



Sub-Tenon Triamcinolone Acetonide Injection in the Acute Treatment of Handheld Laser-Induced Maculopathy

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Abstract

Handheld laser (HHL)-induced maculopathy has increased in frequency in recent years and can lead to severe retinal damage and vision loss. Although there is no consensus on the treatment of HHL-induced maculopathy, the use of systemic steroids to limit damage to the retina has been discussed. In this article, we present a patient who underwent early sub-Tenon triamcinolone acetonide injection for HHL-induced maculopathy. To our knowledge, sub-Tenon steroid administration has not been previously reported in the treatment of HHL-induced retinopathy.

Keywords: Handheld laser, laser pointer, optical coherence tomography, posterior sub-Tenon triamcinolone acetonide, retinal laser injury

Introduction

The recent introduction of stronger and thus more dangerous laser pointers and the ability to easily obtain these lasers online at relatively low prices has led to an increase in cases of handheld laser (HHL)-induced maculopathy, which can cause severe retinal damage and result in visual impairment.^{1,2,3,4,5,6,7,8} They are especially appealing to children and young adults, as they are considered high-tech, are colorful, can ignite paper or matches, and can make holes in objects such as balloons. However, there is a widespread lack of knowledge about the risks and long-term consequences of exposure to high-power laser beams. Because of

general unawareness and low vision or scotomas going unnoticed in the pediatric age group, the number of people affected by HHLs is probably higher than reported.

As opposed to clinical manifestations, the finding of a curvilinear hyperreflective band on optical coherence tomography (OCT) is characteristic of HHL-induced maculopathy.^{5,9,10} Other reported findings include photoreceptor and retinal pigment epithelium (RPE) damage, full-thickness macular hole, macular hemorrhage, and macular edema.^{11,12} Although there is no established consensus regarding treatment necessity and efficacy, it is presumed that early treatment may prevent destruction caused by the photothermal, photomechanical, and

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Received: 08.02.2022 **Accepted:** 13.05.2022

Cite this article as: Cankurtaran M, Şekeryapan Gediz B. Sub-Tenon Triamcinolone Acetonide Injection in the Acute Treatment of Handheld Laser-Induced Maculopathy. Turk J Ophthalmol 2022;52:281-285

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Turkish Journal of Ophthalmology, published by Galenos Publishing House.

photochemical interactions of the laser beam. For this purpose, authors have reported administering steroids, usually systemically in HHL-induced maculopathy, systemically and locally in solar retinopathy, or topically in unilateral cases.^{5,6,7,8,13,14} Here we present a patient who received early sub-Tenon triamcinolone acetonide injection for HHL-induced maculopathy.

Case Report

A 22-year-old man presented with complaints of low vision in the right eye starting 6 hours earlier and described a paracentral scotoma in his right visual field. Best corrected visual acuity (BCVA) (with Snellen chart) was 20/32 in the right eye and 20/20 in the left eye. Intraocular pressure (IOP) was measured as 16 mmHg in both eyes by tonometry. Eye movements were normal, pupil size was within normal range, direct and indirect light reflexes were intact, and relative afferent pupillary defect was not observed. No pathology was detected in anterior segment slit-lamp examination. On dilated fundus examination, there were no pathological findings other than an area of pallor in the fovea of the right eye; the left eye was normal. When asked what precipitated his vision loss, the patient said that he had taken apart and attempted to repair a handheld green laser he had bought to play with his cat and believed was not functioning. OCT scan revealed a curvilinear hyperreflective

band extending from the outer plexiform layer to the ellipsoid zone (Figure 1). According to the information obtained from the website where the patient bought the laser pointer, the laser power was 5,000 mW and it was a green laser. The patient was diagnosed as having HHL-induced maculopathy in the right eye and a sub-Tenon injection of triamcinolone acetonide (40 mg) was administered in the upper temporal quadrant. OCT images obtained on day 4 and at 2 weeks showed progressive resolution of the curvilinear hyperreflective band (Figure 2). At 3-month follow-up, the patient's BCVA was 20/20 in both eyes, IOP was 17 mmHg in the right and 16 mmHg in the left eye, and appearance on OCT was normal (Figure 2). Fundus examination and fundus autofluorescence imaging performed at the same follow-up visit were also normal (Figure 3).

