Unilateral *Streptococcus pneumoniae* microbial keratitis after small-incision lenticule extraction

Sonia Huang, MBBS, Michelle T. Sun, MBBS, PhD, Aanchal Gupta, FRANZCO

A 25-year-old woman had bilateral small-incision lenticule extraction (SMILE) for myopic astigmatism. Three days after the procedure, she noted pain, redness, tearing, and photophobia of the left eye. The uncorrected distance visual acuity (UDVA) was 6/12. Slitlamp examination revealed 2 anterior stromal infiltrates at the SMILE interface, haze, and an epithelial defect in the left eye. The right eye was normal. The patient was initially treated empirically with fortified antibiotics before culture returned positive for *Streptococcus pneumoniae*. Treatment was adjusted according to sensitivities to chloramphenicol (Chlorsig) and vancomycin. As visual acuity further deteriorated to counting fingers, oral prednisolone and prednisolone forte were begun, and vancomycin 5% irrigation of the interface was performed. Postoperatively, there was improvement of the clinical picture with resolution of the corneal infiltrates, improvement of interface inflammation, and improvement of the patient’s vision. At the 9-month postoperative follow-up her UDVA in the left eye was 6/7.5.

Small-incision lenticule extraction (SMILE) is a popular procedure used for the management of myopia and myopia with mild to moderate astigmatism. It is favored for its minimally invasive technique in comparison to other types of refractive surgery such as femtosecond lenticule extraction and laser in situ keratomileusis (LASIK). First introduced in 2011 by Sekundo et al., its postoperative safety, efficacy, and predictability have paralleled LASIK. Microbial keratitis remains a rare complication of SMILE, with a reported incidence of 0.3%. However, there are only 4 previous case reports of microbiologically proven microbial keratitis, with the remaining cases presumed or based on clinical suspicion. We report a case of unilateral culture-positive *Streptococcus pneumoniae* microbial keratitis after bilateral SMILE.

**CASE REPORT**

A 25-year-old woman had bilateral SMILE for myopic astigmatism. Her medical history was remarkable for an episode of adenovirus-related conjunctivitis in the left eye 10 months earlier, which resolved fully with topical steroid therapy. She had no other risk factors for infection and was not previously a contact lens wearer. Standard sterile procedures at the center were followed, and the surgery was uncomplicated. Following the procedure, the patient was prescribed topical dexamethasone 0.1% and ciprofloxacin 0.3% every 6 hours.

Three days after SMILE, the patient noticed increasing redness, photophobia, and lacrimation in the left eye. On presentation to a tertiary hospital, her uncorrected distance visual acuity (UDVA) was 6/6 in the right eye and 6/12 in the affected left eye. Slitlamp examination revealed 2 anterior stromal infiltrates at the SMILE interface, haze, and an epithelial defect (Figure 1, A). There was associated anterior chamber inflammation but no hypopyon. Examination of the right eye was unremarkable. The patient was admitted and treated empirically with cefazolin 5% and gentamicin 1.4% drops 2 hourly day time, oral voriconazole 200 mg twice daily, natamycin 5% drops hourly day time, and oral doxycycline 50 mg once daily. Corneal scrapings were taken from the left eye for microscopic examination and inoculation of culture media. Initial microscopy returned negative. Over the next few days, the visual acuity (VA) in the left eye further deteriorated to counting fingers. There was diffuse haze in the interface, which was suggestive of increased inflammation (Figure 1, B). Oral prednisolone 25 mg once daily and prednisolone forte 3 times daily were initiated. Seven days after the original corneal scrapings, culture returned positive for *S pneumoniae*. The antibiotic regimen was then changed to hourly chloramphenicol and vancomycin in accordance with sensitivities. The patient underwent corneal epithelial debridement, and the interface was irrigated with vancomycin 5% (Figure 1, C). Three days...
after debridement and irrigation, her vision improved to 6/15, pinholing to 6/9 (Figure 2). Oral amitriptyline was added for symptomatic glare with good effect. Thereafter, she continued to improve gradually but required rescrape after 2 months for a new infiltrate outside the treatment area. Microscopy and culture were both negative, and she continued to improve to 6/6 at 3 months postoperatively on chloramphenicol, fluorometholone, and oral amitriptyline. At 7 months, her UDVA was 6/7.5 in the affected eye with evidence of mild central corneal scarring over the site of the infection and minimal epithelial ingrowth at the incision site of the SMILE pocket. Her treatment was ceased at this visit, and she remains on topical lubricants only. At the latest follow-up at 9 months postoperatively, her left UDVA was 6/7.5, and there was no evidence of further epithelial ingrowth (Figure 1, D).

