



Management of bilateral gas-bubble breakthrough during femtosecond LASIK in the presence of anterior basement membrane dystrophy

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We describe the case of a 50-year-old woman with anterior basement membrane dystrophy and dry eyes who had femtosecond laser in situ keratomileusis (LASIK) with gas-bubble breakthrough during flap creation in both eyes. The gas-bubble breakthrough appeared beneath the appplanation interface in advance of the leading laser edge in the right eye and behind the advancing laser edge in the left eye. The surgery was aborted and 5 days later, photorefractive keratectomy with mitomycin-C was performed in the right eye and LASIK in the left eye. When a gas-bubble breakthrough extends in front of the advancing laser edge of the flap, the surgery should be aborted; surface ablation can be performed as a second-stage procedure. However, if the breakthrough occurs behind the advancing laser edge, the flap can be carefully lifted and the LASIK completed.

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The femtosecond laser was introduced into ophthalmology a decade ago and has become a popular alternative to the mechanical microkeratome for flap creation in laser in situ keratomileusis (LASIK).¹ Although it has been considered a safer and more precise method for flap creation, there are several possible complications uniquely specific to the femtosecond laser. These include mechanical, inflammatory, and optical complications such as flap tears, gas-bubble breakthrough, incomplete dissection and flap lifting, macular hemorrhage, transient light sensitivity syndrome, diffuse lamellar keratitis, interface haze and light scattering, rainbow glare, anterior chamber bubbles, and inability of pupil tracking in Asian eyes.^{2–9} Although these potential complications are often less

severe than those seen with mechanical microkeratomes, they present a challenge to the surgeon in terms of their proper management. One of the most challenging is that of gas-bubble breakthrough because the bubbles can interfere with the flap creation.^{3,10} Although all instances of gas-bubble breakthrough do not preclude proper dissection and lifting of the flap, it is important to determine the appropriate management for each case so the visual outcome will not be compromised. We report a case of femtosecond laser LASIK in which bilateral gas-bubble breakthrough occurred during flap creation, requiring a different form of management in each eye.

CASE REPORT

A 50-year-old woman, left eye dominant, was referred for laser vision correction. Her ocular history was significant for dry eyes since the age of 16 and anterior basement membrane dystrophy. Evidence supporting the diagnosis of anterior basement membrane dystrophy was noted preoperatively and postoperatively by the presence of geographic and fingerprint lines within the superior paracentral area of both corneas. There was no history of recurrent erosions. The patient was asymptomatic at the time of presentation. The corrected distance visual acuity (CDVA) was 20/20 in both eyes with a manifest refraction of $-7.00 +1.00 \times 142$ in the right eye and $-7.00 +1.75 \times 53$ in the left eye. The manifest refraction was stable over a year.

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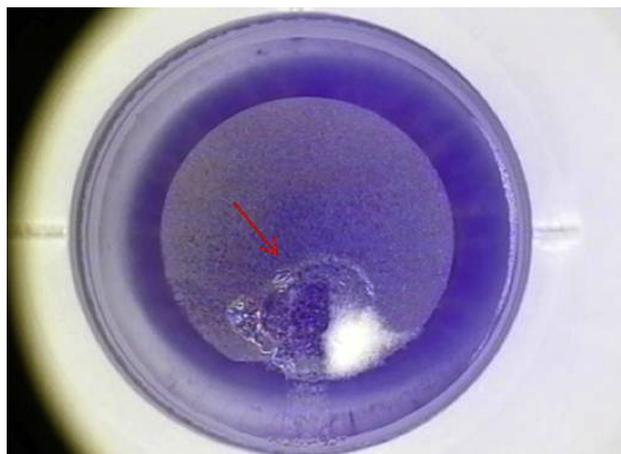


Figure 1. Femtosecond laser-induced flap creation with bubble breakthrough (arrow) in the right eye. The leading edge of the laser pulsing was behind the expansion of the bubble beneath the appplanation glass so subsequent pulses in the area of the bubble were blocked by posterior displacement caused by the bubble. At this point, after the flap creation is completed, one cannot tell whether the leading edge of the laser was in front of or behind the extent of the bubble breakthrough when it occurred, so the temporal value of viewing the bubble expansion is lost.

