Optical Coherence Tomography Angiography Findings of a Handheld Laser-Induced Maculopathy: A Case Report

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ABSTRACT

In this case report we aimed to present the optical coherence tomography angiography (OCT-A) findings of handheld laser-induced maculopathy (HLIM). The clinical course of a 17-year-old boy who stared at a laser beam accidentally for a second is provided. Retrospective review of the OCT-A imaging along with the other multimodal imaging that includes fundus photography, fluorescein angiography, spectral-domain optical coherence tomography (SD-OCT) is used to demonstrate the HLIM lesions.Cystoid changes at the macula and the disruption of the outer retinal layers detected by the SD-OCT. The OCT-A revealed hyperreflective spots in the FAZ on the superficial and deep retinal layers and a hyporeflective area on the choriocapillaris. After 1 month from the exposure, SD-OCT changes were resolved highly but the OCT-A findings have mostly remained. In conclusion while the immediate SD-OCT characteristics are well known and highly specific for HLIM, these distinctive changes could resolve very quickly. At the absence of these findings OCT-A could be in assistance of diagnosis.

Keywords: Handheld laser-induced maculopathy, Optical coherence tomography angiography, Macula.

INTRODUCTION

In recent years handheld laser pointers are used widely for presentations and also by children/teenagers as a game. It is well known that low power (5 mW) lasers considered harmless and safe but many studies reported cases that suggested the opposite.[1-3] An experimental study on monkeys had shown class 3A lasers (output power is between 1 to 5 mW) could cause burns on the retina after 10 seconds of exposure.[4]

Optical coherence tomography angiography (OCT-A) is a moderately new, non-invasive method to visualize the retinal vascular network with separate layers; superficial, deep and choroidal microvasculature. The field of use of OCT-A is expanding in ophthalmology practice and the characteristics of OCT-A findings for many diseases such as diabetic retinopathy, retinal venous obstruction, retinal inflammatory diseases, central serous chorioretinopathy, angioid streaks, choroidal neovascularization, retinal dystrophies, and glaucoma are already defined.[5]

We herein aimed in this study to report the OCT-A findings of a handheld laser-induced maculopathy (HLIM) case.

CASE REPORT

A 17-year-old boy presented to our clinic with an increasing grayish-black spot on his left eye's (LE) sight, 24 hours after accidentally having stared for only a few second at a beam of a handheld laser pointer. A comprehensive consent form signed by the parents of the patient before any examinations proceeded. The handheld laser which the patient had been exposed to, was a green laser and there was no label on it to demonstrate the power of the laser.

His best-corrected visual acuity (BCVA) was 20/20 in both eyes at the initial examination. Amsler-grid test, biomicroscopic and dilated fundus examination, spectral domain optic coherence tomography (SD-OCT), OCT angiography (OCT-A), fluorescein angiography (FA) were performed. Amsler-grid test detected a superotemporal scotoma on the LE (Figure 1). There were no related findings on biomicroscopic anterior segment examination in both eyes. A yellowish plaque at fovea was seen in LE's dilated fundus examination (Figure 2A). LE's SD-OCT (RS-3000 Advance, Nidek Co. Ltd., Aichi, Japan) of the macula revealed cystoid changes at outer plexiform layer

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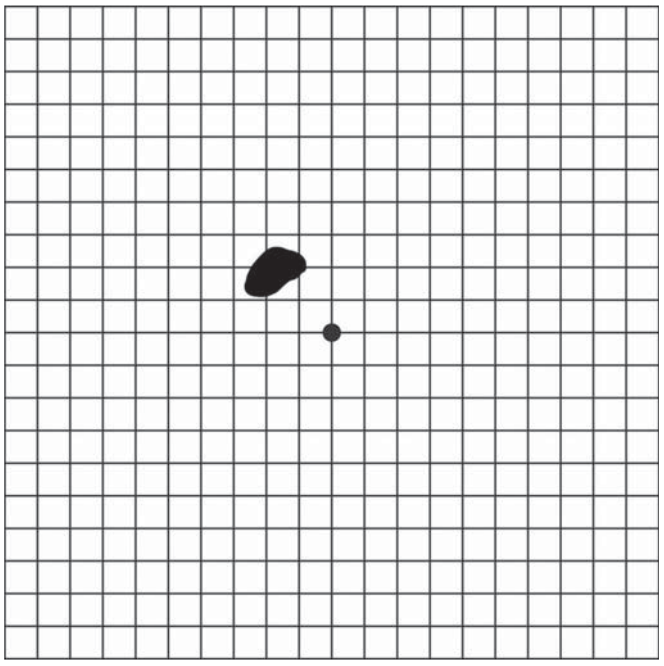

