is no sudden decompression of the globe but failed to mention whether their patient had an associated choroidal haemangioma. The debate on the need for posterior sclerotomy at the time of filtering surgery remains unresolved⁴ although pre-operative screening for choroidal haemangiomas in SW syndrome has been advocated.⁵

We are unaware of previous reports of exudative RD as a complication of DS in SW syndrome and could not find reference to it in a computerised search utilising MEDLINE. Although further experience is required before making definitive judgements on the safety and efficacy of DS in patients with SW syndrome, our experience with these cases does not appear promising.

References

- 1 Bellows AR, Chylack Jr LT, Epstein DL, Hutchinson BT. Choroidal effusion during glaucoma surgery in patients with prominent episcleral vessels. *Arch Ophthalmol* 1979; **97**: 493–497.
- 2 Budenz DL, Sakamoto D, Eliezer R, Varma R, Heuer DK. Two-staged Baerveldt glaucoma implant for childhood glaucoma associated with Sturge–Weber syndrome. *Ophthalmology* 2000; **107**: 2105–2110.
- 3 Rebolledo G, Munoz-Negrete FJ. Nonpenetrating deep sclerectomy for Sturge–Weber syndrome. *Ophthalmology* 2001; **108**: 2152–2153.
- 4 Eibschitz-Tsimhoni M, Lichter PR, Del Monte MA, Archer SM, Musch DC, Schertzer RM *et al*. Assessing the need for posterior sclerotomy at the time of filtering surgery in patients with Sturge–Weber syndrome. *Ophthalmology* 2003; **110**: 1361–1363.
- 5 Mandal AK, Gupta N. Patients with Sturge–Weber syndrome. *Ophthalmology* 2004; **111**: 606.

K Taherian and N Anand

Department of Ophthalmology,
Huddersfield Royal Infirmary,
Calderdale and Huddersfield NHS Trust,
West Yorkshire, UK

Correspondence: K Taherian,
Tel: +44 7980614907;
Fax: +44 1132648775.
E-mail: kasra_taherian@yahoo.co.uk

This work had not been previously published elsewhere and was not under consideration for publication elsewhere. It was however due for presentation as a poster at the North of England Ophthalmological Society meeting in Lancaster in July 2006

The authors have no propriety interest in the work and had no funding for it

Eye (2007) **21**, 842–843; doi:10.1038/sj.eye.6702696;
published online 26 January 2007

Sir, *Aspergillus fumigatus* keratitis after laser *in situ* keratomileusis: a case report and review of post-LASIK fungal keratitis

Laser *in situ* keratomileusis (LASIK) is the most commonly performed refractive surgery procedure. Microbial keratitis after LASIK has become an increasingly recognized, sight-threatening complication of refractive surgery.¹ Predisposing factors include a history of corneal surgery, break in the epithelial barrier, excessive surgical manipulation, intraoperative contamination, delayed postoperative reepithelialization of the cornea, and use of topical steroids.^{1–3}

Here, we describe a case of post-LASIK corneal infection with fungi, which finally resulted in enucleation.

Case report

A healthy 39-year-old man underwent uncomplicated bilateral simultaneous LASIK to correct mild myopic astigmatism on 4 February 2001. The right eye was operated on first, and the same set of instruments was used for the left eye. On the third post-operative day, an intensive course of topical steroids (prednisolone acetate 1% hourly) was started with a clinical diagnosis of diffuse lamellar keratitis (DLK) by his ophthalmologist. Over the next week, he complained of marked worsening of vision, redness, pain, photophobia, and tearing in the left eye. He was then referred to Cornea Service, Farabi Eye Hospital, Tehran, Iran, by his surgeon. At the time of referral, his visual acuity was 20/40 in the right eye and hand motion in the left eye. Slit-lamp examination of the right eye revealed blepharitis and white granular dots in the interface of the flap–stroma, which extended from the periphery of the flap to the pupillary border and was compatible with the diagnosis of DLK. In the left eye, the eyelids were oedematous, the conjunctiva was diffusely injected, and the LASIK flap was necrotic and loosely attached to the underlying stroma (Figure 1a). There was a 1.8-mm height hypopyon in the anterior chamber. Fundus examination was not possible in the left eye; however, B scan ultrasonography showed an echo-free vitreous cavity.

