

Clinical relevance of *p*-tert-butylphenol-formaldehyde resin (PTBP-FR) contact allergy among general dermatology patients

Päivi Lintu¹  | Iina Soramäki^{1,2} | Jussi Liippo¹

¹Department of Dermatology and Allergy Unit, Turku University Hospital and University of Turku, Turku, Finland

²Department of Dermatology, Central Finland, Central Hospital, Jyväskylä, Finland

Correspondence

Päivi J. Lintu, Department of Dermatology and Allergy Unit, Turku University Hospital and University of Turku, P.O. box 52, FIN-20521, Turku, Finland.
Email: paivi.lintu@tyks.fi

KEYWORDS: contact allergy, PTBP-FR, PTBT, *p*-tert-butylphenol formaldehyde resin

Contact allergy to *p*-tert-butylphenol-formaldehyde resin (PTBP-FR) was first reported from a shoe glue in the late 1950s.¹ The prevalence of PTBP-FR contact allergy has been reported as between 1% and 3%,^{2,3} but from 2004 to 2013/14 the prevalence declined by ~50% in Europe.⁴ Contact allergy to PTBP-FR has been associated with leather-shoe-related foot dermatitis.⁴⁻⁶ Leather watch straps, domestic glues, handicraft adhesives, artificial nail adhesives, athletic tapes, neoprene orthopaedic knee braces, and amputation prostheses have also been identified as sources.⁷ Contact allergy to PTBP-FR is mostly non-occupational,⁸ and occupational cases have only been reported in the shoe manufacture and car industry.^{6,9} The aim of this study was to analyze the sources of sensitization, clinical relevance, and the prevalence of contact allergy to PTBP-FR among general dermatology patients.

METHODS

The European baseline series including PTBP-FR 1% pet. (Chemotechnique Diagnostics, Vellinge, Sweden) and additional series were tested in 7084 patients with suspected contact allergy from June 2005 to December 2018. Patch tests were applied to the upper back in Finn Chambers (Epitest, Tuusula, Finland) and the chambers were fastened with Scanpor tape (Norgeplaster, Vennesla, Norway) and removed at day (D) 2. The patch tests were read on D3 to D5 after the removal of the chambers, according to criteria of the International Contact Dermatitis Research Group. The relevance of the positive PTBP-FR reactions and sources of sensitization were retrospectively evaluated from patient records.

RESULTS

The patients were 5160 (73%) females and 1924 (27%) males. Positive PTBP-FR patch test reactions were seen in 46 patients (0.65%) (age

range 17–89 years; 10 [22%] male and 36 [78%] female). Among the 10 male patients, eight had ++ reactions and two had a + reaction. Four of the 36 female patients had +++ reactions (11%), seven ++ reactions (19%), and 25 (70%) patients a + reaction to PTBP-FR. Of the 46 of PTBP-FR positive patients 12 (26%) had active atopic dermatitis and 19 (41%) had atopic constitution or previous atopic dermatitis. Thirty-three (72%) of the PTBP-FR positive patients also had concurrent patch test reactions.

Facial dermatitis was reported in nine (20%) patients, hand dermatitis in 16 (35%), and hand and/or feet dermatitis in 32 (70%). Four (9%) patients had dermatitis of the feet only. Most of the patients had dermatitis in multiple areas. One patient had dermatitis under a leather watch strap. Leather shoes or sandals were regarded as relevant sources in seven patients and handicraft glues in nine patients. Artificial nails and athletic tape had been used by one patient each. A leg support padding was the most likely sensitization source in one case. Earlier exposure to PTBP-FR was considered in 36 (78%) of the patients. Current exposure with allergic contact dermatitis symptoms was present in 10 (22%) patients (six exposed to leather shoes or sandals, two to glues, one to artificial nails, and one to padding in a leg support). Detailed information on the 21 patients with either proven or suspected sensitization sources to PTBP-FR is presented in Table S1. In the remainder of the patients, clinical relevance was unknown.