Figure 1: *Amsler Grid test result of the left eye.*

(OPL) and a disruption of the outer retina from OPL to the retinal pigmented epithelium (RPE), including the ellipsoid zone at the inferonasal parafovea (Figure 3A, B). A hyperreflective spot was present in the foveal avascular zone (FAZ) on both superficial and deep retinal layers and a hyporeflective area on choroidal layer which revealed by the OCT-A (RS-3000 Advance, Nidek Co. Ltd., Gamagori, Japan) (Figure 4A-C). There was a hyperfluorescent spot at both early and late phases on FA which was caused by a window defect (Figure 2B). Multifocal electroretinogram (mf-ERG) could also be helpful to diagnose and follow up the lesion but we could not use mf-ERG do to lack of an electrophysiology laboratory.

One week later the second visit performed to detect if any early complications such as retinal or vitreal hemorrhage and ischemia. Patient's BCVA was stable and the scotoma on the LE was smaller. The cystoid changes at the OPL had vanished, but the other changes of the LE's SD-OCT

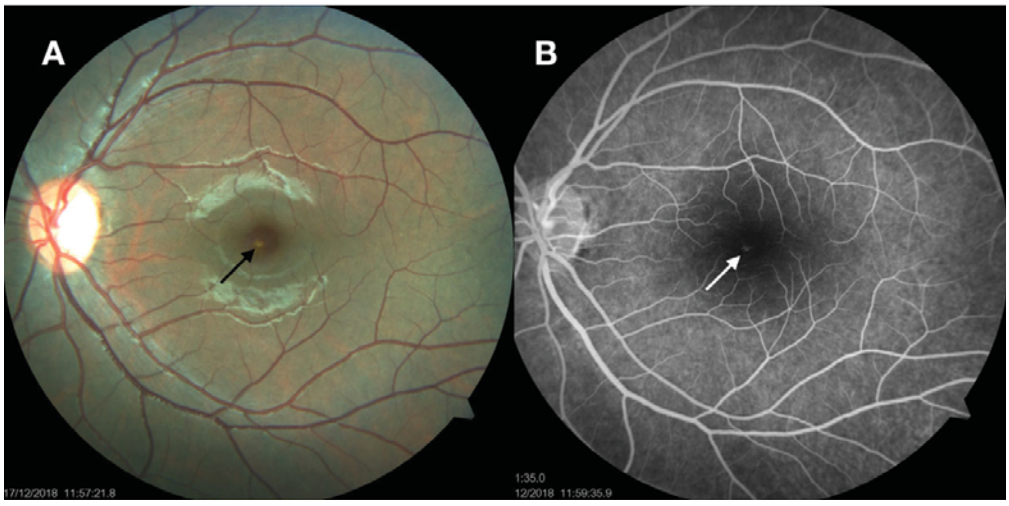

Figure 2: *Colour fundus photograph (A) and FA (B) of the patient's left eye. The yellowish plaque is pointed by the black arrow on color fundus photograph. In correspondence of the yellow plaque, a window defect (white arrow) was present on the FA.*

