

Strip patch testing does not affect reaction profiles of standard allergens

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Summary

Background. It has been hypothesized that positive reactions in the strip patch test are irritant rather than allergic.

Objective. To study reaction profiles of the baseline series patch test substances applied routinely on tape-stripped skin according to the reaction index (RI) and the positivity ratio (PR).

Patients and methods. One thousand two hundred and twenty-eight consecutive patients were routinely strip patch tested with the baseline series between January 2011 and June 2013 (intervention group). On the basis of test reactions at D3/D4, the RI, and the PR, 25 standard allergens were analysed, and the results were compared with those obtained in 1161 patients patch tested conventionally from July 2008 to December 2010 (historical control group).

Results. Nickel sulfate, fragrance mix I, cobalt chloride, *Myroxylon pereirae* (balsam of Peru) and colophonium showed the highest frequencies of positive reactions in both groups, without any significant differences. Of 25 patch test substances of the baseline series, 18 showed good reaction profiles in the intervention group, and 16 in the historical control group.

Conclusions. Reaction profiles of baseline series patch test substances remained largely unaffected by tape stripping the skin prior to patch testing. Thus, if conventional patch test results are presumed to be false-negative, performance of the strip patch test can be recommended independently of the standard allergen.

Key words: contact allergens; patch test; positivity ratio; reaction index; strip patch test.

The strip patch test – a modification of patch testing by tape stripping the skin prior to application of test substances – is used to obtain more valid and reliable test results in special settings (1, 2). In practice, it is

commonly used for patch testing, for example, ophthalmological agents, aeroallergens, drugs, metal salts, and photopatch test substances (3). However, the strip patch test is still not widely utilized.

We proposed the first standardized strip patch test protocol (4), and subsequently verified a defined reduction of the stratum corneum of ~30% (5) in association with increased expression of keratinocyte-derived cytokine mRNAs (6). Increased diagnostic accuracy (7) of the strip patch test relative to the patch test was shown for the standard patch test substances nickel sulfate, potassium dichromate, and lanolin alcohols. However, for routine use with standard patch test substances, it has been

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hypothesized that reactions in the strip patch test are of irritant rather than of positive, that is, allergic, morphology, mainly because of the non-specific stimulation of the immune system in tape-stripped skin (8).

Patch test reaction profiles, including irritant, follicular, questionable, weak (+) and strong positive reactions (++) and (+++), can be described and analysed by use of the reaction index (RI) (9) and the positivity ratio (PR) (10). To date, data on these evaluation parameters from our standardized strip patch test have been lacking. The aim of the present study was to calculate RIs and PRs for patch test substances of the baseline series of the German Contact Dermatitis Research Group (DKG) applied routinely on tape-stripped skin according to our standardized protocol (4, 11).

Patients and Methods

This prospective, open, two-centre study took place from 1 January 2011 to 30 June 2013. During this period, consecutive patients in the patch test units of the dermatological clinics in Bochum and Halle (Saale) underwent a strip patch test with the DKG baseline series (<http://dkg.ivdk.org/dkgblo.html#a001>). Additional series (<http://dkg.ivdk.org/dkgblo.html>) were applied as conventional patch tests, according to the patient's presenting complaints.

The study was approved by the ethics committee of the Medical Faculty of the Ruhr University Bochum (registration no. 2881; date of vote 5 May 2010). Procedures were explained in detail to all patients, who signed informed consent forms prior to participation.

Patients

The inclusion criteria were suspected allergic contact dermatitis, age of at least 13 years, and clinically normal skin at the time of patch testing. The exclusion criteria were pregnancy, lactation, intake of immunosuppressive or immune-modulating drugs, topical use of glucocorticoids on the back and intense ultraviolet exposure on the back within last 4 weeks prior to inclusion in the study. The discontinuation criteria were severe skin reactions or intense discomfort in the test areas of the strip patch test, but these criteria were not met in any case.

Strip patch test and patch test

Strip patch testing was performed according to our standardized method, described in detail elsewhere (4, 11). Tape stripping was carried out with a 3M™ Blenderm™

surgical tape (3M™ Medica, 3M Deutschland GmbH, Neuss, Germany; width, 25 mm). If necessary, any body hair was removed before with a 3M™ clipper. Patch testing was performed according to the DKG guidelines (12).