DISCUSSION
Microbial keratitis is a rare complication of refractive surgery. A study involving 204,586 LASIK procedures found the incidence of microbial keratitis to be 0.035% per procedure.10 SMILE is the latest development in femtosecond laser techniques, and many studies have suggested that its overall safety, efficacy, and predictability parallel LASIK.1,3 The occurrence of microbial keratitis after SMILE remains rarely reported. The pathogens included *Mycobacterium abscessus*, *S pneumoniae*, *Aspergillus*, and *Staphylococcus haemolyticus* and *Staphylococcus warneri* occurring 8 days, 2 days, 1 day, and 5 days postoperatively, respectively.4-7 Another 6 cases of microbial keratitis have also been reported in the literature across 2 different studies that were not culture positive among a total of 1853 eyes.8,9 In these cases, patients were clinically diagnosed after presentation with ocular irritation and identification of interface or corneal infiltrates on examination. All patients were treated for bacterial keratitis, and in 5 cases, the infiltrates had cleared without any scarring within 3 months, and 1 case was lost to follow-up.8,9 A literature review by Moshirfar et al. in 2015, including a total of 56 articles and 2345 eyes, reported an incidence of 0.3%.5 Given the few cases of SMILE-related microbial keratitis reported to date, it remains unclear whether there are significant differences between microbial keratitis post-SMILE compared with other laser corrective procedures. Photorefractive keratectomy is associated with higher rates of infection compared with LASIK, which is likely attributable to the epithelial defect necessitated by the procedure leaving an open epithelium.11 It is possible that the pocket created in SMILE may have the ability to harbor organisms more readily as compared to being washed out with during LASIK.12 In addition, the excimer laser is also thought to sterilize the surface in LASIK. As our experience with SMILE increases, infection patterns may become more evident and further studies reporting SMILE-related complications are required to advance our knowledge in this area.

To our knowledge, our patient is the third reported case of *S pneumoniae* microbial keratitis after SMILE and only the fifth culture-positive case in the literature. In the previous case, bilateral *S pneumoniae* microbial keratitis was reported 2 days after SMILE. The patient presented with a significantly worse UDVA of counting fingers in the right eye and hand motions in the left eye. He was taken to the operation theater for

![Figure 1. Left eye. (A) Clinical photograph on the day of admission demonstrating multiple interface infiltrates, which cultured *Streptococcus pneumoniae* from superficial corneal scrapings. (B) Clinical photograph on day 4 of admission. (C) Clinical photograph on day of discharge, 2 days after debridement, and interface irrigation. (D) Clinical photograph at final follow-up.](image)

![Figure 2. Left eye. Fluorescein photograph taken 2 days after debridement and interface irrigation demonstrating the focus of infection and healing epithelial defect created at the time of washout to allow penetration of antibiotics.](image)
immediate interface rinsing with povidone–iodine 10% solution and flushed with fortified vancomycin before being commenced on hourly topical antibiotics. Three months later, the UDVA was 20/40 in the right eye and 20/32 in the left eye. Corrected distance visual acuity was 20/32 and 20/25, respectively. Residual paracentral stromal scarring remained in the right eye and mild peripheral stromal scarring in the left eye. In our case, we were able to identify a pathogen from superficial corneal scrapings taken at the initial presentation, and interface rinsing was performed after 5 days of hourly fortified antibiotics. Notably, our patient improved significantly after interface irrigation, which represents an important therapeutic intervention in severe cases as it allows penetration of antibiotic directly to the deep cap–stromal bed interface, removal of biofilm, and forms a reservoir of antimicrobial agents in the corneal stroma. It also facilitates acquisition of deep stromal tissue for microscopy and culture if required. Our patient’s symptomatic glare was managed with good effect using oral amitriptyline. glare not otherwise explained by another cause has been reported as a likely form of neuropathic pain, and although its efficacy in different patients remains difficult to predict, it can be considered in patients with intractable symptoms unresponsive to more conservative measures.13