Discussion

HHL-induced maculopathy, first described in 1999, has increased in prevalence in recent years.¹ Although laser-induced macular damage depends on laser characteristics (power, wavelength) and exposure time, the features of the lasers are reported in only one-third of the cases in the literature.² According to the United States Food and Drug Administration classification of HHLs, those with power greater than 5 mW are classified as high-power lasers.² In addition, lasers with lower

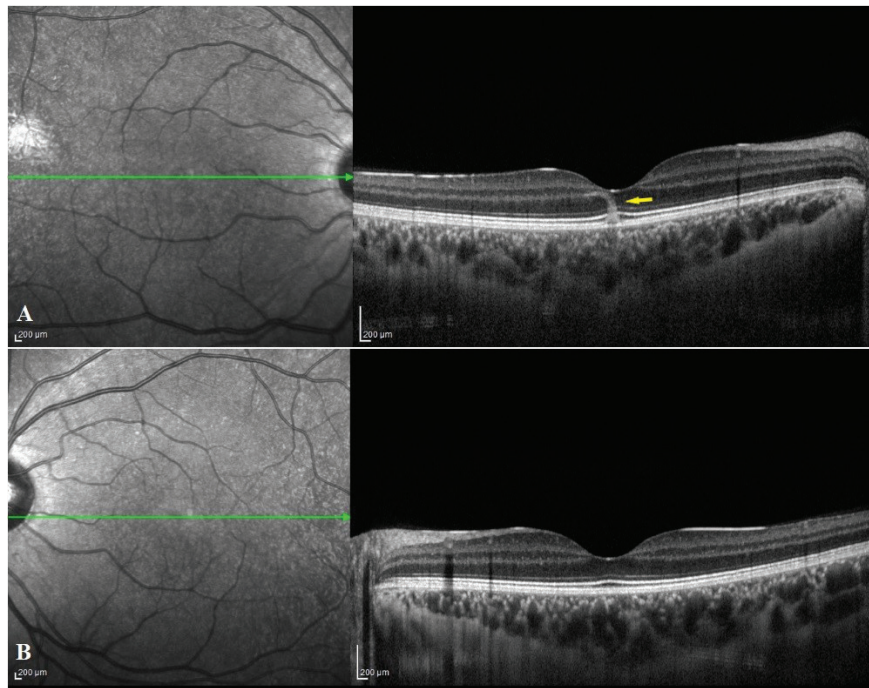


Figure 1. Optical coherence tomography (OCT) image of the patient taken on the same day as the handheld laser injury. A) In the right eye, a curvilinear hyperreflective band extending from the outer plexiform layer to the ellipsoid zone is indicated by a yellow arrow. The hyperreflective band appears to follow the Henle fibers. B) The OCT image in the left eye is normal.

wavelength cause more damage. In our case, the power of the laser that caused the injury was 5,000 mW, which is very high.

Although treatment remains controversial, the use of systemic steroids has been adopted in HHL-induced maculopathy to limit retinal damage. There are a few cases and case series in the literature in which different doses and regimens of systemic corticosteroid were used in patients with different forms and

amounts of ocular exposure to different types of lasers. In all reported cases, systemic steroid therapy was reported to have a favorable impact on anatomic and functional recovery.^{5,6,7,8} In a study by Chen et al.,⁸ patients with HHL exposure were divided into two groups: those who presented within the first week were treated with 1 mg/kg oral prednisolone for 3 days then tapered by 10 mg weekly, while those who presented after the first week received no treatment. Both anatomic and functional outcomes were reported to be better in the treated group at the end of at least 3 months of follow-up. In addition, an animal study demonstrated that treatment with systemic methylprednisolone or indomethacin increased photoreceptor survival in argon laser-induced retinal lesions in rhesus monkeys.¹⁵

In contrast, Dhrami-Gavazi et al.¹⁶ reported resolution of the hyperreflective band within 2 weeks in a patient with HHL-induced maculopathy who received no treatment. However, the authors emphasized that although the patient's visual acuity was improved at 3-month follow-up, the central scotoma persisted. The persistence and degree of damage in HHL-induced maculopathy may vary depending on the laser power and the circumstances and duration of exposure. Systematic controlled studies that would allow evaluation of functional recovery are difficult to design and have not been performed to date, and it is difficult to decide whether treatment is superior to the natural course. However, the presence of persistent OCT findings in long-term follow-up of HHL-induced maculopathy suggests that treatment initiation may be necessary at presentation depending on the laser power, wavelength, and exposure duration.

