Macular Hole After Commercially Available Handheld Diod Laser Exposure

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ABSTRACT

This case report evaluates a 38-year-old male patient with retinal injury and visual impairment due to the exposure of Class 3A handheld green-blue diode laser purchased online. The patient, who was unresponsive to medical treatment, developed a full-thickness macular hole over time and required vitreoretinal surgery. Although the patient had an anatomical and functional improvement by early surgical treatment, it should be noted that these devices have the potential to cause permanent damage to the eye. If unlimited access to high power handheld laser devices continues, this will continue to be a significant global public health problem, leading to a large number of eye injuries.

Key Words: Handheld laser, Macular hole, Optical coherence tomography, Retinopathy.

INTRODUCTION

The unprotected human eye is the most sensitive organ to the laser radiation energy, and retinal injury can occur both from direct and reflected beams. Light emitted from lasers can affect the retina through photochemical/ thermal damage in the visible and near-infrared spectrums (400-1400 nm) known as the retinal hazard zone. Damage can occur after relatively short exposure. Injuries involve a variety of retinal changes, including pigmented deposits or lesions in the fovea, hemorrhage, epiretinal membrane, macular hole, choroidal neovascularization, and atrophic scars in the pigment epithelium.[1] Due to the lack of self-healing properties of the retina, the lesions can sometimes be permanent and lead to irreversible vision loss.

Handheld laser devices commercially available on the internet pose a potential risk for vision loss and represents a significant public health issue.[2] In this case report, we evaluate a 38-year-old man who had visual impairment from handheld laser-induced retinopathy and developed a full-thickness macular hole requiring surgery.

CASE REPORT

A thirty-eight-year-old male patient was admitted to the outpatient clinic due to a sudden decrease in his right vision. In his story, he claimed that two hours ago, his eye had been exposed to the light of a device used to cut off paper and light a cigarette for a few seconds. The patient had brought the handheld laser device with him, and the causative tool was evaluated as a Class 3A green-blue 450 nm diode laser obtained from a manufacturer via the internet.

At the first visit, best-corrected visual acuity was 6/20 in the right eye and 6/6 in the left eye. There was a central vision loss due to a round-shaped scotoma. On dilated fundus examination, a small yellow white pseudo-hole appearance was present in the fovea consistent with a laser burn. Fluorescein angiography results indicated mild late-phase hyperfluorescence representing a window defect. The spectral-domain optical coherence tomography (OCT) revealed irregularities and cystic appearance in the inner and outer layers of the retina (Figure 1). A single dose of intravitreal triamcinolone acetonide injection had been administered for initial therapy. Nevertheless, the foveal

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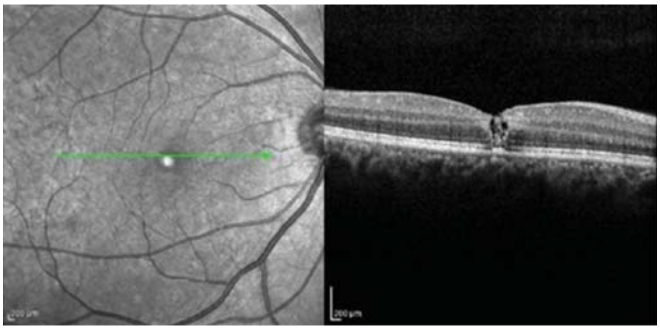

Figure 1: *Spectral-domain OCT imaging of handheld diode laser-induced maculopathy. Examination at presentation showed focal disruption and cystic appearance in the inner and outer retinal layers.*

cystic cavity did not improve, and visual acuity decreased to 6/30 at the time of examination ten days later. Subsequent fundus examination revealed a vitelliform-like lesion with faint whitening at the level of retinal pigment epithelium. Fundus autofluorescence imaging demonstrated a central hypo-fluorescent lesion secondary to retinal pigment epithelium atrophy. OCT showed a progression to a full-thickness macular hole with surrounding cystoid cavities at the outer plexiform layer and nodular excrescences at the level of the retinal pigment epithelium at six weeks after the initial injury (Figure 2). The patient underwent pars plana vitrectomy, posterior hyaloid stripping, and placement of a 15% C3F8 gas tamponade (GY). Attached vitreous was detected at the time of surgery and no perioperative complications were observed. Visual acuity in the right eye increased to 6/12 in the first month postoperatively. On fundus examination, a small, hypopigmented scar persisted in the fovea which could account for his visual acuity score. Postoperative OCT showed normal foveal contour with a central macular thickness of 275 µm, complete hole closure and resolution of the cystoid cavity.

