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Case Report

Arc Welding Induced Maculopathy and Infra-Red Radiation Injury Hypothesis

Fawaz H Alzweimel*, Mowaffaq K Alkassasbeh, Omar A Alsaqour, Yousef B Yaaqba and Etaf A Altanashat

Department of Ophthalmology, King Hussein Hospital, Jordanian Royal Medical Services, Jordan

***Corresponding Author:** Fawaz H Alzweimel, Department of Ophthalmology, King Hussein Hospital, Jordanian Royal Medical Services, Jordan.

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Abstract

Purposes: Arc welding is a known cause of solar maculopathy in phakic eyes. Herein, we report a case of bilateral welding arc-induced maculopathy in a pseudophakic patient, suggesting an increased risk of infrared radiation injury in pseudophakic eyes.

Case report: A 46-year-old male who works as a welder presented with bilateral central scotomas after 5 months of uneventful bilateral cataract surgery. His examination showed no signs of kerato-conjunctivitis, and fundoscopy showed bilateral solar-like maculopathy. Optical coherence tomography showed abnormal IS/OS junctions and foveal outer retinal abnormalities. The patient's visual acuity improved from 6/24 to 6/6 in the right eye and from 6/60 to 6/9 in the left eye after 6 weeks.

Conclusions: Here, we hypothesized an increased risk of infrared radiation-induced maculopathy in the pseudophakic patient as the IOL filters ultraviolet rays and passes more visible and infrared radiations than the crystalline lens. This hypothesis should encourage manufacturers to alter the IOLs so that they can protect the retinas against the infrared radiations.

Keywords: *Welder's Maculopathy; Infrared Radiations; Ultraviolet Radiations; MIG Welder*

Introduction

Photokeratitis is the most common ocular injury from welding. However, welder's maculopathy was first described by Terrien in 1902. Arc welding is a known cause of solar maculopathy in phakic eyes. Herein, we report a case of bilateral welding arc-induced maculopathy in a pseudophakic patient who developed an increased risk of infrared radiation injury after cataract extraction and intraocular lens (IOL) implantation.

In recent years, arc welders of acceptable sizes and reasonable prices have become available and are within the reach of non-experienced individuals. One example is the metal-arc inert gas welder that emits a wide range of radiations. The ultraviolet radiations emitted by these machines are absorbed by the cornea and crystalline lens (if there are no protective glasses), leading to signs and symptoms of kerato-conjunctivitis. Radiations in the near-ultraviolet, visible and near-infrared ranges, however, penetrate the cornea and lens and are absorbed by the retina. This may cause thermal or photochemical damage, which is known as welder's maculopathy [1-8].

Case Report

A 46-year-old man, who was recently diagnosed with diabetes mellitus, was a welder for more than 5 years. He presented to the clinic with bilateral lens opacity and decreased visual acuity but with no signs of diabetic retinopathy. He underwent bilateral cataract surgery, which was uneventful. Vision was 6/6 in the right eye and 6/9 in the left eye after the surgery. However, the patient returned after 5 months with sudden bilateral scotomas and decreased visual acuity (6/24 in the right eye and 6/60 in the left eye). Anterior segment examination showed no signs of kerato-conjunctivitis, but fundus examination revealed bilateral solar-like maculopathy (figure 3). This finding was further confirmed by OCT (figure 4) imaging, which showed abnormal IS/OS junctions and foveal outer retinal abnormalities. The patient used to wear protective goggles, but in some instances, he avoided using goggles and welded with naked eyes in the dark environment for better view.

Patient was followed up after 5 weeks with fundoscopy and OCT (figure 5), and his vision improved to 6/6 and 6/9 in the right and left eyes, respectively.

As the patient was a welder before the cataract surgery (in phakic eyes), he developed welder's maculopathy without any signs of kerato-conjunctivitis after the surgery (in pseudophakic eyes). Since the IOLs filter ultraviolet rays and pass visible and infrared radiations more than the crystalline lens, the hypothesis that infrared radiation may play a role in retinal phototoxicity has to be studied in details so as to facilitate changes in the manufactured IOLs such that they can protect the retina against infrared radiations.