DISCUSSION

According to a large meta-analysis, the average prevalence of contact allergy to PTBP-FR has been 1.3% in both male and female patients.³ In North America, the prevalence of PTBP-FR contact allergy was between 1.0% and 1.5% during 2015–2016.¹⁰ In our study only 0.65% patients reacted to PTBP-FR, which is less than in these

previous studies: PTBP-FR contact allergy was seen in only 0.7% of female patients and 0.5% of male patients. Since male patients made up only 27% of the tested patients, PTBP-FR seems not to be a very important contact allergen in the Finnish male population (0.1% of all the tested patients). By contrast, 36 PTBP-FR-positive female patients (0.5% of the tested patients) were found.

Only seven patients (15%) were suspected to be sensitized from leather shoes or sandals. It is possible that shoe dermatitis is less common in Finland, as socks are worn more often, and perhaps also, shoe-related sweating is less frequent in our cold climate. On the other hand, this finding may also be indicative of a reduced importance of PTBP-FR containing adhesives in footwear, as reported.⁴ Domestic glues in handicraft work were the most common source of sensitization, as nine patients had either current or earlier history of hand dermatitis. Therefore, PTBP-FR should be considered when studying hand dermatitis patients with a history of glue and adhesive exposure.

Only one patient had occupational contact allergy to PTBP-FR. This case has been published previously and, later, the patient was tested for other reasons.¹¹ This patient had been sensitized to PTBP-FR following exposure to glass wool at work. Another patient, a car factory worker, was suspected of having occupational contact allergy to PTBP-FR. It was possible that he had used a glue containing PTBP-FR at work, but PTBP-FR could not be traced from that particular glue.

Most of the patients (ie, 25/46 [54%]), did not have any proven or suspected source for their PTBP-FR contact allergy. These patients may have been asymptomatic, or they have experienced only very mild symptoms upon exposure to PTBP-FR-containing material. Many patients also had other contact allergies that were often currently clinically relevant. Leather shoes, sandals, or wrist-watch straps, and domestic glues seem to represent the most common sources of sensitization. The patients' own materials were not tested and the suspected PTBP-FR exposure could not be traced in many cases; these are limitations of the study. Further studies are needed to obtain more detailed exposure information on PTBP-FR, especially in non-occupational cases.

In conclusion, the prevalence of PTBP-FR contact allergy seems to be rather low and occupational contact allergy to PTBP-FR is rare. Therefore, perhaps PTBP-FR should be tested in more specialized series, for example, glues and/or shoes series, rather than in the European baseline series.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

Päivi Lintu: Conceptualization; data curation; formal analysis; investigation; project administration; visualization; writing-original draft;

writing-review and editing. **Iina Soramäki:** Writing-original draft. **Jussi Liippo:** Conceptualization; formal analysis; project administration; supervision; visualization; writing-original draft; writing-review and editing.

ORCID

Päivi Lintu  <https://orcid.org/0000-0001-5227-0975>

REFERENCES

1. Malten KE. Occupational eczema due to paratertiary butylphenol in shoe adhesive. *Dermatologica*. 1958;117(2):103-109.
2. Diepgen TL, Oftenloch RF, Bruze M, et al. Prevalence of contact allergy in general population in different European regions. *Br J Dermatol*. 2016;174(2):319-329.
3. Alinaghi F, Bennike N, Egeberg A, Thyssen J, Johansen J. Prevalence of contact allergy in the general population: a systematic review and meta-analysis. *Contact Dermatitis*. 2019;80(2):77-85.
4. Uter W, Amario-Hita JC, Balato A, et al. European surveillance system on contact allergies (ESSCA): results with the European baseline series, 2013/14. *J Eur Acad Dermatol Venereol*. 2017;31(9):1516-1525.
5. Landeck L, Uter W, John SM. Patch test characteristics of patients referred for suspected contact allergy of the feet - retrospective 10-year cross-sectional study of the IVDK data. *Contact Dermatitis*. 2012;66(5):271-278.
6. Fousereau J, Cavelier C, Selig D. Occupational eczema from para-tertiary-butylphenol formaldehyde resin: review of the sensitizing resins. *Contact Dermatitis*. 1976;2(5):254-258.
7. Aalto-Korte K, Suuronen K. Plastic materials and glues. In: Johansen J, Mahler V, Lepoittevin JP, Frosch P, eds. *Contact Dermatitis*. Cham, Switzerland: Springer; 2019.
8. Pesonen M, Jolanki R, Larese Filon F, et al; On Behalf of the ESSCA Network. Patch test results of the European baseline series among patients with occupational contact dermatitis across Europe - analysis of the European Surveillance System on Contact Allergy network, 2002-2010. *Contact Dermatitis*. 2015;72(3):154-163.
9. Oosterhaven JA, Febriana SA, Soebono H, Coenraads PJ, Schuttelaar ML. Results of patch testing in Indonesian shoe factory workers. *J Eur Acad Dermatol Venereol*. 2017;31(1):e15-e17.
10. DeKoven JG, Warshaw EM, Zug KA, et al. North American Contact Dermatitis group patch test results: 2015-2016. *Contact Dermatitis*. 2018;29(6):297-309.
11. Kalimo K, Saarni H, Kytta J. Immediate and delayed type reactions to formaldehyde resin in glass wool. *Contact Dermatitis*. 1980;6(7):496.

SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.

How to cite this article: Lintu P, Soramäki I, Liippo J. Clinical relevance of *p*-tert-butylphenol-formaldehyde resin (PTBP-FR) contact allergy among general dermatology patients. *Contact Dermatitis*. 2020;1-2. <https://doi.org/10.1111/cod.13602>

Online supplemental table 1: Patient characteristics

Patient n:o	Gender and age	PTBP- FR	Localization	Diagnosis	Concurrent test reactions	patch	Proven suspected source	or	Exposure
1	F/31	+	Face, flexures, extremities	AD ACD	Colophonium Nickel sulfate Bacitracin		Leather watch strap, Glue		Earlier
2	F/62	+	Body, extremities, face, hands	AD ACD	Potassium dichromate Cocamidopropyl betaine		Glue		Earlier
3	F/21	+	Hands	ICD	MCI/MI		Glue		Earlier
4	M/46	++	Hands, extremities, face, neck	ACD	Bisphenol A and F Bis-GMA 1,4-butanediol diacrylate Nickel sulfate		Glue		Earlier or current
5	M/29	++	Hands	Pompholyx AD	-		Glue		Earlier
6	M/80	++	Feet, body, extremities	ACD Prurigo nodularis	-		Leather shoes		Earlier and current
7	F/24	+	Hands, body	ACD AD	MCI/MI Budesonide Hydrocortison-17- butyrate		Glue		Earlier
8	F/27	+	Feet, body	ACD Lichen simplex	<i>Myroxylon pereirae</i> Colophonium Propolis		Shoes		Current
9	M/33	++	Extremities	ACD	<i>Myroxylon pereirae</i> Black rubber mix Fragrance mix I		Athletic tape		Earlier
10	F/63	+	Feet	ACD	<i>Myroxylon pereirae</i>		Shoes		Earlier

				Leg ulcer	Thiuram mix Colophonium Fragrance mix I etc.		and current
11	F/64	+++	Face	ACD AD	<i>Myroxylon pereirae</i> Colophonium Fragrance mix I MCI/MI, MI etc.	Glue	Earlier and current
12	F/58	+++	Feet	ACD	Cobalt chloride Potassium dichromate	Leather shoes	Earlier and current
13	F/17	+	Feet extremities	ACD AD	-	Leather shoes	Earlier
14	M/38	++	Extremities, trunk	ACD	p- Phenylenediamine Budesonide Hydrocortison-17- butyrate etc.	Leather shoes	Earlier and current
15	F/55	+	Extremities	ACD	Nickel sulfate Disperse blue Framycetin sulfate	Leg support padding	Current
16	F/37	++	Hands	AD	-	Glue	Earlier
17	F/47	++	Feet	ACD	Potassium dichromate Mercapto mix Nickel sulfate etc.	Leather shoes	Earlier and current
18	F/35	+	Hands, face	ICD	-	Glue	Earlier and current
19	F/53	+++	Feet	ACD AD	Nickel sulfate p- Phenylenediamine	Glue	Earlier and current

					Colophonium etc.		
20	F/16	+	Face, eyelids	ACD AD	-	Artificial nail adhesive/glue	Current
21	M/47	+	Hands	ACD AD	Nickel sulfate MCI/MI Potassium dichromate etc.	Mineral wool and glue (occupational)	Earlier

AD atopic dermatitis, ACD allergic contact dermatitis, ICD irritant contact dermatitis, MCI/MI methylchloroisothiazolinone/methylisothiazolinone