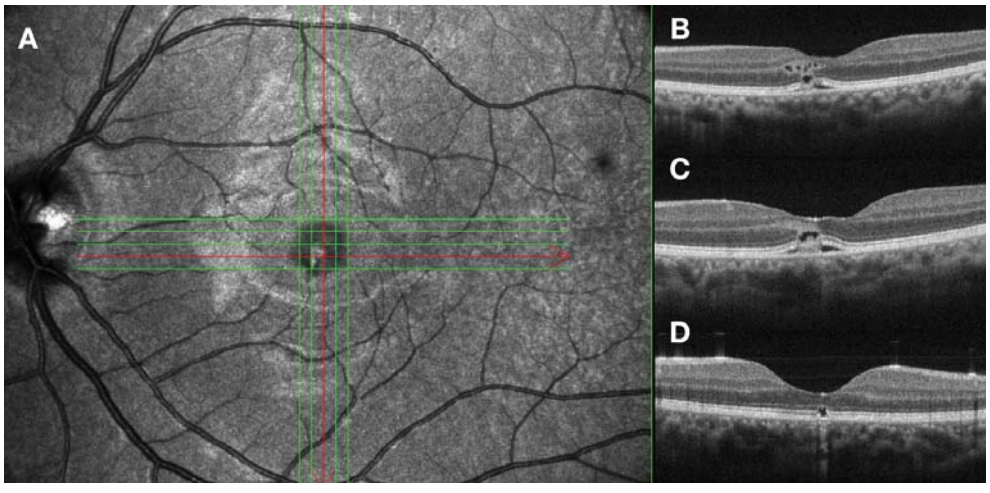

Figure 3: *SD-OCT images of the patient's initial visit (24 hours after the laser exposure) (A, B). After one week at the second visit the cystoid changes were gone (C). Only a small IS/OS band defect remained after 1 month (D).*

