

Ahrensboell-Friis Ulrik (Orcid ID: 0000-0003-4181-0926)
 Simonsen Anne Birgitte (Orcid ID: 0000-0002-9299-0317)
 Johansen Jeanne Duus (Orcid ID: 0000-0002-3537-8463)

Title: Allergic contact dermatitis to dyes used in the temple of spectacles.

¹Ulrik Ahrensboell-Friis (0000-0003-4181-0926), ²Anne Birgitte Simonsen (0000-0002-9299-0317), ³Jakob Dahlin (ORCID?), ³Marléne Isaksson (0000-0002-9005-0962), ^{2,4}Claus Zachariae (0000-0001-5506-1319), and ¹Jeanne Duus Johansen (0000-0002-3537-8463)

¹ National Allergy Research Centre, Department of Dermatology and Allergy, Copenhagen University Hospital Gentofte, 2900 Hellerup, Denmark.

² Department of Dermatology and Allergy, Copenhagen University Hospital – Herlev and Gentofte, 2900 Hellerup, Denmark ³ Lund University, Department of Occupational and Environmental Dermatology, Skåne University Hospital, 20502 Malmö, Sweden.

⁴ Department of Clinical Medicine, University of Copenhagen, Copenhagen, Denmark

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Corresponding author:

Ulrik Ahrensboell-Friis

The National Allergy Research Centre,
 Department of Dermatology and Allergy,
 Copenhagen University Hospital Gentofte,
 Gentofte Hospitalsvej 20A
 2900 Hellerup
 Denmark

Phone: +4538677307

Mail: ulrik.Ahrensboell-friis@regionh.dk

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Author contributions:

Ulrik Ahrensboell-Friis: Conceptualization: lead; Writing-original draft: lead; investigation: lead; Data curation: lead; writing-review & editing: equal;

Anne Birgitte Simonsen: Writing-original draft: support; Data curation: equal; investigation: equal; writing-review & editing: equal;

Jakob Dahlin: Formal analysis: lead; investigation: equal; writing-review & editing: equal;

Marléne Isaksson: Formal analysis: lead; investigation: equal; writing-review & editing: equal;

Claus Zachariae: Conceptualization: support; Data curation: equal; writing-review & editing: equal;

Jeanne Duus Johansen: Conceptualization: support; supervision: lead; writing-review & editing: equal;

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Abstract

Background: We observed an increasing number of patients who presented with facial or retro-auricular dermatitis after skin contact with plastic spectacles or plastic covered temples.

Objectives: To identify the allergens in plastic spectacles that may cause allergic contact dermatitis.

Methods: All patients with suspected allergic contact dermatitis to eyewear were tested with Solvent Orange 60 (SO60), 4 additionally with Solvent Yellow 14 (SY14), and 5 with scrapings from their own spectacles. In one case, a chemical analysis of the spectacles was performed to uncover the causative allergen.

Results: Three patients were allergic to SO60, two patients to SY14, and two patients were allergic to both SO60 and SY14.

Conclusion: Patients with suspected allergic contact dermatitis from spectacles should be tested with SO60 and SY14, and based on findings from previous reports, also with Solvent Red 179.

1 INTRODUCTION

Allergic contact dermatitis from skin contact with spectacles is not rare. Potential allergens in spectacles include metals, plastics, rubbers, and various additives such as plasticizers, preservatives and ultraviolet stabilizers, composites, and polishes.^{1,2} As a result of fashion trends, plastic spectacle frames have been increasingly popular in recent years. Subsequently, reports on contact allergy caused by dyes in spectacles have emerged. So far, the causative allergens reported have been Solvent Orange 60 (CAS no: 6925-69-5; SO60)³⁻⁵, Solvent Red 179 (CAS no: 6829-22-7; SR179)^{3,6}, and Solvent Yellow 14 (CAS no: 842-07-9 ; SY14).⁷ Adding to the existing knowledge, we report 7 cases of allergic contact dermatitis from such dyes.

2 MATERIALS AND METHODS

2.1 Patients

From 1st January 2017 to 31st March 2021, we patch tested all patients referred because of suspected contact allergy caused by the use of spectacles.

