



# Allergic contact dermatitis caused by Solvent Orange 60 dye in the temple tips of eyeglasses and a review of cases of eyeglass allergic contact dermatitis

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## Abstract

**Background:** A 57-year-old Japanese woman developed eczematous skin lesions behind both ears 10 days after she began using a new pair of glasses. The skin lesions resolved two weeks after she stopped wearing the glasses.

**Methods:** Patch testing for material scraped from the temple tips of the glasses was performed. A +2 reaction to the scraped material was observed on D2 and D3. Chemical analyses were performed to determine the causative allergen. A second patch test was performed with 6 fractions from the temple tips and Solvent Orange 60. We retrieved literature addressing eyeglass allergic contact dermatitis from MEDLINE (1997-2017).

**Results:** Patch tests and chemical analyses of the temple tips of the glasses revealed that Solvent Orange 60 dye was a causative allergen.

**Conclusions:** We report a case of contact dermatitis caused by Solvent Orange 60 dye in the temple tips of eyeglasses. Overall, causative allergens of eyeglass allergic contact dermatitis include metals, plastics, plasticizers, solvents, UV stabilizers, antioxidants, dyes, waxes and preservatives; metals and dyes have been the most common such allergens in recent years.

## KEYWORDS

allergic contact dermatitis, chemical analysis, eyeglass, Solvent Orange 60, temple tips

## 1 | INTRODUCTION

Eyeglass allergic contact dermatitis is a relatively common cutaneous disorder that can be caused by a number of allergens, including metals, plastics, plasticizers, solvents, UV stabilizers, and dyes. However, identification of the causative allergen is typically difficult, mainly due to a lack of labeling of eyeglass components.

We report a case of allergic contact dermatitis in an adult woman caused by Solvent Orange 60 dye in the temple tips of the patient's eyeglasses. Sensitization to this dye was confirmed by patch tests and chemical analyses of material scraped from

the temple tips. In addition, we surveyed literature on eyeglass allergic contact dermatitis in MEDLINE; for the collected cases, we summarized the causative allergens and the numbers of cases involving these allergens.

