Orthokeratology-Associated Infectious Keratitis in a Tertiary Care Eye Hospital in Hong Kong

TOMMY C.Y. CHAN, EMMY Y.M. LI, VICTORIA W.Y. WONG, AND VISHAL JHANJI

• PURPOSE: To analyze cases of orthokeratology-associated infectious keratitis managed in a tertiary care eye hospital in Hong Kong between 2003 and 2013.
• DESIGN: Retrospective study.
• METHODS: Case records of patients with infectious keratitis attributable to orthokeratology contact lenses were analyzed. Data analyzed included clinical features, microbiological evaluation, and treatment outcomes.
• RESULTS: A total of 23 patients were included (16 female, 7 male, mean age: 15.0 ± 4.2 years; range: 9–23 years). All patients were using overnight orthokeratology for an average of 2.7 ± 2.8 years (range: 3 months - 10 years) before the onset of infection. Clinical features included corneal infiltrate (n = 14, 60.9%) and corneal perineuritis (n = 12, 52.2%). Fifteen eyes (65.2%) had a positive microbiological culture obtained from corneal scrapings. The most commonly isolated organism was *Pseudomonas aeruginosa* (n = 6), followed by coagulase-negative *Staphylococcus* (n = 5) and *Acanthamoeba* (n = 3). Five cases of *Pseudomonas aeruginosa* and 5 cases of *Acanthamoeba* were identified from contact lenses or contact lens solution. The mean duration from disease onset to remission was 31.9 ± 34.9 days (range: 6–131 days). All patients responded to medical treatment, and no emergency surgical intervention was needed. The best-corrected logMAR visual acuity improved significantly from 0.62 ± 0.51 (20/83 Snellen) to 0.15 ± 0.20 (20/28 Snellen) (Wilcoxon signed rank test, $P < .001$).
• CONCLUSIONS: Orthokeratology-associated infectious keratitis continues to be a serious problem, especially in regions with high prevalence of myopia. Early clinical and microbiological diagnosis and intensive treatment can improve final visual outcomes. (Am J Ophthalmol 2014;158:1130–1135. © 2014 by Elsevier Inc. All rights reserved.)

ORTHOKERATOLOGY IS A NONSURGICAL METHOD for myopia reduction. It aims to improve unaided visual acuity by the application of rigid contact lenses.[1] Reverse-geometry gas-permeable contact lenses that have a base curve flatter than the central corneal curvature and a secondary curve steeper than the base curve radius induce central corneal flattening for correction of myopia.[2] With availability of lens materials with higher oxygen transmissibility, overnight orthokeratology allows patients to achieve an improved unaided vision during daytime. Hong Kong has one of the highest prevalence rates of myopia, with 61.5% of children myopic by the age of 12 years.[3] Consequently, orthokeratology is an appealing option for parents in this part of the world. However, orthokeratology has been reported to be associated with adverse effects, which range from variability in visual acuity and decrease in quality of vision to sight-threatening infective keratitis.[4,5] Over 100 cases of orthokeratology-related infective keratitis have been reported since 2001 in the literature, mainly from East Asia, including China, Taiwan, and Hong Kong.[4] In a review of all reported cases of orthokeratology-related keratitis between 2001 and 2007, the peak year for occurrence was in the early years, followed by a decreasing trend afterwards.[5]

We analyzed the clinical and microbiological characteristics and clinical outcomes of orthokeratology-related keratitis, cases of which were treated at the Hong Kong Eye Hospital between 2003 and 2013.

METHODS

A RETROSPECTIVE CHART REVIEW WAS CONDUCTED FOR all patients with orthokeratology-associated infectious keratitis admitted to the Hong Kong Eye Hospital between January 2003 and December 2013. Cases were identified using the diagnostic codes "Corneal disorder due to contact lens" and "Keratitis" from the Clinical Data Analysis and Reporting System of the Hong Kong Hospital Authority. Exclusion criteria included non-orthokeratology cases and cases treated on an outpatient basis. Medical records were traced, and clinical information was retrieved for analysis. Patients were diagnosed to have infectious keratitis clinically under slit-lamp examination by the presence of an epithelial defect, stromal infiltrate, or specific signs such as perineuritis. Corneal scrapings were performed in all cases for microbiological investigations, including Gram stain. Microbiological samples were inoculated onto blood agar, chocolate agar, Sabouraud's dextrose agar, and non-nutrient agar culture plates. Contact lenses

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From Hong Kong Eye Hospital, Hong Kong SAR, China; and Department of Ophthalmology & Visual Sciences, The Chinese University of Hong Kong, Hong Kong SAR, China.
Inquiries to Vishal Jhanji, Department of Ophthalmology and Visual Sciences, The Chinese University of Hong Kong, Hong Kong; e-mail: vishaljhanji@gmail.com

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TABLE 1. Year-Wise Trend for Orthokeratology-Related Cases With Keratitis in Comparison to Contact Lens–Related Keratitis Cases and Overall Keratitis Cases Admitted to Hong Kong Eye Hospital Between 2003 and 2013