2.2 Patch Testing

All patients were patch tested with the European Baseline series (allergEAZE, SmartPractice, Phoenix, Arizona), additional allergens in a baseline series specific to our department, 26 fragrance allergens, selected dye allergens based on our previous experience from a chemical analysis (thin layer chromatography and gas chromatography / mass spectrometry) of a temple (unpublished data) (SO60 1% in pet), and in 5 patients scraping from the patient's spectacles. Patch testing was performed with Finn Chambers® (8 mm; SmartPractice, Phoenix, Arizona) on Scanpor tape® (Norgesplaster A/S, Alpharma, Vennesla, Norway). The patch tests were applied to the upper back and were occluded for 48 hours. Readings were performed on day 2 (D2), D3/D4, and D7, according to the recommendations of the European Society of Contact Dermatitis⁸. In Case 3 a chemical analysis of the temple tips was performed,

which identified SY14 as the causative allergen.⁷ Because of the results of the patch testing of Case 3, Cases 4-7 were additionally tested with SY14 0.1% in pet. In cases of a positive patch test to SO60 or SY14 the diagnosis of allergic contact dermatitis was made.

3 RESULTS

From 1st of January 2017 to 31st of March 2021, 19 patients were referred to our clinic and we found 7 patients with confirmed allergic contact dermatitis caused by dye allergens in spectacles. The cases and results of the patch test are presented in Table 1. Six out of 7 patients were females and the median age was 59 (range 30-74). In 85.7% (6/7) of patients had developed eczema behind the ears, in 71.4% (5/7) of the patients had developed eczema on the temple, in 57.1% (4/7) of the patients had developed eczema over the bridge of nose. In five patients the spectacles were made of plastic and the colour was either black or "tortoise shell". The remaining two spectacles were made of titanium with plastic covering the temple tips. In Case 3 a chemical analysis was performed, and we identified SY14 as the allergen causing the contact dermatitis. Case 4 had multiple positive reactions. She suffered from eyelid dermatitis for 3 years. She was previously patch tested and reacted to para-phenylenediamine, toluene-2,5-diamine sulphate, and textile dye mix. The reactions to PPD and toluene-2,5-diamine sulphate was judged to be of previous relevance, as the patient reported that she had a skin reaction to hair dye several years earlier.

4 DISCUSSION

Plastic spectacle frames are increasingly popular owing to trends in fashion. Following the increased use of especially black and tortoise shell coloured spectacles, several case reports of allergic contact dermatitis due to skin contact with such spectacles have been reported.^{2-7,9} We present an additional seven cases to the existing literature. In line with our findings SO60 was the causative allergen in the majority of previous published cases.^{3-5,10} SO60 is a perinone-type dye that is used to add colour (brown, red and pink)⁴ to

polystyrene, polycarbonate, polymethyl methacrylate resins, and acrylonitrile/butadiene/styrene (ABS plastic).⁴ It has a wide range of applications such as spectacles³⁻⁵, helmets¹⁰, gloves¹¹, the orange turn-signal lamps for automobiles⁴ and other materials for both occupational and private use.⁵ Another plastic dye identified in spectacles is CI Solvent Red 179 (SR179), which seems to cross react to SO60.^{3,5,6} None of our patients were tested with SR179 as we were not aware of the relevance of this allergen at the time.

Three of our patients reacted to SY14. One of the patients was previously described.⁷ SY14 is an azo dye. Azo dyes is used in printing ink and in paints.¹² SY14 was also reported as a contact allergen in different cosmetics¹³⁻¹⁵ but may further be an overlooked allergen in cases of contact dermatitis caused by plastic spectacles. One patient reacted to SO60, SY14, and Disperse Orange 3 (Case 4). The manufacturer confirmed the presence of SO60 in the Tom Ford spectacles, whereas the content of the Specsavers spectacles was not further investigated. It seems likely that the specific dyes may be used in plastic spectacles individually, as supported by previous findings in literature. It is unknown if cross-reactions occur. Case 4 reacted to PPD, toluene-2,5-diamine sulphate, textile dye mix, C.I. Solvent Yellow 1, Disperse Orange 3, SO60, and SY14. She had a history of contact dermatitis following the use of hair dye. As PPD is known to cross-react with the plasticizer 4,4-diaminodiphenylmethane (DDM)¹⁶ and azo dyes¹⁷, our patient were not tested with DDM, but this primary sensitization to PPD may in this case explain the skin reaction from the spectacles. However, none of the other cases with positive patch test reactions to SO60 and SY14 reacted to PPD, which speaks against a significant degree of cross reactivity.