Patients were tested on the upper back with test substances purchased from Almirall Hermal (Reinbek, Germany). Small Finn Chambers® on Scanpor® tape (Epitest Ltd Oy, Tuusula, Finland) were used. The patch test application time was 24 hr. Patch tests were read at D1 (24 hr), D3 (72 hr) or D4 (96 hr; in a few exceptional cases), and D7 (168 hr). Test reactions were graded according to the DKG scoring system (13, 14).

Evaluation parameters

We used the RI (9) in combination with the PR (10) to assess the reaction profiles of standard patch test substances concerning the differentiation of allergic and doubtful or irritant reactions. RIs range from -1 to $+1$. Patch test substances with negative RIs elicit more unwanted reactions (questionable, follicular, or irritant) than positive reactions (+, ++, or +++). An RI of 0 indicates equal numbers of unwanted and positive reactions. An RI above 0.5 characterizes an almost ideal distribution of reactions to the patch test substance. The PR is defined as the percentage of weak positive reactions (+) among the sum of all positive reactions (+, ++, and +++), and values therefore range from 0% to 100%.

The RI and PR are inversely related (10). Patch test substances with a good reaction profile should have a high RI (≥ 0.5) and a low PR ($< 75\%$). Patch test substances with a lower RI (< 0.5) or a higher PR ($\geq 75\%$), respectively, are regarded as having a 'problematic' reaction profile. A low RI combined with a high PR indicates many unwanted reactions and a high proportion of weak positive reactions.

Irritant control

As an irritant control, sodium lauryl sulfate (SLS) 0.25% aq. was included in the DKG baseline series.

Atopic dermatitis

Patients diagnosed as having atopic dermatitis had a personal history of flexural involvement and/or visible flexural eczematous or lichenified dermatitis.

Intervention group and historical control group

Consecutive patients strip patch tested routinely with the DKG baseline series between 1 January 2011 and 30

June 2013 constituted the intervention group. Patients patch tested conventionally with the DKG baseline series between 1 July 2008 and 31 December 2010 constituted the historical control group. In both dermatology clinics, all patch tests throughout this 5-year period were read and scored by the same experienced dermatologists (H.D. and B.K.).

Data management

Both dermatology clinics are active members of the Information Network of Departments of Dermatology (IVDK; <http://www.ivdk.org/de/>). Patient data were subjected to quality control, and entered into a computerized database (WinAllDat/IVDK) at the respective clinics. Anonymized data were then sent to the IVDK central office for evaluation (performed by J.G.). The progress of the study was presented on a regular basis in scheduled meetings of the DKG.

Statistical analysis

For data analysis, patch test reactions at D3 were selected. In few exceptional cases, when no reading was possible at D3, and a reading was performed at D4 instead, the D4 reaction was chosen. RIs and PRs of 25 allergens from the DKG baseline series tested continuously over the 5-year period from 1 July 2008 to 30 June 2013 were calculated according to published formulae (9, 10), together with the corresponding 95% confidence intervals (CIs) (15). Differences in the frequencies of several items in different patient subgroups were tested for statistical significance with the chi-square test (significance level: $\alpha = 0.05$) or by comparison of 95%CIs (significance level: non-overlapping of CIs), as appropriate. All statistical analyses were performed with the software package SAS® (SAS Institute Inc., Cary, NC, USA), Version 9.3.

Results

Routinely collected patch test data from two dermatology clinics in Germany were included in the study (Table 1).

The demographic and clinical characteristics according to the MOAHLEA index (16) are shown in Table 2. There was a fairly uniform distribution of the characteristics in the intervention group and the historical control group.

Patch test results

Age-standardized and sex-standardized percentages of positive reactions are shown in Table 3. Most frequently, positive reactions were observed to nickel sulfate,

Table 1. Numbers and percentages of patients tested with the baseline series of the German Contact Dermatitis Research Group at the clinics in Bochum and Halle (Saale), Germany

	Intervention group January 2011 to June 2013		Historical control group July 2008 to December 2010	
	n	%	n	%
Bochum	1072	87.3	1020	87.9
Halle (Saale)	156	12.7	141	12.1
Total	1228	100	1161	100

Table 2. MOAHLEA index of patients patch tested in Bochum and Halle (Saale)

