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Ocular Injury After Laser Hair Reduction Treatment to the Eyebrow

Laser hair reduction/removal techniques have advanced significantly since the Food and Drug Administration approved the procedure in 1996. In 1998, the first 2-year study demonstrating long-term success of permanent hair reduction/removal was reported using the normal-mode Ruby laser.[1] Adverse effects of laser hair procedures include pain, surface burns to the superficial and deeper skin layers, reddening of the skin in the treated area, and folliculitis.[2]

As laser hair procedures have advanced, so has the ability to apply treatment to various areas of the body. Facial hair removal, including the hair located on the eyebrow, is one area of the body where newer, advanced lasers have had success.[3] Safety precautions when using lasers on and around the face include the donning of safety goggles or the application of eye shields over closed eyelids. In this report, we describe 6 cases of ocular injury directly related to laser hair removal/reduction procedures to the eyebrow both with and without eye protective devices. In each case, the associated iris damage was permanent and topical steroids were needed to address the associated uveitis. In 1 case, there was steroid-induced glaucoma that abated, but in another case, there was progression from ocular hypertension to uncontrolled glaucoma that required invasive intervention. In 2 cases, there was lens damage leading to cataract surgery.

Report of Cases. *Case 1*. A 55-year-old woman with an ocular history of ocular hypertension and myopia had laser hair removal to her left eyebrow using the LightSheer Diode 800-nm laser (Lumenis). She noticed pain above and behind her left eye during the laser procedure under the shield she was wearing and notified the technician who immediately aborted the procedure. She noticed that same day that her left pupil was a horizontal ellipse and her left eye was somewhat sore. Examination 1 day after the laser treatment showed visual acuity was unchanged from her baseline examination of 20/25 OU. Intraocular pressure (IOP) was 21 mm Hg OD and 22 mm Hg OS. Pupil examination was normal in the right eye but left eye examination revealed a 5 × 4-mm elliptical horizontal pupil with sluggish reaction but no relative afferent pupillary defect; the temporal one-third of the pupil in the left eye showed an irregularity (**Figure 1**) that was more notable in the dark. Gonioscopy in the left eye showed an open angle with no obvious defect and normal pigment deposition. Anterior chamber examination showed trace cell and flare in the left eye indicative of circulating inflammatory cells and protein leakage into the anterior chamber. Dilated fundus examination findings were unremarkable. At that time, a diagnosis was made of traumatic anisocoria with mild anterior uveitis. The patient was treated with prednisolone, 1%, ophthalmic topical drops administered 4 times per day in the left eye for 5 days; she was instructed to then discontinue the medication and return for a follow-up examination in 5 weeks, sooner if her symptoms increased.

The patient returned with concerns of 2 weeks of blurred vision. Best-corrected visual acuity was 20/20 OU. Her IOP was 23 to 24 mm Hg OD and 60 mm Hg OS. Slitlamp examination findings were unchanged in the right eye; slitlamp examination findings in the left eye revealed trace cell and flare with mild pigment on the posterior cornea and

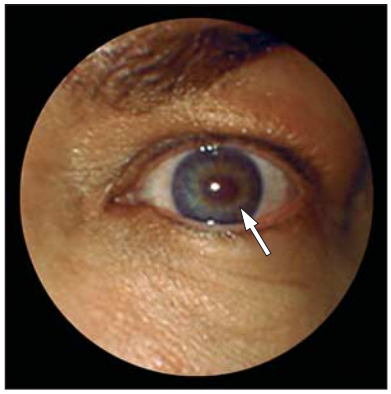

Figure 1. External photograph of the left eye of case 1 one day after eyebrow laser photoepilation. Note the temporal distortion of the pupil (arrow).

transillumination of light through the iris temporally (referred to subsequently as iris transillumination defects) where the pupil had previously been described as abnormal. Repeated gonioscopy showed open angles in both eyes with increased pigmentation on the trabecular network in the left eye. Her cup-disc ratio in the left eye had increased from 0.3 to 0.5. She was treated with fluorometholone acetate, 1%, 4 times per day. Fixed combination timolol, 0.5%, and dorzolamide, 2%, twice a day in the left eye; apraclonidine, 0.5%, twice a day in the left eye; and latanoprost, 0.003%, were prescribed topically to address the marked elevation of IOP in the left eye. Several hours later, her IOP was 34 mm Hg and she was sent home taking timolol, 0.5%–dorzolamide, 2%; latanoprost, 0.003%; and fluorometholone acetate, 0.1%. The IOP remained in the high 30–mm Hg range in the left eye and she was referred to a glaucoma specialist, who subsequently performed a selective laser trabeculoplasty in the left eye and ultimately a trabeculectomy in the left eye to control IOP.