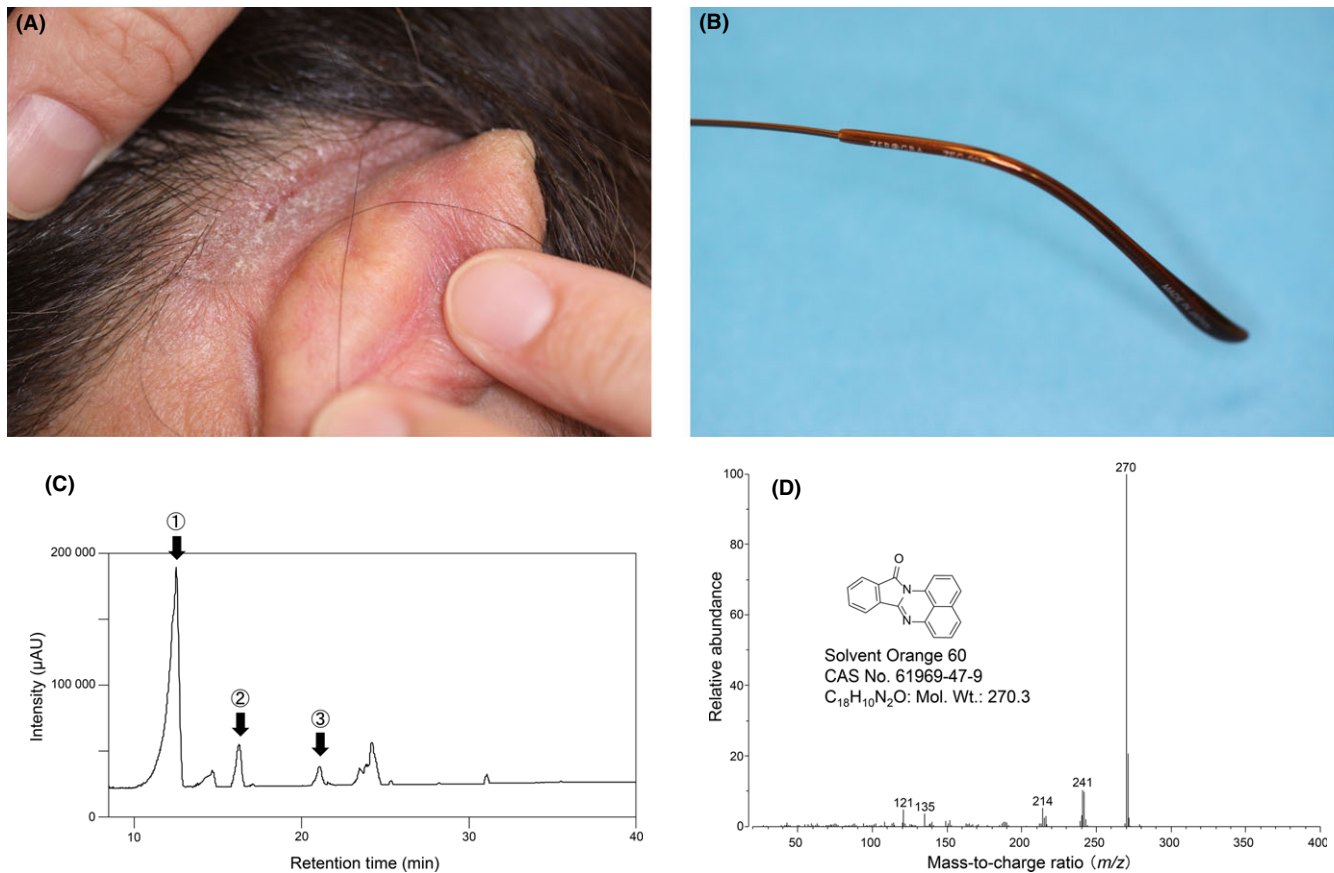
## 2 | PATIENTS, METHODS, AND RESULTS

### 2.1 | Case report

A 57-year-old Japanese woman visited us complaining of infiltrative erythematous skin lesions with pruritus behind both ears (Figure 1A)

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**FIGURE 1** Clinical appearance of the patient and chemical analysis of the causative material. A, Clinical feature of the eczematous skin lesion on the right upper periauricular region. B, A temple tip of the patient's eyeglasses. C, The results of Pr-HPLC for the component materials in an extract from the temple tips of the glasses. Flow rate: 20 mL/min. Linear gradient elution was performed with 100% water as eluent A and 100% acetonitrile as eluent B, using a gradient of 50% B to 100% B in 30 min. The substances associated with the three peaks were ① Disperse Red 5 for the peak at 12 min, ② Solvent Orange 60 for the peak at 16 min, and ③ an unknown material for the peak at 21 min. D, The results of direct-probe mass spectrometry; in particular, the mass spectrum for the fraction extracted at 16 min. Chemical and structural formulae for Solvent Orange 60 are also shown

that manifested 10 days after she began wearing a new pair of glasses (Figure 1B). The patient had no prior history of contact dermatitis. The skin lesions resolved 2 weeks after she stopped wearing the glasses.

## 2.2 | First patch test

Patch testing of material scraped from the brown temple tips was performed using Finn Chambers<sup>®</sup> on Scanpor<sup>®</sup> tape (SmartPractice,

Phoenix, AZ, USA). The tested chambers were occluded for 2 days, and the reaction was read on day (D) 2 and D3. Based on International Contact Dermatitis Research Group criteria, a + 2 reaction to the scraped material was observed on D2 and D3. The manufacturer of the glasses informed us of the materials that composed the temple tips (Table 1).

## 2.3 | Chemical analyses

Chemical analyses were performed to determine the causative allergen. The material scraped from the temple tips of the glasses was first extracted with acetone and methanol. The extracted solution was then analyzed via silica gel column chromatography using hexane, hexane/chloroform (1:1), chloroform, chloroform/methanol (1:1), and methanol as eluents. Subsequently, separation of dyes was performed via preparative high-pressure liquid chromatography (Pr-HPLC; Figure 1C). Dyes separated using Pr-HPLC were identified using direct-probe mass spectrometry. Solvent Orange 60 was detected in the Pr-HPLC fraction at 16 minutes (Figure 1D).