Amitriptyline is a first-line agent for the treatment of neuropathic pain, and while its efficacy in different patients remains difficult to predict, it can be considered in patients with intractable symptoms unresponsive to more conservative measures.14

Given the infection occurred unilaterally despite the procedure being performed bilaterally, systemic factors and poor postoperative drop compliance are unlikely to have contributed in our case. Intraoperative contamination is unlikely, given the standard sterile procedures followed and disposable nature of the instruments used. Self-inoculation is a possibility if the patient rubbed her nose and then the eye, disturbing the epithelium and thus introducing the source for infection. It is vital to reiterate the importance of maintaining good hygiene practice, particularly near the eye, in addition to usual postoperative care to reduce the risk for infectious keratitis after any refractive procedure.

REFERENCES

1. Moshirfar M, McCaughhey MV, Steinert DS, Shah R, Santiago-Caban L, Fenz CR. Small-incision lenticule extraction. J Cataract Refract Surg 2015;41:652–665
2. Sekundo W, Kunert KS, Blum M. Small incision corneal refractive surgery using the small incision lenticule extraction (SMILE) procedure for the correction of myopia and myopic astigmatism: results of a 6 month prospective study. Br J Ophthalmol 2011;95:335–339
3. Zhang Y, Shen Q, Ju Y, Zhou D, Zhou J. Clinical outcomes of SMILE and FS-LASIK used to treat myopia: a meta-analysis. J Refract Surg 2016;32:256–265
4. Chan TC, Chow WW, Jhanji V. Collagen cross-linking with photoactivated riboflavin (PACK-CXL) for bacterial keratitis after small incision lenticule extraction (SMILE). J Refract Surg 2017;33:278–280
5. Chehabou I, Sandali O, Ameline B, Bouteranaou N, Borderie V, Laroche L. Bilateral infectious keratitis after small-incision lenticule extraction. J Cataract Refract Surg 2016;42:626–630
6. Liu HY, Chu HS, Chen WL, Hu FR, Wang UI. Bilateral non-tuberculous mycobacterial keratitis after small incision lenticule extraction. J Refract Surg 2018;34:633–636
7. Sachdev GS, Diwan S, Sachdev MS. Unilateral fungal keratitis after small-incision lenticule extraction. JCRS Online Case Rep 2019;7:11–13
8. Iversen A, Aas S, Hjortdal J. Safety and complications of more than 1500 small-incision lenticule extraction procedures. Ophthalmology 2014;121:822–828
9. Vestergaard A, Iversen AR, Aas S, Hjortdal JO. Small-incision lenticule extraction for moderate to high myopic predictability, safety, and patient satisfaction. J Cataract Refract Surg 2012;38:2003–2010
10. Llovet F, de Rojas V, Interlandi E, Martin C, Cobo-Soriano R, Ortega-Usoibiaga J, Baviera J. Infection keratitis in 204586 LASIK procedures. Ophthalmology 2010;117:232–8.e1–232–8.e4
11. Schallhorn JM, Schallhorn SC, Hettinger K, Hanan H. Infectious keratitis after laser vision correction: incidence and risk factors. J Cataract Refract Surg 2017;43:473–479
12. Allan BD, van Saarloos PP, Russo AV, Cooper RL, Constable LJ. Excimer laser keratotomy: the in vivo development of a modified open mask delivery system. Eye (Lond) 1993;7:47–52
13. Rosenthal P, Borsook D. Ocular neuropathic pain. Br J Ophthalmol 2016;100:128–134
14. Moore RA, Denny S, Aldington D, Cole P, Witten PJ. Amitriptyline for neuropathic pain in adults. Cochrane Database Syst Rev 2015;CD008242

Disclosures: None of the authors has a financial or proprietary interest in any material or method mentioned.

First author: Sonia Huang, MBBS
South Australian Institute of Ophthalmology, The University of Adelaide and Royal Adelaide Hospital, Adelaide, South Australia