Welder’s maculopathy is a form of photochemical damage to the retina and is typically characterized by involvement of the outer retinal layers. Spectral domain optical coherence tomography (SD-OCT) imaging was performed in three eyes of two patients with clinical findings suggestive of Welder’s maculopathy in occupational welders. A faceted foveal lesion characterized clinical examination and the SD-OCT line scans images showed a distinct discontinuity of the photoreceptor inner and outer segment (IS/OS) junction. The external limiting membrane (ELM) and the retinal pigment epithelial (RPE) layer remained intact at the site of IS/OS defect. SD-OCT imaging offers a noninvasive way of evaluating the microstructural changes at the fovea in Welder’s maculopathy.

Key words: Inner and outer segment junction, spectral domain optical coherence tomography, Welder’s maculopathy

Electrical welding arcs causing retinal injuries have been reported in international literature,[1] but these injuries are not commonly reported in our country. Here we report two patients of welding arc maculopathy.

The most common presentation in occupational welders is as follows:
• Photo-ophthalmia (Welder’s Flash).[1]
• Keratoconjunctivitis.[1]
• Cataracts caused by UV radiation.[5]

UV radiation is produced in large amounts by welding arcs.

Case Report

Two patients working as welders with diagnosed Welder’s maculopathy were studied. Patient 1 is 43 years and patient 2 is 28 years of age. Patient 1 had past episodes of Welder’s flash (photo-ophthalmia). Both the patients gave history of persistent dark spot (positive scotoma) near the center of vision and complained of inability to focus on the welding spot. On examination, visual acuity was reduced in both eyes to 6/18 (partial) of patient 1 and only one eye of patient 2. Color vision was normal in both.

Ophthalmoscopic examination of the fundus revealed in patient 1 pigmented foveal changes which appeared like lamellar macular hole and lack of foveal reflex, and chorioretinic para-macular small pigmented changes in patient 2.

Both the patients were imaged with the Spectralis SD-OCT machine (Heidelberg engineering, Germany). Advanced visualization option of the software was used to identify a portion of OCT restricted to the outer retina.

In patient 1, fluorescein angiography was normal and autofluorescence images showed central hypo-autofluorescence.

Fig. 1 demonstrates the imaging results from the right eye of patient 1. At this relatively low magnification, an irregular fovea is difficult to appreciate clearly in both the color photograph and the OCT fundus image.

The OCT shows a square-shaped outer retinal hole. An en-face image [Fig. 2] of the OCT data, restricted to the data from the outer retina, clearly demonstrates an outer retinal hole.

Fig. 3 contains a magnified view of the fovea from the right eye of patient 1.

The fundus photographs show irregular, multifaceted foveolar hole(s). The outer retinal OCT data more clearly demonstrate these holes, which were multifocal in one of the three eyes and solitary in the other two eyes.

Specifically, the hole extends from the inner border of the RPE line up to the external limiting membrane, a region consisting of the inner and outer photoreceptor segments. A large, solitary outer retinal hole is demonstrated. In addition, there is hyper reflective material lining the edge of the hole, especially the outer edges and top surface at the level of the IS/OS junction line, which correlates with the location of the hyper reflective ring seen around the hole seen in Fig. 1. The correlation was confirmed in additional eyes and was not present in a normal eye.

Macular thickness maps showed preserved central subfield thickness in both eyes of patient 1 [Fig. 4] (245 μm OD), and reduced (not significant) central subfield thickness in patient 2 (192 m OD, 191 m OS).

Discussion

A welding arc emits a wide spectrum of radiation, from IR to UV light and beyond. The cornea and the lens absorb UV and far-IR radiation, whereas visible light (VL) and near-IR radiation penetrates to the retina.[3] The damage to the retina from welding arc units comes from the visible light especially the 400-440 nm range and from the potential 300-310 nm “window” which may penetrate the cornea and the crystalline lens.[3]

UV keratoconjunctivitis, or “arc-eye,” is a painful condition, which is not considered a threat to sight in the long term.[1] It is associated with relatively short exposures to light sources, such as welding arcs or tanning lamps. The corneal effects are seen within a few hours following exposure and typically will resolve within 72 h.
Chronic exposure to environmental UV light may lead to a variety of ocular surface abnormalities that rarely resolve in the absence of therapy.\[^3,4\] Welding-arc-like injury may lead to secondary sub retinal neovascularization.\[^3\]

In most cases, retinal injuries heal spontaneously without loss of vision.\[^1,5\] Severe burns of the macula, on the other hand, may lead to permanent complete or partial loss of central vision.\[^1\]

The prevalence and seriousness of the illness depend both on the intensity and characteristics of emitted radiation, and the availability of protective measure.

Previous publications have used stratus OCT to describe these structural changes at the fovea in Welder’s maculopathy.\[^6,7\] describing it as disruption of the inner high reflective layer (HRL) corresponding to the outer neurosensory retina. However with the advent of high resolution OCT imaging, we are now better able to visualize and stratify the outer retinal layers. The fundus lesions corresponded with the areas of disruption of the IS/OS junction on the SD-OCT scans. SD-OCT shows a characteristic outer retinal hole that, on an OCT B-scan appears as a hypo reflective rectangle with straight edges. The hole stretches from the RPE band to the external limiting membrane corresponding to the IS/OS junction. There is a hyper-reflective ring around the hole seen in Spectralis OCT scan using the enhanced depth analysis for advanced data visualization which has not been reported in any previous literature.

This hyper-reflective ring is subtle or partial in some of the eyes and therefore should not be used as a diagnostic tool; rather, the hypo reflective rectangle encompassing the outer retina on OCT B-scan is the diagnostic finding. Histological finding\[^8\] on solar retinopathy have shown that the changes were confined to the photoreceptor OS, seen as vesiculation and fragmentation of the photoreceptor lamellae and the presence of discrete whorls within the disc membranes. They
also suspected that the foveal photoreceptor OS membranes appeared more susceptible to damage than any other cell component. This may mimic situation in eyes with Welder’s maculopathy.

The present series points to occurrence of retinal damage despite wearing protective lenses and speculated that the retinal damage had resulted from use of inadequate filters as discussed by Arend et al.\(^\text{[9]}\)

A comprehensive approach to the management of retinal lesions should acknowledge both the individual and organizational levels of intervention. Preventive strategies should include good welding equipment, environmental background lighting, eye protection redesign, and training of workers. Workers should be adequately informed about the danger of welding too close to the eyes and of looking round the side of the visor, even for a very short period. Workers should be advised to avoid ingestion of photosensitizing drugs, such as hydro-chlorothiazide, furosemide, allopurinol, benzodiazepines,\(^\text{[8]}\) and fluphenazine,\(^\text{[3]}\) while welding.

In conclusion, Welder’s maculopathy results in a characteristic outer retinal hole on SD-OCT that is present long after the initial injury. The hyper-reflective ring that surrounds the hole presumably represents cellular debris.

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