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Case Report Open Access

# Handheld Laser Pointer Maybe a Dangerous "Toy": A Case of Maculopathy from DPSS Red Handheld Laser Pointer

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## Abstract

To describe a case of maculopathy induced by a handheld laser pointer in a 12-year-old male patient. He was exposed to handheld DPSS red laser pointer of 100 mW for some second. He was complained of central scotoma. His visual acuity decreased in both eyes. Fundus examination showed a grayish lesion in foveal region. Fluorescein angiogram showed hypofluorescence in the central macula in early phase with late ill-defined leakage. Optical coherence tomography (OCT) revealed the disruption of the retinal epithelium and edema in the foveal area. He was treated with one dose of Triamcinolone aceonide (40 mg) periocular injection in his both eyes combined with oral Chinese patent medicine for one month. Four weeks later, the patient's visual acuity increased markedly, OCT showed unhealed retinal epithelium disruption. Laser pointer would be a dangerous "toys", both parents and teachers should pay attention to it.

**Keywords:** Laser pointer; Macular damage; Optical coherence tomography; Fluorescein fundus angiogram

## Introduction

Handheld laser pointers emit a bright signal even in daylight. Laser pointers are efficient signaling tools that are used in a wide range of applications. In educational and business presentations, for instance, laser pointers are commonly used as eye-catching pointing devices; green laser pointers can also be used in amateur astronomy to point the location of stars. Recent advancements have facilitated the development of low-cost, high-power laser pointers. However, these instruments are hazardous. Since 2010, many incidents on the careless use of high-power green laser pointers have been reported all over the world; notable are eye injuries, whose victims are commonly children [1-4]. Laws and regulations that specifically address the use of such laser pointers have been established only in a few countries [5,6]. High-power laser devices are currently produced in several countries, such as China, where consumers have easy access to these tools. Diode-pumped solid-state (DPSS) laser pointers are characterized by their high stability, high efficiency, and low cost. This type of laser pointer can emit infrared light aside from visible laser. This invisible light is harmful to the human eye. A case report of retina injury induced by a DPSS red handheld laser pointer in a Chinese child is presented in this article for discussion.

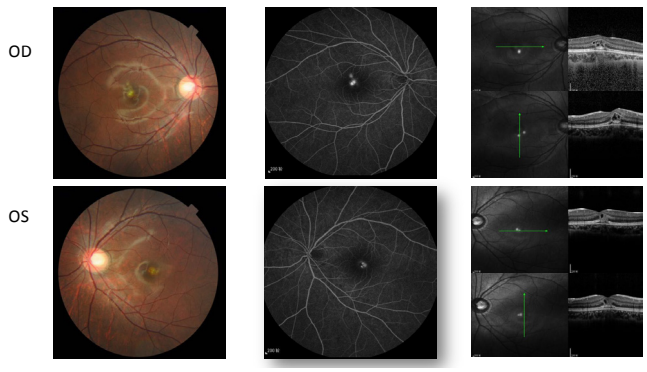


**Figure 1:** Fundus photographs (left) , fluorescein angiogram (middle) and OCT-images (right). 2 days after the laser pointer beam exposure, fundus photographs showed yellowish-grey spot without hemorrhage in the foveal region, the OCT showed intraneurosenory edema and disruption of the RPE layer at foveal central region, fluorescein angiogram showed ill-definded leakage in the foveal region.

## Clinical Observation

A 12-year-old Chinese boy was playing with a handheld red laser pointer in front of a mirror, during which the reflected laser pointer beam hit his eyes for several seconds before his parents were able to stop him. The boy had myopia and was wearing glasses when he played with the laser pointer. No immediate disturbing symptoms were evident. A few days later, however, the boy complained of blurry vision and central scotoma in both the eyes (OU), so he was immediately brought by his parents to our hospital. The patient had no ophthalmologic medical history and no abnormalities. Anterior segment examination of both eyes was unremarkable. The pupil was round, and direct or indirect light reflex was normal. The boy's best-corrected visual acuity was 20/200 in both eyes. Funduscopic examination showed a yellowish-grey spot without hemorrhage in the foveal region (Figure 1), but edema, hemorrhage, or degeneration of the optic disc or the peripheral retina was not observed. Optical coherence tomography (OCT) indicated intraneurosenory edema and disruption of the retinal pigment epithelium (RPE) layer at the central foveal region (Figure 1). Fluorescein fundus angiogram (FFA) showed late hyperfluorescence and an ill-defined leakage in the foveal region in both the eyes of the boy (Figure 1). Clinical findings were consistent with severe bilateral laser injury [7]. The boy was treated with retrobular injection of triamcinolone acetonide 40 mg once and oral administration of the Chinese medicine Fufang XueShuanTong (FXST) for one month. Four weeks after the event, the boy came back to the hospital for his follow-up check-up. His best-corrected visual acuity improved to 20/50 in his

