Hyphema after laser in situ keratomileusis using the femtosecond laser

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A 50-year-old man developed active anterior chamber bleeding immediately following uneventful myopic laser in situ keratomileusis (LASIK) using the femtosecond laser. Although the mechanism of this patient’s hyphema is not entirely clear, we postulate that decentration of the suction ring led to episcleral vessel damage in the area of the peripheral flap pocket. Presumably, the blood passed from the pocket in a retrograde fashion through Schlemm canal and the trabecular meshwork into the anterior chamber.

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Femtosecond (10⁻¹⁵ second) laser corneal flap creation is a crucial step in laser in situ keratomileusis (LASIK) using the femtosecond laser. Its popularity has increased recently as a result of the high precision, predictability, and minimal collateral tissue damage associated with this technique. Parameters such as flap centration, diameter, hinge angle and width, and flap thickness are programmable and adjustable, but there is heterogeneity among the various commercially available laser platforms, largely due to differences in the energy and frequency of the laser. The solid-state femtosecond laser uses focused infrared light energy to cause ionization, generation of shock waves, and the subsequent creation of electrically charged particles or plasma. This process, also known as optical breakdown, results in cavitation and subsequent gas-bubble formation composed of water vapor and carbon dioxide that can create an incisional plane within the corneal stroma.

Although femtosecond flap creation is safe and predictable, the American Academy of Ophthalmology has reported the following associated complications: diffuse lamellar keratitis, corneal hypesthesia, rainbow glare, transient light sensitivity, displaced flaps, epithelial ingrowth, opaque bubble layer, epithelial buttonhole formation due to gas bubbles, dry eye, and aberrant gas-bubble migration including into the anterior chamber. We report a patient who developed a new complication—antero chamber bleeding following uneventful myopic LASIK performed with a femtosecond laser.

CASE REPORT

A 50-year-old white man with a history of high myopic astigmatism in both eyes developed a rhegmatogenous retinal detachment in the right eye that was successfully treated with pars plana vitrectomy and membrane stripping. Postoperatively, he developed a visually significant nuclear sclerotic cataract and expressed interest in reducing the refractive error in the left eye prior to having cataract extraction in the right eye. The ocular history was otherwise negative. The patient used no anticoagulant medications, and his family history was negative for a bleeding diathesis.

In the pre-LASIK examination, the corrected distance visual acuity was 20/70 in the right eye and 20/20 in the left eye. The manifest refraction was −8.50 +1.25 × 105 and −7.25 +0.75 × 77, respectively. Slitlamp examination showed a dense nuclear sclerotic cataract in the right eye and a clear and quiet bulbar conjunctiva, clear cornea, deep anterior chamber, normal iris, and clear lens in the left eye. The corneal diameter measured 11.4 mm. Keratometry readings showed with-the-rule astigmatism: 43.60/44.53 @ 94 in the right eye and 43.38/45.06 @ 91 in the left eye. The axial length was 25.31 mm in the right eye and 25.89 mm in the left eye. The anterior chamber...
depths were 3.02 mm and 3.19 mm, respectively. The central corneal thickness was 617 μm in the left eye. Before surgery, the patient received a full explanation of the procedure and written informed consent was obtained.

Corneal applanation was performed with a disposable glass contact lens and a plastic suction ring docked slightly eccentrically toward the superior limbus. A 9.0 mm diameter, 120 μm flap with a superior hinge was created with the Intralase femtosecond laser (Abbott Medical Optics, Inc.). The superior pocket depth was 250 μm. The flap was created using a raster pattern with a bed energy of 0.70 μJ and a spot/line separation of 7 μm. When the suction ring was released, a small hemorrhage was noted at the superior limbus partially overlying the flap hinge. The corneal flap was lifted without difficulty, and Customvue ablation was performed with the Visx Star 4 excimer laser (Abbott Medical Optics, Inc.). The ablation zone measured 8.0 mm. The optical zone was 6.4 × 6.0 mm. Four-hundred forty-one pulses were delivered, creating a total ablation depth of 105 μm. No blood was detected at the corneal hinge, and the flap was repositioned atraumatically. The flap was allowed to dry for 2 minutes, after which the operative eye was examined at the slitlamp.

