When a "Safe" Toy Turns Dangerous: A Case of Permanent Vision Loss due to Intraretinal Microvasulcar Abnormalities from a Laser Burn

Hansan Jones1; William Sidwell 1; Austin Bay 1; John Ashurst, DO 1; Richard E Jones, MD 2
Arizona College of Osteopathic Medicine 1; Jones Eye Center 2

Introduction

Prevention through public education and government policy is a major tenet of holistic medical care. Despite many consumer-grade lasers are marketed as “safe,” because they claim that they do not exceed safety thresholds set by regulatory agencies such as the U.S. Food and Drug Administration, which caps the output of Class II and Class IIIa lasers at 5 mW for visible light[1]. However, studies have shown that many inexpensive, widely available lasers labeled under these categories emit far higher power levels, posing a serious risk of retinal damage[2].

Laser pointers are commonly used for educational and recreational purposes, but improper use can lead to severe ocular injuries, including permanent vision loss. This case highlights the risks of laser pointers marketed to pediatric demographics as “safe,” discusses the mechanisms of laser-induced retinal injury, and underscores the importance of public awareness and regulation

Case Description

An 18-year-old female with no previous ocular pathology presented to the ophthalmology clinic with a complaint of acute loss of vision in one eye when a red laser pointer was directed into her eye for 30 seconds by her younger sibling. Fundus photography showed diffuse macular and foveolar damage with retinal pigment epithelium whitening and a lesion in the macula consistent with prolonged laser exposure and total blindness (Firgure 1). Line scan showed loss of outer retinal layers and fibrinoid subretinal deposition in the foveal region (Figure 2). Her vision did not return with subsequent visits, and in the end proved to be permanent central vision loss.

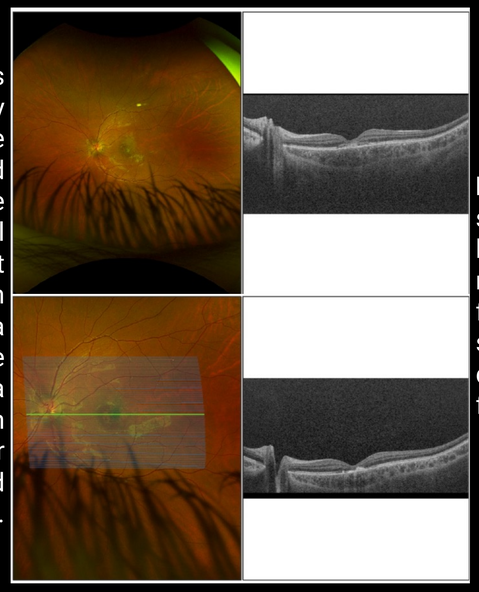

Figure 1: Fundus photography showing diffuse macular and foveolar damage with retinal pigment epithelium whitening and a lesion in the macula consistent with prolonged laser exposure and total blindness.

Figure 2: Line scan showing loss of outer retinal layers and fibrinoid subretinal deposition in the foveal region.

Figure 3: A visual representation of the laser that was shown into the patient’s eye.

Discussion

Epidemiological data on laser-induced blindness are sparse. Case reports have shown incidence of laser-induced blindness in many populations, including military and industrial as well as pediatrics[3-10]. Pediatric cases are particularly concerning due to children’s curiosity and limited understanding of the dangers associated with laser exposure. This report underscores the need for stricter regulations on laser manufacturing, improved labeling, and public education on the safe use of lasers. For medical students and healthcare providers, understanding the classification and risks associated with lasers is crucial for both patient education and management of injuries.

Laser-induced retinal injury occurs primarily through two mechanisms: thermal damage and photochemical injury. Thermal damage results from concentrated energy absorption in retinal tissues which leads to coagulative necrosis, while photochemical injury is caused by prolonged exposure to lower-intensity light, generating reactive oxygen species that damage photoreceptor cells and the retinal pigment epithelium. The macula is the most vulnerable due to its role in central vision and high concentration of melanin and lipofuscin, which readily absorb laser energy.

Outcomes and Conclusion

Diagnosis of laser-induced retinal injury requires a thorough history focused on details such as laser wavelength, power, and duration. Unfortunately, treatment options for laser-induced ocular damage are limited, with outcomes often dependent on the severity of initial injury. Given this, prevention measures should be aimed towards public education and government regulation.

References

1. CFR - Code of Federal Regulations Title 21. Accessdata.fda.gov. Published August 30, 2024. Accessed [insert date]. https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/cfrsearch.cfm?fr=1040.10
2. Hadler J. Random testing reveals excessive power in commercial laser pointers. Presented at: International Laser Safety Conference; March 20, 2013; Orlando, FL.
3. Stuck BE, Zwick H, Lund BJ, Scales DK, Gagliano DA. Accidental human retinal injuries by laser exposure: implications to laser safety. In: International Laser Safety Conference Proceedings. 1997:576-585.
4. Boldrey EE, Little HL, Flocks M, Vassiliadis A. Retinal injury due to industrial laser burns. Ophthalmology. 1981;88(1):101-107.
5. Stuck BE, Zwick HM, Molchany JW, Lund BJ, Gagliano DA. Accidental human laser retinal injuries from military laser systems. In: SPIE Proceedings. Vol 2674. Bellingham, WA: SPIE–The International Society for Optical Engineering; 1996:7-20.
6. Barkana Y, Belkin M. Laser eye injuries. Survey of Ophthalmology. 2000;44(5):459-478.
7. Gabel VP, Birngruber R, Lorenz B, Lang GK. Clinical observations of six cases of laser injury to the eye. Health Physics. 1989;56(5):705-710.
8. Rockwell RJ Jr. Laser accidents: reviewing thirty years of incidents: what are the concerns—old and new? Journal of Laser Applications. 1994;6(3):203-211.
9. Thach AB, Lopez PF, Snady-McCoy LC, Golub BM, Frambach DA. Accidental Nd:YAG laser injuries to the macula. American Journal of Ophthalmology. 1995;119(6):767-773.
10. Ness JW, Hoxie SW. Database structure for the Laser Accident and Incident Registry (LAIR). In: SPIE Proceedings. Vol 2974. Bellingham, WA: SPIE–The International Society for Optical Engineering; 1997:2-7.

Acknowledgements

Thank you to Midwestern University Arizona College of Osteopathic Medicine and Jones Eye Clinic for their collaborations.