On the left eye, the flap was lifted and multiple scrapings for smear and culture were obtained; then the interface was irrigated with vancomycin and amikacin solutions. The culture (Saburaud's dextrose agar) revealed a significant growth of fungus, which was identified as *Aspergillus fumigatus*. The patient was admitted and treated with topical natamycin 5% every half-hour, atropine 1% three times a day, and oral ketoconazole 200 mg twice a day. Over the next days, the condition of the left eye was deteriorated under treatment. The infiltration progressed to involve the whole thickness of corneal stroma and extended further peripherally to the limbus with necrosis of the overlying flap (Figure 1b). To control the infection, penetrating keratoplasty with a large graft was performed on the left eye.

Post-operatively, the patient was maintained on a regimen of 400 mg daily ketoconazole, topical natamycin 5%, and topical betamethasone. After 2 weeks, stromal infiltration and evidence of melting appeared in the host-donor interface (Figure 1c), together with vitreous opacities and other signs of deep intraocular involvement (endophthalmitis). A second penetrating keratoplasty was performed with lens extraction, deep vitrectomy, and intravitreal injection of amphotericin B. Culture obtained from the vitreous sample was positive for *A. fumigatus*.

After 3 weeks, visual acuity was poor light perception accompanied with 3+ RAPD. There was deep stromal infiltration and melting in the donor cornea, with signs of panophthalmitis. Enucleation was performed owing to severe pain and loss of vision.

Comment

Infection after LASIK is a rare complication. Reported frequency of infection ranged from 0 to 1.5%.¹ Although many post-LASIK infection cases have been reported infection that resulted to enucleation has not been reported properly; we found only three cases in the literature.^{1,3}

Results of an ASCRS survey on ASCRS members in the US and international members showed 116 post-LASIK infections that were reported by 56 LASIK surgeons, who had performed an estimated of 338 550 procedures.¹ A major review on post-LASIK infection, based on integration of the published literature, revealed a total of 103 infections involving 87 patients that had been described in 42 articles.² The most common causative organisms based on major review were Gram-positive bacteria and mycobacterium.^{1,2}

Fungal keratitis after LASIK is rare and *A. species* are the most common cause of fungal keratitis.⁴ Kuo *et al*⁵ reported the first case of *A. fumigatus* keratitis after LASIK. However, the first case of fungal keratitis after LASIK was

Figure 1 (a) Necrotic LASIK flap, anterior chamber hypopyon, and severely injected eye. (b) Infiltration progressed to involve the whole thickness of corneal stroma and extended further peripherally to the limbus with necrosis of the overlying flap. (c) Stromal infiltration and evidence of melting appeared in the large graft-host interface.

reported by Sridhar *et al*,⁶ who stated that keratitis was due to infection with *Aspergillus flavus*. We find two reports of mixed infection with *Aspergillus* and coagulase-negative *Staphylococcus*.^{7,8} Trauma is the most antecedent event in fungal keratitis, but how such fungi become established in the corneal stroma after minor trauma is not understood fully.⁹ It is possible that infection started at the interface. First, our case had no epithelial defect at any time after the procedure. Second, the pattern of haze and white-cell infiltration in the flap supports the hypothesis that the infection started in the interface.

Although interface infections after LASIK are uncommon, once an organism is established, the infection may be extremely difficult to eradicate because the nidus of infection is sequestered from the ocular surface defenses and because the epithelium serves as a relative barrier to penetration of antimicrobial agents.⁵ On the other hand, corneal penetration of antifungal agents, such as amphotericin and natamycin, is poor in comparison with antibacterial therapy.⁹ Owing to the above reasons, post-LASIK corneas might be considered compromised because of lack of ocular surface protection in the interface.⁵

Clinical manifestations of keratomycosis may become evident as quickly as 24–48 h or may be delayed for 10–20 days.⁹ Invasion is characteristically deep in the stroma, and fungi can penetrate Descemet's membrane.¹⁰ For this reason, deep corneal scraping or biopsies are needed to establish the diagnosis in the cases of presumed keratomycosis.^{11,12}

It may be difficult in some cases to distinguish between infective infiltrates and diffuse lamellar keratitis, as in our case. However, we emphasize that a high index of suspicion must be maintained whenever an infiltrate is detected during the post-operative course of LASIK surgery. Although corticosteroids have been shown to be effective treatment in cases of diffuse lamellar keratitis occurring after LASIK, such therapy for infectious cases may delay proper treatment, and indeed exacerbates the infection. Indeed if no organisms are found on initial culture, steroids must be used with caution: many of the initial culture-negative cases treated with steroids were later found to be due to mycobacteria and fungus, which resulted in poor outcomes² as in our case.