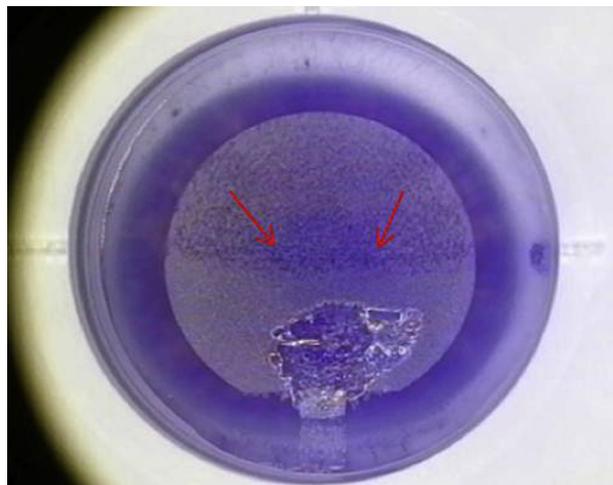


Figure 2. Femtosecond laser-induced flap creation with bubble breakthrough in the left eye. The leading edge of the laser pulsing was in front of the extent of the bubble expansion (arrows) so subsequent laser pulses were unaffected by the bubble-induced corneal displacement. In this image, one can see the demarcation that characterizes the pulses before and after the bubble breakthrough (arrows), but this is not always noted and again emphasizes the temporal value of viewing the dynamics of bubble breakthrough.

Slitlamp examination showed mild inferior punctate epithelial erosions and mild superior anterior basement membrane dystrophy in both eyes. Preoperative corneal topography revealed regular astigmatism with mean keratometric readings of 45.57 diopters (D) and 46.43 D in the right eye and left eye, respectively. Preoperative ultrasound pachymetry was 568 μm and 568 μm , respectively. The patient was started on cyclosporine 0.05% twice a day and artificial tears 4 times a day.

On a subsequent preoperative visit after the patient had been using the artificial tears and topical cyclosporine, there were no further signs of punctate epithelial erosions, although a mild topographic irregularity due to anterior basement membrane dystrophy was still present. At no preoperative visit did the patient report symptoms of epithelial erosions.

The treatment options were discussed with the patient, and photorefractive keratectomy (PRK) with topical mitomycin-C (MMC) in both eyes was advised, targeting monovision in the right eye. The patient requested LASIK over PRK because of her desire for faster recovery time and on mutual agreement, an informed consent was obtained for femtosecond LASIK.

A flap was created with the Wavelight FS-200 laser (Alcon Laboratories, Inc.) with an intended flap thickness of 110 μm and a diameter of 8.7 mm in both eyes. During flap creation, a superior bubble breakthrough appeared beneath the appplanation interface in both eyes, extending in front of the advancing laser edge in the right eye (Figure 1) and behind the advancing laser edge in the left eye (Figure 2). The decision was to abort the flap separation and excimer laser ablation portion of the procedure on that day. The patient was counseled concerning the reason for the delay and sent home with topical antibiotics and steroids.

Four days later, the patient returned with a CDVA of 20/20⁺ in each eye and a stable refraction. The eyes were not inflamed, and the patient was asymptomatic.

The following day, a PRK with MMC was performed in the right eye with the Allegretto Wave Eye-Q excimer laser system (Alcon Laboratories, Inc.). Following the laser ablation, a fine 4.0 mm circular demarcation line was noted centrally, outlining the residual unablated flap edge around the area of deep central ablation. In the left eye, the flap was easily lifted and the previously planned LASIK ablation was performed.

On the first postoperative day, the patient experienced mild light sensitivity and blurry vision in both eyes with an uncorrected distance visual acuity (UDVA) of 20/40⁺ in the right eye (PRK) and 20/20⁻³ in the left eye (LASIK). At 1 week, the patient was very happy and had no complaints; the manifest refraction was plano with a UDVA of 20/20 in the right eye and 20/15⁻¹ in the left eye. At 1 month, the patient was pleased with both distance and intermediate/near vision; the UDVA was 20/30⁻¹ ([Jaeger] J1) in the right eye (monovision) and 20/20 (J3) in the left eye (distance). The manifest refraction was -0.75 D and +0.50 D, respectively.

DISCUSSION

Although gas-bubble breakthrough is not a newly reported complication of femtosecond laser LASIK, it is a controversial one with regard to its proper management when encountered. Most surgeons will acknowledge its presence, but the significance of its effect on the laser disruption process during flap creation is not well differentiated. Previous reports of gas-bubble breakthrough mostly report an attempt to lift the flap, which results in resistance due to incomplete flap creation.^{3,10} Our report outlines the diagnostic

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