Case 2. A 39-year-old woman with an ocular history of refractive surgery in both eyes (laser-assisted in situ keratomileusis) received laser hair treatment to her eyebrows bilaterally with a near-infrared GentleLASE 755-nm Alexandrite laser (Candela). Initially, the patient reported she was wearing safety glasses while the laser procedure was performed on her legs and underarms but was asked by the laser technician to remove the glasses while he was working on her eyebrows.

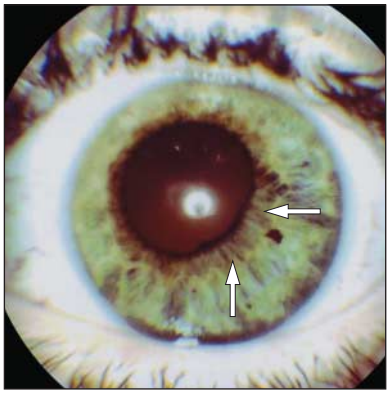

Figure 2. Slitlamp photograph showing temporal posterior synechiae with iris transillumination defects (arrows).

The patient reported that the technician used his hand to cover her right eye while working on her right brow and covered both of her eyes with his hand while working on her left brow. She did not have any discomfort during the procedure, but about 6 hours later, she noticed blurred vision in the left eye. Approximately 12 hours after the procedure, she experienced ocular pain and photophobia. She awoke the following morning with continued pain in her left eye and photophobia. She also noticed an irregularity of her left pupil. She went to her ophthalmologist 24 hours after the laser procedure and was diagnosed with anterior uveitis in the left eye. She was treated with topical steroids (prednisolone acetate, 1%, ophthalmic suspension) and asked to return in 4 days. At the subsequent examination, the patient was noted to have pigment cells in the anterior chamber in the left eye as well as iris transillumination defects inferiorly in the left eye. In addition, she had posterior synechiae from the 1-o'clock to 6-o'clock position (**Figure 2**). She was treated with atropine, 1%; asked to continue the topical steroid; and told to follow up in 1 week. Over the next month, treatment with both drops was gradually tapered and treatment with phenylephrine, 2.5%, was started 3 times a day in an attempt to break the synechiae in the left eye. After 3 weeks of treatment with phenylephrine, 2.5%, the synechiae remained and the phenylephrine was stopped. At the 4-month follow-up, the patient's visual acuity was 20/20 OU, but the iris atrophy, posterior synechiae, and corectopia remained in the left eye. Her IOP remained normal throughout.