	Intervention group January 2011 to June 2013		Historical control group July 2008 to December 2010	
	n	%	n	%
Male	420	34.2	415	35.7
Occupational dermatitis	184	15.0	147	12.7
Atopic dermatitis	186	15.1	147	12.7
Hand dermatitis	249	20.3	205	17.7
Leg dermatitis	101	8.2	101	8.7
Face dermatitis	170	13.8	138	11.9
Age ≥ 40 years	947	77.1	883	76.1

There were no significant differences between the groups.

fragrance mix I, cobalt chloride, *Myroxylon pereirae*, colophonium and potassium dichromate in the intervention group, and to nickel sulfate, *M. pereirae*, fragrance mix I, cobalt chloride, fragrance mix II and colophonium in the historical control group. The relative frequencies of positive reactions to all standard patch test substances showed no significant differences between the two groups.

RIs ranged from 0.3 to 1.0 in the intervention group, and from 0.0 to 0.9 in the historical control group (Table 4). Significant differences were observed for *M. pereirae* and fragrance mix II, both of which gave more questionable reactions in the intervention group (data not shown). PRs ranged from 28.6% to 100% in the intervention group, and from 36.4% to 100% in the historical control group. A single significant difference was observed for *M. pereirae*, with fewer weak positive reactions in the intervention group.

In the intervention group, 18 of 25 patch test substances of the DKG baseline series showed good reaction profiles, with $RI \geq 0.5$ and $PR < 75\%$. 'Problematic' reaction profiles were seen with fragrance mix II, oil of turpentine, mercapto mix, formaldehyde, paraben mix,

Table 3. Results for 25 patch test substances of the German Contact Dermatitis Research Group (DKG) baseline series in Bochum and Halle (Saale) based on reactions at D3 (or D4 in exceptional cases), as age-standardized and sex-standardized percentages of positive reactions (Standardized % pos.), with accompanying 95% confidence intervals (CIs)

DKG baseline series	Intervention group January 2011 to June 2013 Standardized % pos. (95%CI)	Historical control group July 2008 to December 2010 Standardized % pos. (95%CI)
Nickel sulfate 5% pet.	12.5 (10.3–14.7)	12.4 (10.1–14.6)
Fragrance mix I 8% pet.	6.0 (4.5–7.6)	6.3 (4.8–7.7)
Cobalt chloride 1% pet.	5.6 (4.0–7.3)	5.1 (3.5–6.7)
<i>Myroxylon perei</i> 25% pet.	4.8 (3.4–6.1)	7.0 (5.5–8.6)
Colophonium 20% pet.	3.8 (2.5–5.1)	3.5 (2.1–4.8)
Potassium dichromate 0.5% pet.	3.6 (2.3–4.9)	2.2 (1.3–3.2)
Fragrance mix II 14% pet.	2.9 (1.8–4.0)	4.1 (2.9–5.4)
Methyldibromo glutaronitrile 0.2% pet.	2.4 (1.4–3.5)	2.8 (1.8–3.9)
Propolis 10% pet.	2.2 (1.3–3.1)	2.4 (1.4–3.4)
Thiuram mix 1% pet.	2.2 (1.2–3.2)	2.0 (1.1–2.9)
Hydroxyisohexyl 3-cyclohexene carboxaldehyde 5% pet.	1.5 (0.7–2.2)	1.2 (0.6–1.8)
Methylchloroisothiazolinone/methylisothiazolinone (3:1) 0.01% aq.	1.3 (0.7–2.0)	1.7 (0.8–2.5)
Mercaptobenzothiazole 2% pet.	1.0 (0.4–1.6)	1.0 (0.3–1.7)
Oil of turpentine 10% pet.	1.0 (0.4–1.6)	1.7 (0.9–2.5)
Lanolin (wool) alcohols 30% pet.	1.0 (0.2–1.7)	1.8 (1.0–2.7)
Epoxy resin 1% pet.	0.9 (0.4–1.4)	1.2 (0.5–1.9)
<i>N</i> -isopropyl- <i>N'</i> -phenyl-4-phenylenediamine 0.1% pet.	0.9 (0.2–1.6)	0.2 (0.0–0.6)
Mercapto mix (without MBT) 1% pet.	0.7 (0.2–1.2)	1.0 (0.3–1.8)
Formaldehyde 1% aq.	0.6 (0.1–1.2)	0.4 (0.0–0.9)
2-Bromo-2-nitropropane-1,3-diol 0.5% pet.	0.6 (0.1–1.0)	1.4 (0.6–2.2)
Bufexamac 5% pet.	0.6 (0.1–1.0)	1.2 (0.5–2.0)
Paraben mix 16% pet.	0.5 (0.1–1.0)	1.5 (0.6–2.3)
Cetearyl alcohol 20% pet.	0.4 (0.1–0.6)	0.7 (0.2–1.2)
Zinc diethyldithiocarbamate 1% pet.	0.3 (0.1–0.6)	0.1 (0.0–0.2)
<i>p</i> -tert-Butylphenol formaldehyde resin 1% pet.	0.3 (0.0–0.7)	0.9 (0.2–1.7)