In addition to the subconjunctival hemorrhage, a small superficial corneal hemorrhage was present anterior to the limbus; a deeper intracorneal and episcleral hemorrhage was noted in the perilimbal region at 12 o’clock. A superficial subconjunctival hemorrhage can be seen as a brighter shade of red, and the faded shade of red reflects an organized and vascularized superficial layers of scleral collagen. Within a confined space and under pressure from active bleeding, the blood probably passed from this pocket through Schlemm canal and the trabecular meshwork into the anterior chamber. The mild bleeding stopped spontaneously and did not affect the patient’s postoperative recovery.

Alternative explanations for the active anterior chamber bleeding include mechanical trauma to the chamber angle or peripheral iris from the suction ring, LASIK instrumentation, and direct photodisruption from the femtosecond laser. It is also possible that undetected small gas bubbles exited the peripheral pocket near the superior limbus and disrupted vascularity in the vicinity of the chamber angle. However, no bubbles were visualized in the anterior chamber.

**DISCUSSION**

In this case, mild anterior chamber bleeding was seen immediately following myopic LASIK using the femtosecond laser. The hemorrhage appeared to arise from the superior chamber angle, although this could not be confirmed gonioscopically because of concerns about displacing the corneal flap. Coincidentally, a single perilimbal hemorrhage was noted adjacent to the superior limbus and coincided with the location of the peripheral flap pocket. The peripheral location of the pocket was due, in turn, to a slightly smaller than normal corneal diameter (11.4 mm) as well as mild superior decentration of the suction ring during the femtosecond laser flap creation. The anterior chamber hemorrhage was not noted intraoperatively, and anterior chamber gas bubbles were not seen prior to the excimer ablation.

To our knowledge, anterior chamber bleeding has not been described as a complication of femtosecond laser–assisted myopic LASIK. Although the mechanism of bleeding into the anterior chamber remains uncertain, it appears similar to that described for anterior chamber gas bubbles resulting from femtosecond laser flap creation. To minimize complications of bubble migration, a peripheral pocket or gutter that is continuous with the flap interface is designed to clear the opaque bubble layer more expeditiously, but this can occasionally direct escaping gas bubbles toward the trabecular meshwork. In our case, the creation of a peripheral lamellar pocket partially overlaid the limbal conjunctiva and episclera. The latter tissue layer was composed of more loosely organized and vascularized superficial layers of scleral collagen. Within a confined space and under pressure from active bleeding, the blood probably passed from this pocket through Schlemm canal and the trabecular meshwork into the anterior chamber. The mild bleeding stopped spontaneously and did not affect the patient’s postoperative recovery.

![Slitlamp photograph of the left eye 1 day after femtosecond laser LASIK.](image)
During the surgery and our patient had bleeding superiorly that was inconsistent with existing data that suggest gas bubbles during femtosecond laser flap creation have a tendency to enter the anterior chamber from the nasal and inferior quadrants. Although external compression of the globe from the suction ring could lead to blood in Schlemm canal, it is an unlikely cause of chamber angle bleeding as the bleeding was not noted while the suction ring was in place and occurred well after the suction ring was removed from the eye. In addition, the intraocular pressure elevation associated with activation of the suction ring would create resistance against blood entering the anterior chamber.

In conclusion, a transient anterior chamber hemorrhage occurred following myopic LASIK using a femtosecond laser. The hemorrhage appears to have originated in the vicinity of the flap pocket and may represent retrograde blood flow from the episclera through the trabecular meshwork and Schlemm canal.

REFERENCES
1. Robert M-C, Khreim N, Todani A, Melki SA. Anterior chamber gas bubble emergence pattern during femtosecond LASIK-flap creation. Br J Ophthalmol 2015; 99:1201–1205
2. Farjo AA, Sugar A, Schallhorn SC, Majmudar PA, Tanzer DJ, Trattler WB, Cason JB, Donaldson KE, Kymionis GD. Femtosecond lasers for LASIK flap creation; a report by the American Academy of Ophthalmology. Ophthalmology 2013; 120(3):e5–e20
3. Soong HK, de Melo Franco R. Anterior chamber gas bubbles during femtosecond laser flap creation in LASIK; video evidence of entry via trabecular meshwork. J Cataract Refract Surg 2012; 38:2184–2185
4. Fine BS, Yanoff M. Ocular Histology; a Text and Atlas, 2nd ed. Hagerstown, MD, Harper and Row, 1979; 191

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