In patients presenting with contact dermatitis following the use of spectacles, the work up is often complicated, as it is extremely difficult or even impossible to retrieve information regarding the composition of plastic spectacles and similar consumer items. The cases described here adds to the growing body of evidence of allergic contact dermatitis caused by spectacles and highlights the need for legislation, regulation, prohibition, and labelling of dyes used in products used for long term contact to skin. A

physician needs to be alert if there is a concomitant relationship between the use of eyewear and the development of eczema behind the ears, over the nose bridge, the temples and/or the eyelids.

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CONCLUSIONS

Retro- or preauricular dermatitis may be allergic contact dermatitis caused by dye in spectacles, most often SO60 and SY14. SR179 should also be considered because it has been identified in spectacles. We recommend that these three allergens are added to commercial spectacles patch test series.

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Table 1. Schematic overview of the seven cases; brand, colour, positive reactions

Patient	Sex	Age	Previous AD ¹	Skin reaction	Frame material	Colour	Brand	Tested allergens	Positive reactions
1	F	30	+	Dermatitis in areas of skin contact with spectacle frame	Plastic	Turtoise shell	Tom Ford	EBS ² , ABA ³ , DFS ⁴ , SO60 ⁵	+++ SO60
2	F	49	+	Dermatitis behind ears, cheeks, bridge of nose	Plastic	Turtoise shell	Tom Ford	EBS, ABA, DFS, SO60, scraping of the plastic temple	+ scraping from plastic temple + nickel sulfate ++ SO60
3	F	59	-	Dermatitis behind ears	Titanium frame with plastic covering the temple tips	Black	Lindberg	EBS, ABA, DFS, SO60, scraping of the plastic temple	++ scraping from temple tip + SY14 ^{6,7}
4	F	61	N/A ⁸	Dermatitis in areas of skin contact with spectacle frame and eyelids	Plastic	1)Black 2)Black 3)Brown	1)Tom Ford 2) Specsavers Flexi 94 3) Specsavers Lambeth	EBS, ABA, DFS, glue/plastic series, scraping of the temple, SO60, SY14	++ PPD ++ Textile dye mix ++ C.I. Solvent Yellow 1 ++ Disperse Orange 3 ++ SO60 + SY14 ++ scraping from Tom Ford ++ scraping from Specsavers Flexi 94 + scraping from Specsavers Lambeth Former positive reaction to; toluene-2,5-diamine sulphate
5	F	59	-	Dermatitis on the bridge of the nose	N/A	Tortoise shell	Tom Ford 1 Tom Ford 2	EBS, ABA, DFS, SO60, textile finish, scraping of the temple, SO60, and SY14	+ scraping from Tom Ford 2 ++ Nickel Sulphate ++ SO60
6	M	74	-	Pronounced erythema and infiltration of the entire face and bullae formation behind the ears and in both temples	Black coated titanium frame with black plastic covering the temple tips	Black	N/A	EBS, ABA, DFS, rubber chemicals, SO60, SY14, and scrapings from the plastic covering on the temple tips	++ SY14 + scrapings from the plastic tips
7	F	37	-	Erythema and rash around eyes, behind ears, on the bridge of the nose and erythema and swelling involving the forehead and cheeks.	Plastic	1)Tortoise shell 2)Tortoise shell	1) Stella McCartney 2) Yves Saint Laurent	EBS, ABA, DFS, textile allergens including SO60 and SY14	++ SO60 + SY14

¹ AD: Atopic dermatitis² EBS: European Baseline Series³ ABA: Additional baseline allergens specific to our department⁴ DFS: Declared fragrance substances⁵ SO60: Solvent Orange 60⁶ SY14: Solvent Yellow 14⁷ Chemical analysis of temple tip showed that they contained SY14. The patient was subsequently patch tested with this specific allergen⁸ N/A: Not available