There were no significant differences between the groups.

cetearyl alcohol, and *p*-tert-butylphenol formaldehyde resin. In the historical control group, 16 standard patch test substances showed good reaction profiles, whereas the reaction profiles of cobalt chloride, *M. perei*, propolis, oil of turpentine, lanolin alcohols, *N*-isopropyl-*N'*-phenyl-4-phenylenediamine, 2-bromo-2-nitropropane-1,3-diol, paraben mix and zinc diethyldithiocarbamate appeared to be 'problematic'.

Irritant control test results

Remarkably, there were significantly more irritant reactions to SLS in the historical control group without tape stripping than in the intervention group with tape stripping (Table 5). In order to control for seasonal variation in reactivity to SLS (17), we calculated standardized reaction frequencies for a standard of 25% of the tests performed in spring, summer, autumn, and winter. The observed difference remained mostly unchanged, with standardized reaction frequencies of 2.975% in the intervention group and 8.65% in the historical control group.

In both groups, there was a trend towards lower RIs and higher PRs in patients with a positive irritant control test reaction. However, this was not significant for any of the standard patch test substances (data not shown).

Atopic dermatitis

No modification of reaction profiles by atopic dermatitis status was observed in either group (data not shown).

Discussion

This is the first study presenting reaction profiles of baseline series patch test substances obtained with the strip patch test.

As Table 3 shows, there were no significant differences between the intervention group and the historical control group concerning age-standardized and sex-standardized frequencies of positive reactions to any of the standard patch test substances. On the one hand, this may indicate

Table 4. Reaction indices (RIs) and positivity ratios (PRs) with accompanying 95% confidence intervals (CIs)