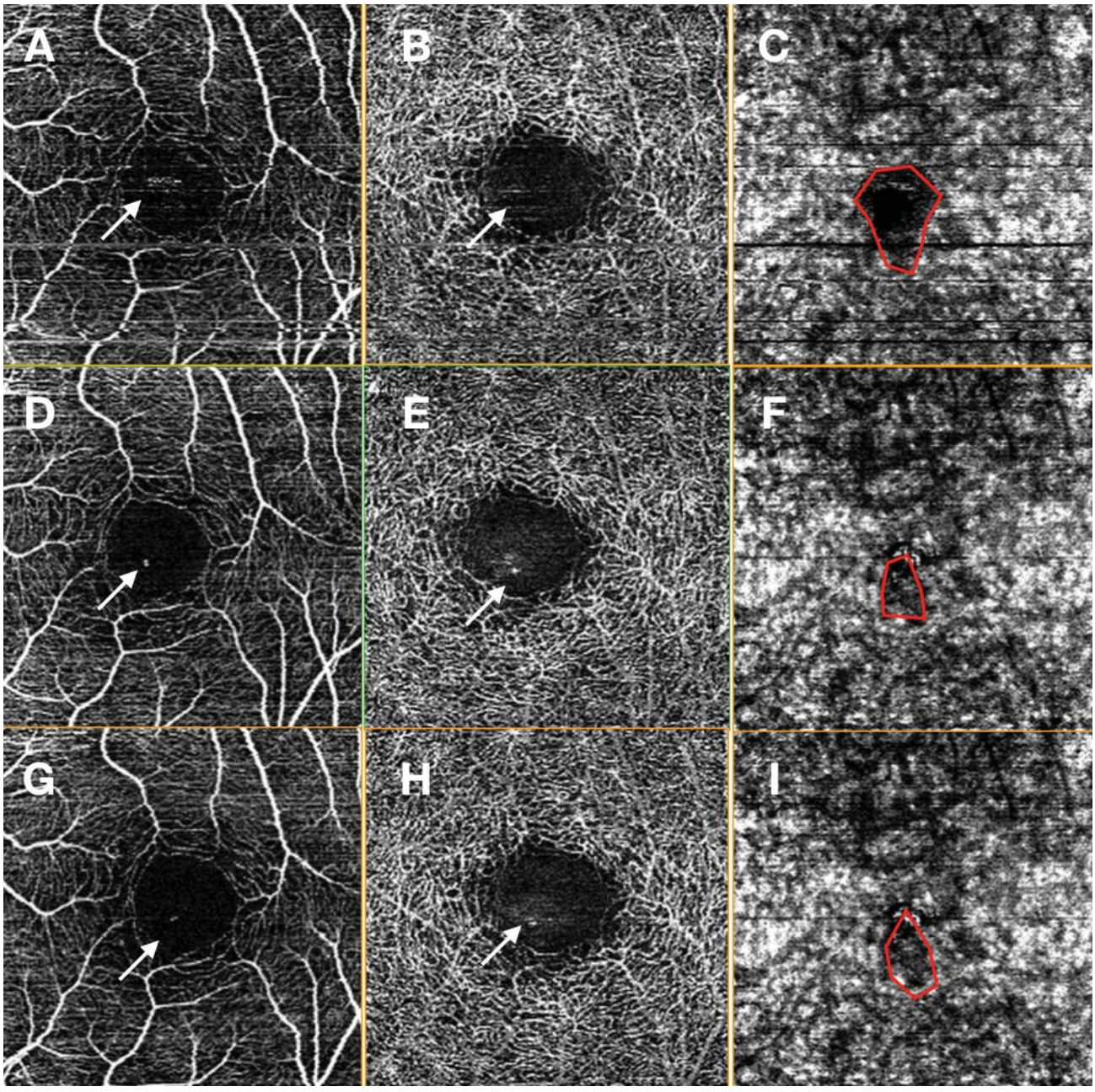

Figure 4: *OCT-A images of the initial (A-C), the second (D-F) and the third visits (G-I). There is a hyperreflective spot (white arrow) at the superficial (A, D, G) and the deep retinal layers (B, E, H). In correspondence of this hyperreflective spot there is a hyporeflective area on the choriocapillaris (C, F, I). This hyporeflective area had been gotten smaller but was still detectable after 1 month (I).*

were still there (Figure 3C). The hyperreflective spot in the FAZ which was revealed by OCT-A, was stable but the hyporeflective area on the choroidal layer was smaller (Figure 4D-F).

At the third visit, after 1 month, the patient's complaint of scotoma was replaced with mild metamorphopsia. There was not any remarkable change in the patient's dilated fundus examination. Only a small inner segment/outer segment (IS/OS) band defect at the fovea remained on the SD-OCT of the macula (Figure 3D), but OCT-A findings were the same as the last visit (Figure 4G-I). We decided to follow up the patient for possible late comlications such as choroidal neovascular membrane and retinal pigment epithelium changes.

CONCLUSION

Handheld laser pointers are commercially available and easily obtained by the internet. This may be the reason why the handheld laser-induced maculopathy (HLIM) has been seen more frequently for the last years. Because of

this increasing frequency, it is important to determine the multimodal imaging characteristics of HLIM. Therefore, there are so many case reports and series about this subject.[2, 6, 7] Thanks to these studies HLIM's characteristics of the SD-OCT, fluorescein angiography, fundus autofluorescence, microperimetry and indocyanine green angiography are well established.

In this case report, we present HLIM with OCT-A findings. The yellowish plaque that was seen in dilated fundus examination was a hyperreflective spot both on the superficial and deep retinal layers' OCT-A images. To our knowledge, this is the first OCT-A definition of laser-induced maculopathy change of the superficial and deep retinal layers. We hypothesize that the cause of this hyperreflective spot may be a speckle artifact. Speckle is a pattern of varying light intensity caused by mutual interference of wavefronts.[8] The superposition of the reflected light waves can constructively interfere and cause a hot spot on the OCT-A image. If the lesion is stable the speckle does not change with time. In the present case, at first the disruption of the outer retinal layers, and later the tubular space which was caused by the loss of the IS/OS band could have induced the interference of the wavefronts. The OCT-A also detected a hyporeflective area, in correspondence of the hyperreflective spots detected on the superficial and deep retinal layers, on the choroidal layer. This area had gotten smaller after 1 month but was still detectable. Tomasso et al reported a case and they also found out that laser beam caused hyporeflectivity on choriocapillaris which was detected by OCT-A. [9] Authors suggested a hypothesis that this hyporeflectivity is caused by the rarefaction of the choriocapillaris. Clemente-Thomas et al reported a HLIM case that showed the rarefaction of the choriocapillaris revealed by the OCT-A was still detectable even after 9 months.

To diagnose HLIM it is very important to take patient's history carefully. At acute phase of the laser eye injury there can be serious but characteristic changes at the macula which could be detected mainly by the SD-OCT. These typical changes could resolve within several days as they did in our case. It seems, in the light of the previous case reports and the results of our case, the lesions detected by the OCT-A are more stable at acute and late phases. [9, 10] In the lack of the SD-OCT changes and unclear patient history, OCT-A could be in assistance of diagnosis. However, to suggest a hypothesis about the importance of OCT-A's place for laser-induced maculopathy, experimental studies and clinical researches are needed.

DISCLOSURES

The authors certify that they have NO affiliations with or involvement in any organization or entity with any financial or non-financial interest in the subject matter or materials discussed in this manuscript.

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