors were not present in our patients, who had *Pseudomonas* keratitis rather than *Acanthamoeba* keratitis.

All of the ulcers in our cases, as in the literature, were either central or paracentral. This may be due to the points of contact between the lens and cornea at the center (18) and secondary curve junction at the paracentral region (16, 17). This paracentral region is under the steeper portion of the optic of the OKL. As it is steeper than the lens periphery, this makes it difficult to clean with simple finger rubbing. Thus proteins remain on the lens surface, providing a substrate for bacterial proliferation (19).

After obtaining corneal scraping for cultures, intensive topical antimicrobial treatment was started, including a combination of aminoglycosides and cephalosporins in three of our four cases and aminoglycosides with vancomycin in the fourth. This combination therapy of aminoglycosides with cephalosporins was also the most commonly used in cases reported in the literature. Other treatment options were cephalosporins, aminoglycosides, or fluoroquinolones in isolation. In two of our cases, systemic antibiotic treatment was also initiated according to an infectious specialist recommendation; this was used in only one case in the literature (19). In other patients, local steroidal treatment was added after the epithelial defect healed. This was previously reported in only one case, where oral prednisone was used (19). These variations in the systemic antibiotic and steroidal treatment reflect different approaches at different medical centers, with local antibiotic treatment being the common regimen.

The BCVA varied from 20/20 to hand motion according to the location, size, and density of the corneal scar. Other reported complications were secondary cataract in two cases and secondary glaucoma in one case (31), all caused by *Acanthamoeba* and ultimately affecting the visual outcome.

Here, we report the first series of OKL-related infectious keratitis in Israel. It is not known if OKLs are associated with a higher risk of infection, as there are no reliable data on the number of patients wearing such lenses and the absolute number of infectious keratitis related to OKLs. However, eye care practitioners should be aware of this complication, and educate their patients to the importance of strict lens hygiene and seeking prompt medical attention if symptoms or signs of keratitis appear.

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