The pathophysiology of retinal laser damage is known to involve mechanical and thermal destruction of the retinal architecture, as well as retinal and choroidal occlusion.¹⁷ In mild injuries, there may be focal defects in the outer retina and RPE; with more severe injury, external retinal atrophy and choriocapillaris ischemia may occur.⁵ Vascular occlusion causes lipid peroxidation and increases retinal damage. Although ellipsoid zone disruption, intraretinal cyst, subretinal fluid, and changes in the inner retinal layers are among the reported OCT signs of retinal damage, the curvilinear hyperreflective band extending from the outer plexiform layer to the ellipsoid zone and characterized by acute opacification of the Henle fibers is typical of HHL-related maculopathy.^{5,9,10,11,12}

The strong antioxidant and anti-inflammatory properties of steroids are important in preserving the integrity of the blood-retinal barrier and minimizing laser-induced retinal damage. In our case, treatment was planned because the laser source was very powerful and the patient presented soon after exposure. As the maculopathy was unilateral, we opted for posterior sub-Tenon steroid injection to avoid the undesirable effects of systemic steroid therapy. Posterior sub-Tenon steroid injection is a known treatment option for the treatment of adverse effects such as

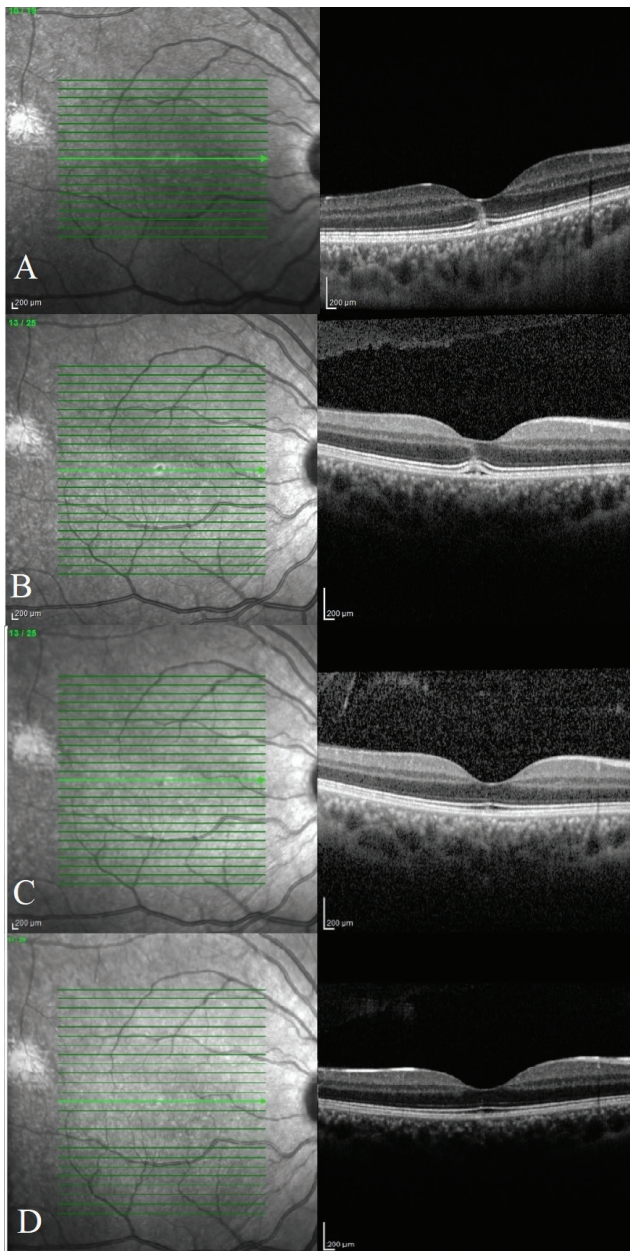


Figure 2. Changes optical coherence tomography images of the right eye obtained over 3 months. The scans were taken on day 1 (A) of visual symptoms and at 4 days (B), 2 weeks (C), and 3 months (D). The vertical curvilinear hyperreflective band was observed to resolve rapidly and disappear, and the subfoveal hyporeflective space that increased on day 4 had completely disappeared at 2 weeks.