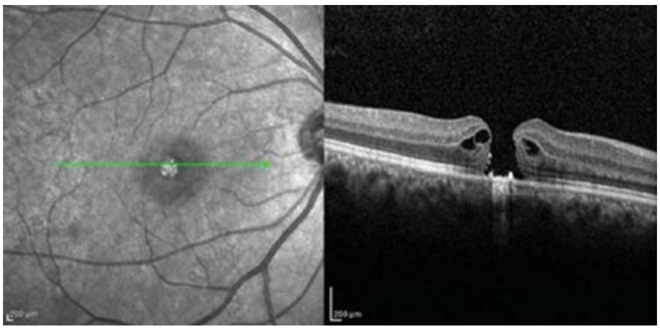

Figure 2: *Spectral-domain OCT showed a progression to a full-thickness macular hole with surrounding cystoid cavities at the outer plexiform layer and nodular excrescences at the level of the retinal pigment epithelium at six weeks after the initial presentation.*

CONCLUSIONS

Widely available handheld laser devices sold on the internet pose a potential risk for ophthalmic injuries. Retinal injuries have been reported to occur, particularly in the young age group, when these devices are inadvertently or deliberately exposed to the eye. If they are directed towards the eye, lasers with wavelengths of 400-780 nm may cause photochemical damage and retinal burn in the retina.[3] The laser to which the patient is exposed is a Class 3A green-blue 450 nm diode laser, and retinal damage was induced by direct viewing condition. Although the American National Standards Institute has reported that Class 3A lasers do not cause serious ocular damage with an exposure of less than 10 seconds[4], clinical and histopathological changes for Class 3A green laser handheld devices have been demonstrated for the same duration.[5]

While the effect of laser exposure is usually restricted by blink reflex and aversion response, these mechanisms can fail to protect the eye, which may result in mild to severe retinal injury. Bartsch et al. demonstrated that a 455 nm laser directed at the eye cause damage even if only exposed for a few milliseconds, shorter than the duration of a blink reflex.[6] As a specific feature of the eye, the energy of a laser beam can also be increased up to 100,000 times due to the focusing ability of the lens. Thus, even a low-power laser can cause damage if it focuses directly on the retina.

Most accidental ocular laser injuries in the literature consist of children or young adults, and retinopathy was observed within 24 hours on clinical examination.[5] Cases typically complain visual disturbances within 4 hours to 1 week after laser exposure, and most had an asymmetric injury. Central scotoma, blurry central vision, and metamorphopsia were commonly reported. The initial best-corrected visual acuity covered a wide range of presentations, from counting fingers to 20/20.

The accidental laser exposure can cause a variety of retinal changes, including vitelliform-like lesions, small hypopigmented spots, and hemorrhages at various retina levels. Although some authors reported that these lesions might spontaneously heal without any treatment, complications such as epiretinal membrane, macular hole, choroidal neovascularization, and large atrophic scars in the pigment epithelium may occur during the follow-up.[1]

The spectral-domain OCT findings of laser-induced maculopathy are reported varying from mild inner /outer segment junction dehiscence to severe damage in the inner retinal layers. Lesions are characterized by ellipsoid zone and external limiting membrane disruption, vertical hyperreflective streaklike bands originating from the pigment epithelium, and hyporeflective cavities.[7]

Medical treatment of eyes without complications is limited to systemic corticosteroids; however, the efficacy of steroid use has not been well established.[8] It has been proposed to reduce epithelial cell proliferation and migration of pigments as well as to reduce the inflammatory response.

A laser-induced macular hole can occur instantly or may progress over time as a result of the photobiological effect of the laser beam and vitreomacular traction.[9] Unlike neodymium:yttrium-aluminium-garnet (Nd:YAG) laser, which may cause instant macular hole by producing mechanical damage, diode laser produce thermal burns to the fovea that takes time to evolve into a macular hole. Spontaneous closure is reported occasionally in some cases; however, early surgical intervention is recommended due to the high likelihood of macular hole enlargement. Ciulla et al. reported a patient with laser-induced full-thickness macular hole in whom visual acuity increased from 6/18 to 6/9 six months after the surgery.[10] A more extensive study suggests that early surgical intervention is required in most cases, and the anatomical success rate is as high as 80%. However, visual recovery is limited in some patients, and this is attributed to ellipsoid zone disruption in the fovea.[9]

This case shows that the acute thermal laser burn to fovea from a handheld laser device may progress into a full-thickness macular hole over time. Patients should, therefore, be closely monitored. Although the vision may be well preserved with early surgical intervention, it should be kept in mind that there may be severe visual loss depending on the power of the laser and duration of the exposure. Easy access to low-cost, high-powered handheld laser devices on the market has led to cases of macular holes as an increasingly new phenomenon in recent years which may lead to an epidemic of vision loss particularly in young age groups. Given the risks, it may be necessary to put regulations on the sale of handheld laser devices currently available on the internet and to educate people about the inherent danger.

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