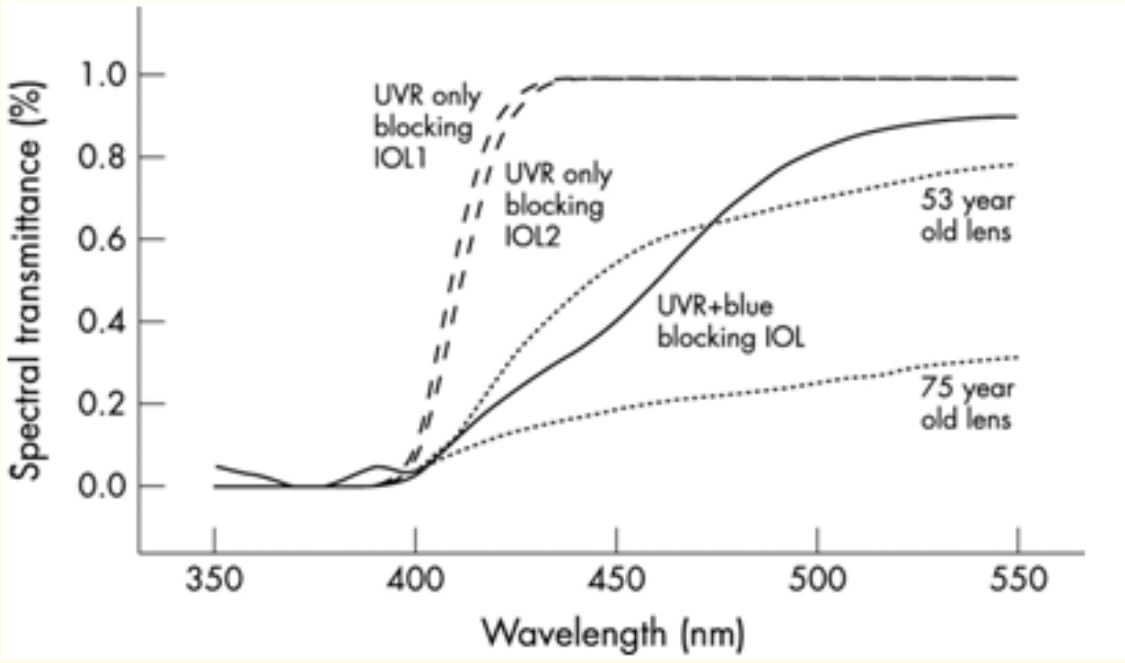

Figure 1: *Comparision of the different transmission properties of different types of IOL's and crystalline lenses.*

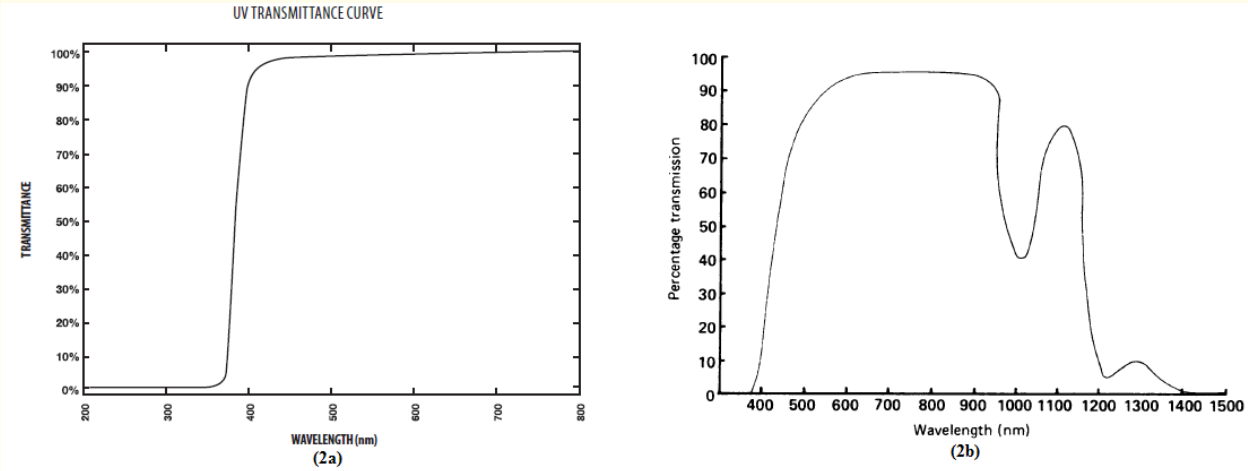

Figure 2: *(2a) Transmission properties of the IOL that were used in our case report (Bausch & Lomb). (2b) Percentage emission and spectral transmission curve of ocular media (after Geeraets and Berry).*