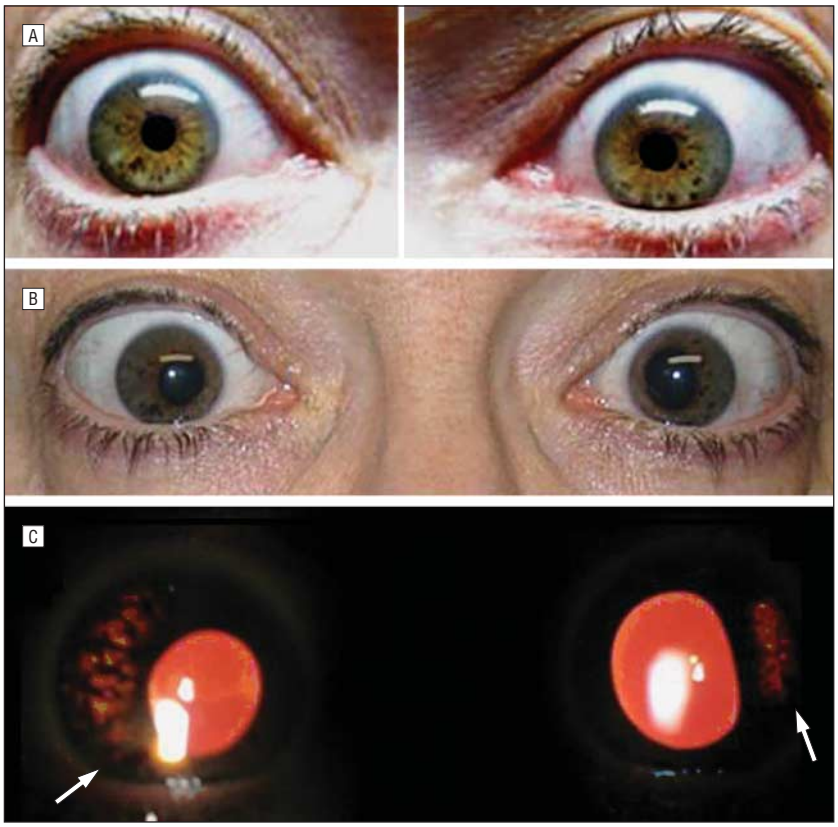

Figure 3. Case 3 illustrating relatively normal pupillary appearance 4 months after laser eyebrow photoepilation (A). However, residual damage to the temporal iris stroma resulted in pupillary distortion that is evident after pharmacological mydriasis (B). Retroillumination slitlamp photography (original magnification ×10) illustrates the pupillary distortion more clearly and also shows temporal iris transillumination defects in both eyes (C) (arrows).

Case 3. A 58-year-old woman underwent a laser hair removal procedure around both eyebrows using the Candela GentleLASE 755-nm laser. The treating physician reports that he used the recommended shielding for both eyes. The next day, the patient saw an optometrist because of eye pain and photosensitivity in both eyes. The examination findings noted visual acuity of 20/20 OU with rare anterior chamber cells and a trace of corneal surface epithelial stippling in both eyes. She was treated with topical steroids (loteprednol etabonate, 0.5%, ophthalmic suspension) 4 times per day in both eyes. Five days later, repeated examination showed anterior chamber cells in the right eye and IOP was 18 mm Hg OU. Six days after that examination, she noted continued photophobia and pain in the right eye. The topical steroid treatment was increased to every 2 hours and then tapered over follow-up examinations when all symptoms seemed resolved by the examination from the optometrist. The optometrist, however, noted a decentered, elongated pupil in the right eye. Four months later, a dilated fundus examination revealed eccentric pupils and bilateral iris transillumination defects. No change in the macula was apparent when compared with past retinal examination findings (which had noted macular pigment changes in both eyes). Gonioscopy showed increased pigment deposition in widely open angles; findings of Humphrey visual field perimetry using 30-2 threshold visual fields were normal in both eyes. Her IOP was 18 mm Hg OU. She noted that she had become more photosensitive to sunlight even while using sunglasses. Examinations by 2 retinal specialists prior to the photoepilation procedure did not note any pupil irregularity on dilation. Her undilated pupils are not eccentric and match the shape of her pupils seen on prior passport photographs (**Figure 3**).

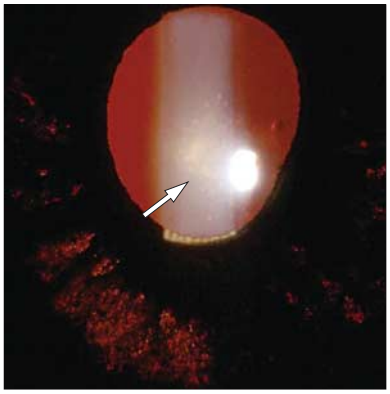

Figure 4. Retroillumination slitlamp biomicroscopic appearance in the left eye (original magnification ×16) in case 4 four years after eyebrow photoepilation illustrating iris transillumination defects and posterior subcapsular cataract formation (arrow).

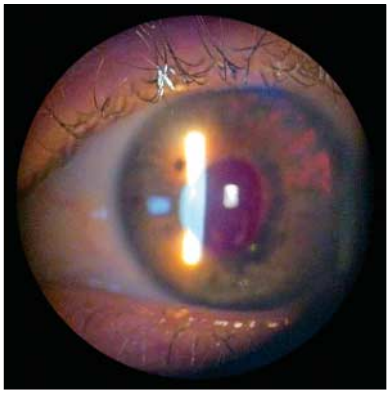

Figure 5. Slitlamp photograph (original magnification ×10) of the left eye taken with an iPhone 4 (Apple) custom adaptor 1 month after incident. No dilation drops were used. The slitlamp beam is focused nasally at the pupillary margin to illustrate pupillary distortion and temporal iris transillumination defects.