Our case, as described, developed stage 1 DLK in the right eye, but the clinical findings of the left eye were not consistent with the mere diagnosis of DLK. This severe case of fungal keratitis was probably the result of a combination of predisposing factors, including poor personal hygiene, blepharitis, and frequent use of topical steroids. Early stages of infection in the interface may be confused with diffuse lamellar keratitis and, consequently, delay the appropriate treatment.

It has been reported that symptoms and signs such as pain, discharge, flap separation, epithelial defects, and anterior chamber reaction were strongly associated with Gram-positive infections, and redness and tearing were more common with fungal infections.² Gram-positive infections and mycobacterial infections were more likely to present less than 7 days and 10 or more days after LASIK, respectively.^{1,2,13} Severe reductions in visual acuity were significant with fungal infections.²

As LASIK increases in popularity, the incidence of post-LASIK infectious complications will also likely increase. Surgeons should perform a vigilance culture for post-LASIK infections and be encouraged to report these

infectious complications to quantify better the true risks involved.

References

- Solomon R, Donnenfeld ED, Azar DT, Holland EJ, Palmon R, Pflugfelder SC *et al.* Infections keratitis after laser *in situ* keratomileusis: results of an ASCRS survey. *J Cataract Refract Surg* 2003; **29**: 2001–2006.
- Chang MA, Jain S, Azar DT. Infections following laser *in situ* keratomileusis: an integration of the published literature. *Surv Ophthalmol* 2004; **49**: 269–280.
- Krap CL, Tuli SS, Yoo SH, Vroman DT, Alfonso EC, Huang AH *et al.* Infectious keratitis after LASIK. *Ophthalmology* 2003; **110**: 503–510.
- Foster CS. Fungal keratitis. *Infect Dis Clin N Am* 1992; **6**: 851–857.
- Kuo IC, Margolis TP, Cevallos V, Hwang DG. *Aspergillus fumigatus* keratitis after laser *in situ* keratomileusis. *Cornea* 2001; **20**: 342–344.
- Sridhar MS, Garg P, Bansal AK, Gopinathan U. *Aspergillus flavus* keratitis after laser *in situ* keratomileusis. *Am J Ophthalmol* 2000; **129**: 802–804.
- Ritterband D, Kelly J, McNamara T, Kresloff M, Koplin R, Seedor J. Delayed-onset multifocal polymicrobial keratitis after laser *in situ* keratomileusis. *J Cataract Refract Surg* 2002; **28**: 898–899.
- Sharma N, Singh S, Agarwal T, Sinha R, Vajpayee RB. Polymicrobial keratitis after subepithelial keratomileusis. *J Refract Surg* 2006; **22**: 129–130.
- Forster R. Fungal keratitis and conjunctivitis: clinical disease. In: Smolin G, Thoft RA, (eds). *The Cornea*. Boston: Little, Brown and Company, 1994, pp 239–247.
- Naumann G, Green WR, Zimmermann LE. Mycotic keratitis: a histopathologic study of 73 cases. *Am J Ophthalmol* 1967; **64**: 668–682.
- Ishibashi Y, Kaufman HE. Corneal biopsy in the diagnosis of keratomycosis. *Am J Ophthalmol* 1986; **101**: 288–293.
- Alexandris G, Haimovici R, Miller D, Alfonso EC. Corneal biopsy in the management of progressive microbial keratitis. *Am J Ophthalmol* 2000; **129**: 571–577.
- Freitas D, Alvarenga L, Sampaio J, Mannis M, Sato E, Sousa L *et al.* An outbreak of mycobacterium chelonae infection after LASIK. *Ophthalmology* 2003; **110**: 276–285.

F Rahimi, MN Hashemian and MT Rajabi

Farabi Eye Hospital, Tehran University, Eye Research Center, Tehran, Iran

Correspondence: MT Rajabi,
Eye Research Center, Farabi Eye Hospital, South
Kargar ST, Tehran, Iran
Tel: +98 912 188 4153;
Fax: +98 21 8824 3708.
E-mail: mt_rajabi@yahoo.com

Eye (2007) **21**, 843–845; doi:10.1038/sj.eye.6702698;
published online 2 February 2007