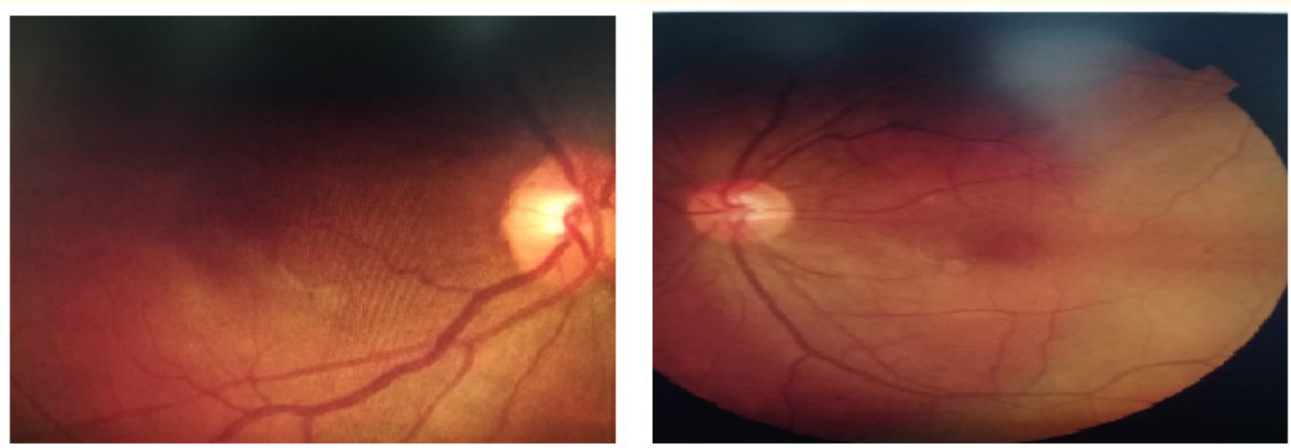

Figure 3: *Fundus image of right and left eyes at presentation*

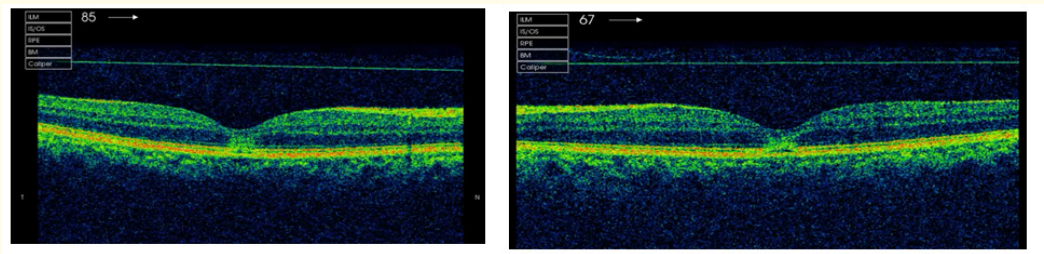

Figure 4: *Oct at presentation: left for right eye, right for left eye.*

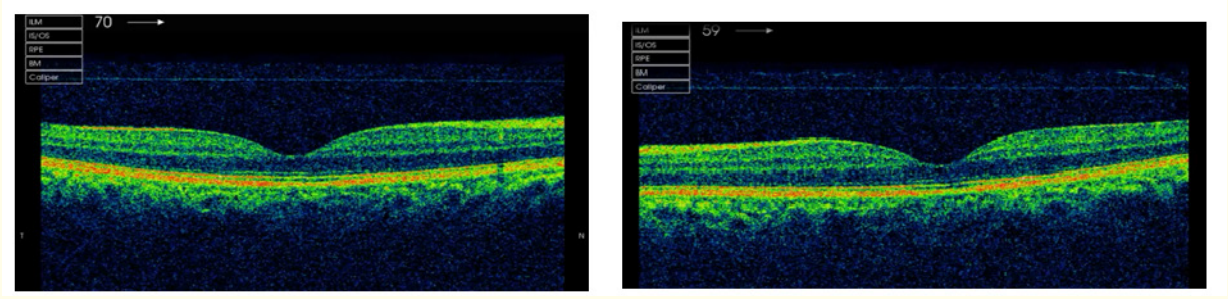

Figure 5: *OCT after 5 weeks: left image for right eye, right image for left eye.*

Discussion

Welding techniques have improved over the years. Recently, it has become possible to create plasma in atmospheric air. Plasma arc welding has a good energy concentration ratio, and its temperature reaches up to 30,000 degrees Celsius. For this reason, plasma arc welding has reduced the duration of welding operations. However, the high temperature of plasma arc welding results in the radiation of many electromagnetic waves, making it more likely to cause retinal damage than the conventional arc welding techniques.

Photic retinal injury caused by welding is quite rare. However, until now, no cases of photic retinal injury associated with arc welding in pseudophakic eyes as proven by optical coherence tomography (OCT) imaging have been published in the literature.

Figure (1) also shows that as the crystalline lens become older, it blocks more visible and infrared radiation compared to the implanted IOLs. This transmutability of high amount of infrared radiation by the implanted IOLs might be harmful to the retina and might lead to photoreceptor damage.

Figure 2 (2a and 2b) compare the difference in spectrum wavelength and percentage of transmission to the retina in pseudophakic (regarding the type of IOL in this case) and phakic eyes.

Conclusion

In this case, we hypothesized an increased risk of infrared radiation-induced maculopathy in our pseudophakic patient as the IOL filters ultraviolet rays and passes visible and infrared radiations more than the crystalline lens. This hypothesis should encourage manufacturers to modify the IOLs to provide protection against infrared radiations.

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