Case 4. A 34-year-old woman presented with sudden onset of pain and photophobia with a mild decrease in vision in the left eye 1 day following a laser hair removal procedure applied below her eyebrows bilaterally using a Lumenis LightSheer Diode laser (800 nm). Uncorrected visual acuity was 20/20 + 2 in the unaffected right eye and 20/20 + 1 in the affected left eye. The right pupil was 8 mm reacting to 4 mm and the left pupil was 5 mm reacting to 3 mm with no relative afferent pupillary defect. Slitlamp examination revealed iris pigment epithelial atrophy with transillumination defects from the 7-o'clock to the 2:30 position in the left eye. There was pigment deposition on the anterior lens capsule and posterior synechiae were noted temporally from 3 to 4 o'clock. The vitreous had rare pigmented cells. Findings of dilated fundus examination bilaterally were unremarkable. Over the next 4 years, the patient developed gradual onset of posterior subcapsular cataract sufficient to decrease her visual acuity to 20/30 OS (**Figure 4**). Cataract surgery resulted in improved best-corrected visual acuity to 20/20 OS.

Case 5. A 37-year-old woman presented with sudden onset of pain and photophobia following "laser pigment rejuvenation" around both eyes using a laser source that was not documented. She was referred after several weeks of treatment with topical steroids and cycloplegics, with continued concerns of decreased vision, trouble driving at night, blurry vision in both eyes, and severe photophobia. Visual acuity was 20/40+ OD and 20/25– OS with present correction. Slitlamp examination revealed the pupils to be slowly reactive with posterior synechiae inferiorly in both eyes. Slitlamp examination of the right eye revealed iris pigment epithelial defects for near 360° with posterior synechiae inferotemporally and pigment on the anterior lens surface inferotemporally. The patient had 1+ posterior subcapsular cataract in the right eye. There was trace cell and flare in the anterior chamber in the right eye. Examination of the left eye revealed rare cells and trace flare in the anterior chamber and iris pigment epithelial transillumination defects inferiorly. Findings of dilated fundus examination bilaterally were unremarkable. Because of the remote possibility of herpes simplex or herpes zoster virus uveitis, which can be associated with transillumination defects, the patient underwent anterior chamber paracentesis of the right eye, and samples were sent for polymerase chain reaction testing for varicella-zoster and herpes simplex virus; these test results came back negative for the presence of either virus. The posterior subcapsular cataracts worsened slightly over the next several months and the patient underwent sequential bilateral phacoemulsification of the cataracts with intraocular lens implants and placement in each eye of Morcher iris diaphragm capsular tension rings under compassionate use exemption from the Food and Drug Administration. Uncorrected visual acuity returned to 20/20 OU and the patient's photophobia decreased strikingly.

Case 6. A 23-year-old woman developed immediate left eye pain after laser photoepilation of the eyebrow with the Candela 755-nm laser. The patient was wearing safety glasses and had her eyes closed during the incident. Ophthalmic examination after photoepilation revealed best-corrected visual acuity of 20/20 OD and 20/30 OS. Her IOP was 12 mm Hg OD and 14 mm Hg OD. External examination findings were remarkable for 1+ left upper eyelid edema. Slitlamp examination findings were unremarkable in the right eye but in the left eye there was 1+ conjunctival hyperemia, 2+ cell, and 3+ flare, and a large iris transillumination defect was present in the superior temporal quadrant. The rest of the examination findings were unremarkable. The patient was treated with prednisolone, 1%, ophthalmic topical drops every hour and tropicamide, 1%, twice a day in the left eye, but the uveitis was not improved in follow-up 2 days later. The patient was switched to difluprednate, 0.05%, every 2 hours while awake and a Medrol dosepak was added. Ten days later, the patient reported improved ocular comfort. The cell and flare cleared, but IOP was increased to 37 mm Hg OS. On gonioscopy, the angle was wide open in both eyes with 1+ trabecular meshwork pigmentation in the right eye and 3+ pigmentation in the left eye. Steroids were tapered, and subsequently, all glaucoma medications were withdrawn with return of visual acuity of 20/20 OU and normal IOP. A subsequent glaucoma workup did not reveal any functional or structural loss consistent with glaucoma. However, the patient did develop mild vertical elongation of the pupil in the left eye (**Figure 5**).