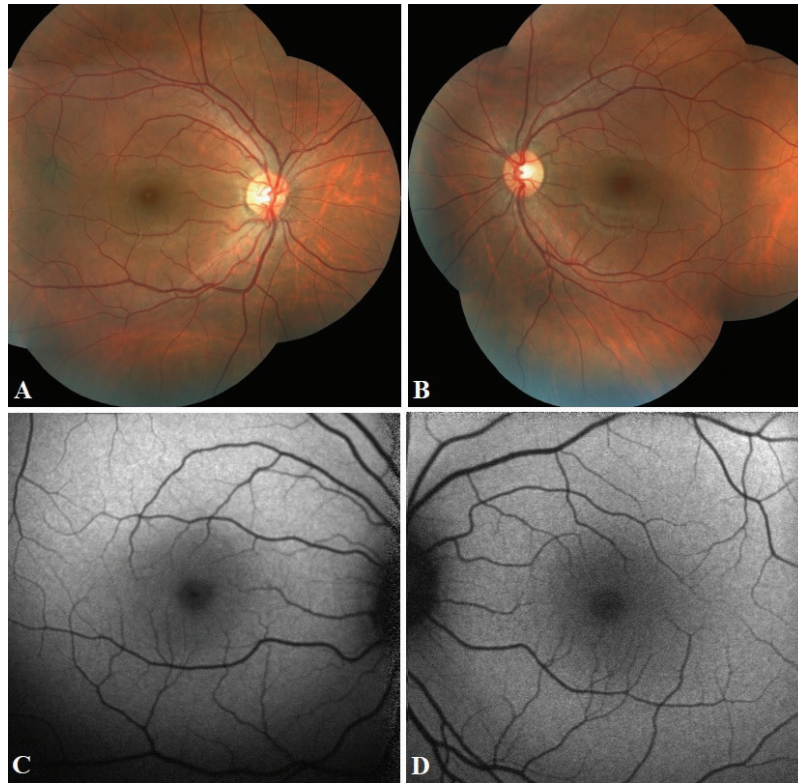


Figure 3. The patient's 3-month follow-up images. A and B) Fundus photographs appear normal in both eyes. C and D) Fundus autofluorescence examination showed no significant loss of autofluorescence in either eye.

macular edema or serous retinal detachment associated with the destructive effect of photocoagulation. To our knowledge, however, sub-Tenon steroid administration for the treatment of HHL-induced maculopathy has not been previously reported in the literature. Posterior sub-Tenon triamcinolone acetonide injection was shown to be effective in the treatment of both macular edema and serous macular detachment by stabilizing the temporary disruption of the blood-retinal barrier caused by the laser.^{18,19} In our case, sub-Tenon steroid injection may have allowed faster treatment of thermal and mechanical retinal damage and thus earlier anatomic and visual and functional recovery after HHL exposure.

In conclusion, sub-Tenon steroid injection may be beneficial in obtaining good visual outcome and rapid structural improvement in HHL-induced maculopathy, especially in patients who are affected unilaterally and present soon after laser exposure.

Ethics

Peer-review: Externally peer reviewed.

Authorship Contributions

Surgical and Medical Practices: M.C., B.Ş.G., Concept: M.C., B.Ş.G., Design: M.C., B.Ş.G., Data Collection or Processing: M.C., B.Ş.G., Analysis or Interpretation: M.C., B.Ş.G., Literature Search: M.C., B.Ş.G., Writing: M.C., B.Ş.G.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study received no financial support.

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