**TABLE 1** Chemical composition of the dyes within the temple tips

	Weight ratio (%)
Anthraquinone-type red	25.16
Perinone-type orange	31.51
Carbon black	11.82
Dispersant	31.51
Total	100.00

**TABLE 2** D3 results for the second patch test

Material	D3
Acetone/methanol extracts 2% pet.	+
Chloroform fraction <1% pet.	++
Chloroform/methanol fraction <1% pet.	+
Pr-HPLC fraction 12 min (Figure 1C, ①) <1% pet.	–
Pr-HPLC fraction 16 min (Figure 1C, ②) <1% pet.	+
Pr-HPLC fraction 21 min (Figure 1C, ③) <1% pet.	–
Solvent Orange 60 1% pet.	+++

## 2.4 | Second patch test

A second patch test with Finn Chambers<sup>®</sup> on Scanpor<sup>®</sup> tape was performed using 6 fractions obtained from the temple tips as well as commercially available Solvent Orange 60 (Sankyo Chemical Industry Co., Ltd, Osaka, Japan). The tested chambers were occluded for 2 days, and the reaction was read on D2 and D3.

The results of the second patch test are shown in Table 2. A + 3 reaction was obtained with Solvent Orange 60 1% pet. This substance provoked a surrounding vesicular erythematous reaction and induced a flare-up of itchy rash on the whole body.

## 2.5 | Review of case reports

We surveyed literature on eyeglass allergic contact dermatitis from MEDLINE (1997-2017; Table 3). The retrieved literature described five cases of eyeglass allergic contact dermatitis induced by dyes, including two cases induced by Solvent Orange 60.

Furthermore, we summarized causative allergens and the numbers of cases involving these allergens based on a review by Nakada and Maibach (for cases up to 1996)<sup>1</sup> and the newly identified cases (1997-2017; Table 4). In Nakada and Maibach's review of 127 cases of eyeglass allergic contact dermatitis, the causative allergens included metals, plastics, plasticizers, solvents, UV stabilizers, antioxidants, dyes, and waxes. Our cohort of 59 cases reported after 1997 involved similar causative allergens and included two cases caused by preservatives that have not yet been reported.

## 3 | DISCUSSION

Solvent Orange 60 is a perinone-type dye that is used to add color to polystyrene, polycarbonate, polymethyl methacrylate, and acrylonitrile/butadiene/styrene resins. It is a light-orange oil solvent dye with high fastness, good temperature resistance, and wide applications.

Shono and Kaniwa<sup>2</sup> reported allergic contact dermatitis caused by Solvent Orange 60 dye in the temple tips of eyeglasses. They performed chemical analysis and determined that Solvent Orange 60 was the causative allergen. Similarly to our case, in their case, Solvent Orange 60 0.1% pet. produced a + 3 reaction and surrounding erythema; in contrast, Solvent Orange 60 0.1% pet. patch tests yielded negative results for all five normal controls.