Comment. All laser devices distributed for both human and animal treatment in the United States are subject to mandatory performance standards.[4] The Food and Drug Administration and the Occupational Safety and Health Administration are charged with classifying and maintaining safety guidelines for all la-

sers in use in the United States.[5] All lasers used in this series were in the near-infrared spectrum (700 nm-1400 nm).[4] All of the lasers used in the cases described earlier are labeled class IV lasers and, as such, require the use of eyewear to protect against laser-induced damage to ocular structures.[4]

Ocular tissues are known to be susceptible to damage from exposure to laser emission.[6] In certain instances, laser application at various wavelengths to structures such as the retina and uveal tissues is the current method used to treat many eye disorders such as diabetic retinopathy, macular degeneration, and glaucoma. However, when laser emission is applied to ocular tissues inadvertently, there can be damaging consequences. Thermal, mechanical, and photochemical damage to ocular structures caused by lasers include corneal burns, uveitis, cataract formation, and retinal burns.[6] Common patient symptoms are blurred vision, photophobia, pain, and conjunctival hyperemia.[7] In our series, the common adverse effect seen from unintended laser exposure was uveal tissue damage, specifically damage to the iris. Past studies also document iris damage such as posterior synechiae, pigment dispersion, and iris transillumination defects in patients who had undergone laser photoepilation to periocular tissues[8]—all signs that were seen in 1 or more of the patients in our series. In addition to direct iris damage, 2 patients developed secondary open-angle glaucoma due to combination of exposure to topical steroids needed to treat uveitis and trabecular obstruction from circulating pigment and inflammatory cells. One of these patients required surgical intervention to control IOP. Two other patients who were younger than 40 years developed visually significant cataracts requiring surgery that were at least partially attributable to the inadvertent ocular exposure to laser energy.

Several studies went so far as to advise against the use of periocular laser[9,10] or that individuals contemplating laser-assisted eyebrow hair removal be advised of the potential risks to the eyes.[11] Patients undergoing laser hair reduction to tissues around the eye are required to wear protective eyewear that shields the ocular tissues from laser damage. However, inadequate shielding may expose external and internal eye tissues to damage. Particularly susceptible are tissues that contain pigment because most lasers use selective photothermolysis to target melanin in the dermis hair follicle as the method to obtain the laser hair reduction.[12] In the anterior segment of the eye, the iris and ciliary body are tissues composed of melanin and could be damaged from laser exposure during photoepilation procedures. Further, there is limited pigment in the eyelids and if there were eyelid exposure from absent or inadequate shielding, then there would be a possible avenue in which the laser could penetrate through the less pigmented eyelid tissue and be absorbed by the pigment-rich iris. In our series, iris damage occurred in all our patients in some form even though in some cases there was documented eye shielding. Laser application that was not directly aligned at the proper angle to apply directly to the intended tissue (eyebrow or other periocular structure) but was angled in such a way as to align the application through an exposed eyelid would explain how even "shielded" patients can get a laser exposure to the eye and potentially cause the injuries seen in the earlier-described cases. The orbital rim is an area of tissue with a rolled surface rather than a flat plane; this may represent an area where the laser probe could be displaced under the safety goggle/shield.

In conclusion, we urge all physicians and their support staff who perform laser hair reduction procedures to the periocular surface to be aware that the absence or improper use of eye shielding can result in serious and long-lasting ocular damage. Proper eye shielding covers the entire surface area of both eyelids up to the superior orbital rim down to the inferior orbital rim as it forms the roof of the maxilla. Included are the areas nasally near the caruncle and temporally to the zygomatic arch. In addition, if patients complain of eye pain, then the procedure should be terminated immediately, and the patient should receive ophthalmic consultation. We recommend that shielding take into account the anatomy present in the periocular area and be designed to prevent these ocular injuries caused by inadequate protection.

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Author Contributions: Dr Parver takes authorship responsibility for this article.
Financial Disclosure: None reported.
Funding/Support: Dr Pasquale is supported by the Harvard Glaucoma Center of Excellence and a Harvard Ophthalmology Scholar Award.
Additional Contributions: Andrew Lee, OD, contributed to this article.
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Ophthalmic Images

Iris Ring Melanoma With Extrascleral Extension

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Figure 1. External photography showing extrascleral extension of the ring melanoma and dark pigmentation at the iris root.

Figure 2. Microscopic picture of a hematoxylin-eosin–stained slide revealing melanoma cells at the iris root with extrascleral extension through a ciliary artery and the Schlemm canal (original magnification ×40).