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Total
OrthoK keratitis (cases)	2	3	1	1	1	3	1	1	1	4	5	23
CL keratitis (cases)	6	11	18	20	10	7	5	10	10	9	15	121
Overall keratitis (cases)	37	33	46	62	32	24	22	33	37	39	28	393
Proportion of OrthoK keratitis in CL keratitis (%)	33.3	27.3	5.6	5.0	10.0	42.9	20.0	10.0	10.0	44.4	33.3	19.0
Proportion of OrthoK keratitis in total microbial keratitis (%)	5.4	9.1	2.2	1.6	3.1	12.5	4.5	3.0	2.7	10.3	17.9	5.9
OrthoK *Acanthamoeba* (cases)	0	2	0	1	1	2	0	0	0	3	3	12
CL *Acanthamoeba* (cases)	2	3	5	5	3	5	2	1	0	4	2	32

CL = contact lens–associated; OrthoK = orthokeratology-associated.

and storage solutions were also obtained for microbiological cultures. All patients received intensive empirical broad-spectrum antimicrobial or amoebicidal therapy. The treatment was modified according to culture and sensitivity results as well as the clinical response after admission.

The study was approved by the Institutional Review Board of the hospital and adhered to the tenets of the Declaration of Helsinki. Statistical analysis was performed using PASW software version 18.0 (SPSS/IBM, Inc, Chicago, Illinois, USA). *P* values of .05 or less were considered to be statistically significant.

RESULTS

OVERALL, 23 PATIENTS (16 FEMALE, 7 MALE) WERE INCLUDED in this study (Table 1). The mean age of patients was 15.0 ± 4.2 years (range: 9–23 years). All patients had unilateral ocular involvement (14 right eyes, 9 left eyes). Patients were using overnight orthokeratology for an average of 2.7 ± 2.8 years (range: 3 months–10 years) before the onset of infection. There were no other associated risk factors. All patients claimed to have good contact lens hygiene and did not recall any prior ocular injury. Moreover, none of them suffered from ocular surface diseases or systemic illness. Fourteen patients had received previous treatment from other ophthalmologists in the form of amoebicidal eye drops, topical fluoroquinolones, aminoglycosides, and antiherpetic eye ointment. The mean duration from onset of disease to hospital admission was 16.5 ± 30.2 days (range: 1–122 days). All patients presented with painful red eyes and reduced visual acuity. The best-corrected logMAR visual acuity at presentation was 0.62 ± 0.51 (20/83 Snellen). Clinical features and microbiological profile of all patients are summarized in Table 2. A central or paracentral corneal infiltrate was noted in 14 eyes (60.9%) with an average size of 2.7 ± 1.7 mm (range: 0.5–6.0 mm). There was an associated hypopyon in 3 eyes (13.0%). Corneal perineuritis suggestive of *Acanthamoeba* keratitis was noted in 12 eyes (52.2%).

Fifteen eyes (65.2%) had a positive microbiological culture obtained from corneal scrapings (Table 2). One pathogen was identified in 12 cases, while 3 cases had polymicrobial infection. The most commonly isolated organism was *Pseudomonas aeruginosa* (n = 6), followed by coagulase-negative *Staphylococcus* (CNS) (n = 5) and *Acanthamoeba* (n = 3). *Staphylococcus aureus*, *Serratia marcescens*, *Micrococcus luteus*, and *Flavobacterium* species each accounted for a single case. Orthokeratology lenses or lens storage solution were available for microbiological investigations in all cases. There were 5 cases of *P aeruginosa* and 5 cases of *Acanthamoeba* identified from contact lenses or solution. When the results of corneal scraping, contact lenses, and storage media were combined, the culture-positive rate was 78.2% (n = 18), and the most common pathogens were *P aeruginosa* (n = 8), *Acanthamoeba* (n = 6), and CNS (n = 5). No fungal organisms were isolated in any of the cases, although 1 case responded well to combined antibacterial and antifungal treatments.

At the time of presentation, empirical treatment was started in the form of hourly levofloxacin 0.5% or moxifloxacin 0.5% eye drops and once-daily ofloxacin 0.3% ointment. For ulcers involving the visual axis and stromal infiltrates larger than 2 mm, fortified vancomycin (50 mg/mL) and fortified tobramycin or gentamicin (14 mg/mL) were administered hourly. Polyhexamethylene biguanide 0.02% and propamidine isethionate 0.1% were started in cases suspected to have *Acanthamoeba* keratitis. Overall, 12 eyes, which presented with corneal perineuritis, were treated empirically with amoebicidal drugs. The mean duration of hospitalization was 15.3 ± 9.8 days (range: 5–31 days).

All patients responded to medical treatment. The mean duration from disease onset to remission was 31.9 ± 34.9 days (range: 6–131 days). Residual central or paracentral corneal scarring was observed in all cases. The final best-corrected logMAR visual acuity was 0.15 ± 0.20 (20/28 Snellen), which was significantly better than the visual acuity at presentation (Wilcoxon signed rank test, $P < .001$).