**TABLE 3** Reported cases of eyeglass allergic contact dermatitis (1997-2017)

No.	Author	Year	Age	Sex	Allergen
1	Ongenaes et al <sup>6</sup>	1998	56	F	Resorcinol monobenzoate
			51	M	Tricresyl phosphate
			47	F	Resorcinol monobenzoate
			64	F	Resorcinol monobenzoate
			60	F	Resorcinol monobenzoate
			36	F	Resorcinol monobenzoate
2	Glas and Egelrud <sup>7</sup>	1999	7	M	Nickel
3	Shono and Kaniwa <sup>2</sup>	1999	66	M	Solvent Orange 60
4	Leow et al <sup>8</sup>	2000	19	M	Rubber
			20	M	rubber
			20	M	Rubber
5	Suhonen and Kanerva <sup>9</sup>	2001	36	F	Palladium 1
6	Tsunoda et al <sup>10</sup>	2001	61	F	Solvent Red 179
7	Bircher and Stern <sup>11</sup>	2001	66	F	Nickel, palladium
8	Nakada et al <sup>12</sup>	2005	35	M	Paraphenylenediamine
9	Batchelor and Wilkinson <sup>13</sup>	2006	51	M	Colophonium, turpentine
					Abietic acid
					paraphenylenediamine
					Solvent Yellow 1
					Disperse Orange 3
					Disperse Yellow 3
					Disperse Red 1 and 17
					Disperse Blue 3, 35, 106, 124, and 153
					Disperse Brown 1
					Direct Orange 34
4-aminophenol					
10	Hague and Ilchysyn <sup>14</sup>	2006	61	M	Nickel
11	Kosboth et al <sup>15</sup>	2007	61	F	Nickel, cobalt
12	Yeo et al <sup>3</sup>	2011	51	F	Solvent Orange 60
13	Crépy et al <sup>16</sup>	2011	31	F	p-tert-butyl-phenol
14	Kim et al <sup>4</sup>	2013		M	Nickel (8 cases)
				F	Nickel (23 cases)
				M	Chromium (4 cases)
				F	chromium (5 cases)
15	Andersen et al <sup>5</sup>	2014	51	M	Triethylene glycol bis(2-ethylhexanoate)
16	El-Houri et al <sup>17</sup>	2016	48	M	Methylisothiazolinone

**TABLE 4** Allergens in reported cases of eyeglass allergic contact dermatitis

Allergens	Number (1996)	Number (1997-2017)
<b>Metals</b>		
Cobalt	16	1
Nickel	63	35
Chromium	0	9
Palladium	0	1
<b>Plastics</b>		
Butyl acrylate	1	0
Cellulose acetate	2	0
Epoxy resin	1	0
Phenol-formaldehyde	1	0
Rubber	1	3
<b>Plasticizers</b>		
Abietic acid	1	1
Diethyl phthalate	1	0
Tricresyl phosphate	1	1
Triphenyl phosphate	4	0
Tritolyl phosphate	1	0
Triethylene glycol bis(2-ethylhexanoate)	0	1
<b>Solvents</b>		
Ethylene glycol monomethyl ether acetate	2	0
Methylethylketone	1	0
<b>UV stabilizers</b>		
Resorcinol monobenzoate	5	5
Phenyl salicylate	4	0
<b>Antioxidant</b>		
p-tert-butyl-phenol	1	0
<b>Dyes</b>		
Anthraquinone	1	0
Paraphenylenediamine	3	2
Paraaminophenol	2	0
Solvent Yellow 1	0	1
Solvent Yellow 3	2	0
Solvent Red 26	1	0
Solvent Red 179	0	1
Solvent Red 481	1	0
Solvent Orange 60	0	2
Disperse Orange 3	0	1
Disperse Yellow 3	0	1
Disperse Red 1	0	1
Disperse Red 17	0	1
Disperse Blue 3	0	1
Disperse Blue 35	0	1
Disperse Blue 106	0	1

(Continues)

**TABLE 4** (Continued)

Allergens	Number (1996)	Number (1997-2017)
Disperse Blue 124	0	1
Disperse Blue 153	0	1
Disperse Brown 1	0	1
Direct Orange 34	0	1
4-aminophenol	0	1
<b>Waxes</b>		
Aliphatic isocyanate	1	0
Turpentine	1	1
Colophonium	1	1
<b>Preservatives</b>		
Methylisothiazolinone	0	1
Triethylene glycol bis(2-ethylhexanoate)	0	1

Yeo et al<sup>3</sup> reported two cases of allergic contact dermatitis caused by Solvent Orange 60, including one case induced by occupational exposure and another case attributable to glasses. Both patients developed a + 2 reaction to Solvent Orange 60 0.1% pet. Only one of the 31 controls showed a positive response to Solvent Orange 60.

Our survey of previously reported cases of eyeglass allergic contact dermatitis revealed various causative allergens. In particular, many cases in Korea have been induced by various metals. Kim et al<sup>4</sup> reported 37 cases of allergic contact dermatitis caused by nickel or chromium, including 3 cases with positive results for both nickel and chromium. On the other hand, Andersen et al<sup>5</sup> reported a case caused by triethylene glycol bis(2-ethylhexanoate), a new contact allergen identified in a spectacle frame.

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## CONFLICT OF INTEREST

The authors declare no conflict of interest.

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