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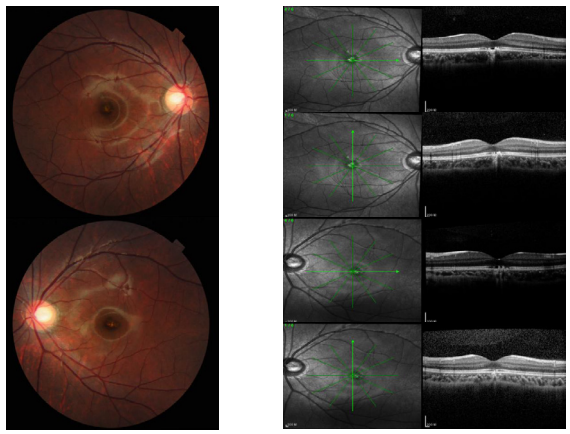


**Figure 2:** Fundus photographs (left) and OCT-images (right). One month after laser beam exposure. Fundus photographs showed hypopigmented spot in the foveal region. OCT images revealed the edema was disappeared , the disruption of the RPE layer still exist.

right eye and 10/20 in his left eye. Funduscopic examination showed a hypopigmented spot in the foveal region (Figure 2), and OCT indicated that disruption of the RPE layer decreased but did not yet fully heal (Figure 2).

## Discussion

A laser pointer looks deceptively safe in the hands of a speaker pointing at a chart or screen. However, the light energy that laser pointers can aim into the eyes can be more damaging than that obtained from directly staring at the sun. The eye, especially the retina, is a tissue vulnerable to laser radiation. The refractive media of the eye increase retina irradiance over 10,000 times more than the irradiance incident at the cornea [8]. In the past, commercial laser pointers had a maximal output of 5 mW. This level of energy was regarded as harmless [9]. However, incidents on low-energy laser devices causing retinal injury have also been reported [10,11]. Nowadays, high-power laser pointers with an output up to 1000 mW are common all over the world. Three factors may contribute to the development of retina injury induced by light: power density, wavelength, and pulse duration. Laser exposure can damage the eye by thermal, mechanical, or photomechanical means, and more than one mechanism can be involved in a particular injury [7]. The type of laser pointer we examined in the current case is called a diode-pumped solid-state (DPSS) laser pointer. DPSS lasers are solid-state lasers made by pumping a solid gain medium, for example, a ruby or a neodymium-doped YAG crystal, with a laser diode. The DPSS laser module contains a powerful IR diode laser (808 nm in wavelength) component that pumps a Nd:YVO4 laser crystal, which in turn outputs 1,342 nm light. This output is immediately doubled inside a non-linear KTP crystal and results in red light at the half-wavelength of 671 nm. While an IR filter is omitted in most cheap pointers because of its cost and heat problem, an extra IR output distinguishes this type of laser pointer from other pointers. High-powered DPSS-type laser pointers can produce a high IR output. As a beam component, this IR light can pass laser safety goggles designed to block only the visible wavelengths of the laser and thus pose a serious hazard to the users of such pointers. In our case, the measured output of the laser pointer was 100 mW, and the wavelength was 671 nm. The boy's father bought the pointer to show stars to the boy at night, the father was unaware of the potential damage of the pointer to the eye. The boy, however, mistook the pointer as a toy. When his father noticed what he was doing and stopped him, it was too late. Although visual acuity spontaneously improves without treatment, anti-inflammatory therapy has been used to treat laser retinal injury in most cases. Final visual acuity ranged from 20/20 to 20/60 vision [3]. However, data on effective and safe treatment remain lacking. We used Chinese traditional drug FXST capsules as backup. FXST capsules that contain Panax (Sanqi), Astragalus (Huangqi), Salvia (Danshen), and Scrophulariaceae (Xuanshen) have been used for more than 20 years to treat retinal diseases in China. FXST has also been used to treat glaucoma, AMD, and anterior chamber hyphema. Previous studies have shown that FXST can promote blood circulation, protect the retinal structure, and promote visual function [12,13]. FXST has been proven effective in protecting human retinal pigment epithelium cells and retinal vascular endothelial cells against oxidative injury [14,15]. However, whether FXST affects the course of retina light damage remains unclear, and making an accurate prognosis is difficult. Supplementation with macular carotenoids, such as lutein, zeaxantin, and mesozeaxantin, can be another effective treatment approach to increase macular pigment optical density and improve visual performance in glare [16].

Powerful laser devices are available at low prices in online or physical sports stores. A study that conducts random testing of commercial laser pointers has shown that excessive power was very common in these laser devices; for instance, handheld lasers labeled as class 3R can in fact be class 3B handheld lasers [17]. These high-power devices that look identical to low-power pointers can cause immediate, severe retinal injury. Single exposure to high-power handheld laser devices can cause retinal damage that can permanently reduce central vision [3]. Laser pointers are considered by children as "cool" toys, and the potential risks of these laser pointers are always overlooked. We have noticed that children are the most common victims of laser-related eye injuries. We therefore suggest that not only children or teenagers but also parents should be educated about the risk of using laser pointers. Children and teenagers should not be allowed to play with high-power laser pointers, and the purchase of these should require parents' consent. We hope that rules and laws that focus on the safe use of laser pointers be developed by countries soon.

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