	Intervention group January 2011 to June 2013		Historical control group July 2008 to December 2010	
	RI (95%CI)*	PR (95%CI)	RI (95%CI)*	PR (95%CI)
DKG baseline series				
Nickel sulfate 5% pet.	0.9 (0.9–1.0)	35.8 (28.1–44.1)	0.9 (0.9–1.0)	51.8 (43.2–60.3)
Fragrance mix I 8% pet.	0.8 (0.7–0.9)	54.4 (42.8–65.7)	0.8 (0.7–0.9)	65.6 (54.8–75.3)
Cobalt chloride 1% pet.	0.6 (0.5–0.8)	61.7 (48.2–73.9)	0.7 (0.6–0.9)	76.5 (62.5–87.2)
<i>Myroxylon perei</i> 25% pet.	0.5 (0.4–0.7)	60.3 (47.2–72.4)	0.8 (0.7–0.9)	86.6 (78.2–92.7)
Colophonium 20% pet.	0.7 (0.5–0.9)	43.2 (28.3–59.0)	0.8 (0.5–1.0)	60.0 (42.1–76.1)
Potassium dichromate 0.5% pet.	0.8 (0.6–1.0)	60.0 (43.3–75.1)	0.5 (0.2–0.8)	64.3 (44.1–81.4)
Fragrance mix II 14% pet.	0.4 (0.1–0.6)	59.5 (42.1–75.2)	0.8 (0.7–1.0)	73.7 (60.3–84.5)
Methyldibromo glutaronitrile 0.2% pet.	0.8 (0.5–1.0)	58.6 (38.9–76.5)	0.9 (0.7–1.0)	67.6 (50.2–82.0)
Propolis 10% pet.	0.6 (0.4–0.9)	53.1 (34.7–70.9)	0.9 (0.7–1.0)	80.6 (62.5–92.5)
Thiuram mix 1% pet.	0.8 (0.5–1.0)	41.7 (22.1–63.4)	0.8 (0.6–1.0)	50.0 (29.1–70.9)
Hydroxyisohexyl 3-cyclohexene carboxaldehyde 5% pet.	0.7 (0.4–1.0)	60.0 (36.1–80.9)	0.7 (0.3–1.0)	68.4 (43.4–87.4)
Methylchloroisothiazolinone/methylisothiazolinone (3:1) 0.01% aq.	0.7 (0.5–1.0)	35.0 (15.4–59.2)	0.8 (0.6–1.0)	66.7 (43.0–85.4)
Mercaptobenzothiazole 2% pet.	0.9 (0.6–1.0)	50.0 (23.0–77.0)	0.8 (0.5–1.0)	36.4 (10.9–69.2)
Oil of turpentine 10% pet.	0.4 (0.0–0.8)	64.3 (35.1–87.2)	0.8 (0.6–1.0)	87.5 (67.6–97.3)
Lanolin (wool) alcohols 30% pet.	0.6 (0.2–1.0)	55.6 (21.2–86.3)	0.8 (0.6–1.0)	78.3 (56.3–92.5)
Epoxy resin 1% pet.	1.0 (1.0–1.0)	64.3 (35.1–87.2)	0.6 (0.3–1.0)	42.9 (17.7–71.1)
<i>N</i> -isopropyl- <i>N'</i> -phenyl-4-phenylenediamine 0.1% pet.	0.8 (0.3–1.0)	28.6 (3.7–71.0)	0.3 (–0.7 to 1.0)	100.0 (15.8–100.0)
Mercapto mix (without MBT) 1% pet.	1.0 (1.0–1.0)	80.0 (44.4–97.5)	0.8 (0.4–1.0)	55.6 (21.2–86.3)
Formaldehyde 1% aq.	0.4 (–0.2 to 1.0)	71.4 (29.0–96.3)	0.7 (0.1–1.0)	60.0 (14.7–94.7)
2-Bromo-2-nitropropane-1,3-diol 0.5% pet.	0.8 (0.4–1.0)	62.5 (24.5–91.5)	0.7 (0.3–1.0)	93.3 (68.1–99.8)
Bufexamac 5% pet.	1.0 (1.0–1.0)	37.5 (8.5–75.5)	0.9 (0.6–1.0)	46.7 (21.3–73.4)
Paraben mix 16% pet.	0.3 (–0.3 to 0.8)	85.7 (42.1–99.6)	0.5 (0.1–0.9)	86.7 (59.5–98.3)
Cetearyl alcohol 20% pet.	0.3 (–0.3 to 0.8)	71.4 (29.0–96.3)	0.8 (0.5–1.0)	60.0 (26.2–87.8)
Zinc diethyldithiocarbamate 1% pet.	0.7 (0.2–1.0)	50.0 (11.8–88.2)	0.0 (–1.0 to 1.0)	100.0 (2.5–100.0)
<i>p</i> -tert-Butylphenol formaldehyde resin 1% pet.	0.6 (–0.1 to 1.0)	100.0 (39.8–100.0)	0.6 (0.0–1.0)	57.1 (18.4–90.1)

DKG, German Contact Dermatitis Research Group.

Bold print indicates patch test substances with a 'problematic' reaction profile, that is, RI < 0.5 or PR ≥ 75%.

Comparison of 95% CIs of the RIs and the PRs between the groups shows no significant differences for almost all patch test substances, except for *Myroxylon perei* (balsam of Peru) and fragrance mix II.

*95%CI of RI truncated to range of RI, that is, (–1.0 to 1.0).

Table 5. Results obtained with the irritant control sodium lauryl sulfate of the German Contact Dermatitis Research Group (DKG) baseline series in Bochum and Halle (Saale) based on patch test reactions at D3 (or D4 in exceptional cases) with accompanying 95% confidence intervals (CIs)

	Intervention group January 2011 to June 2013 % irritant reactions (95%CI)	Historical control group July 2008 to December 2010 % irritant reactions (95%CI)
DKG baseline series		
Sodium lauryl sulfate 0.25% aq.	3.2 (2.3–4.4)	8.6 (7.0–10.4)

Significant difference between the groups, $p < 0.0001$.

that no significantly increased diagnostic yield is obtained with the routinely performed strip patch test. On the other

hand, it shows that all baseline series patch test substances can be tested in the strip patch test without confusing the general outcome.

By tape stripping prior to patch testing, the epidermal barrier, which is located in the stratum corneum (18), is reduced (5). Thus, permeation of patch test substances may be enhanced, resulting in increased bioavailability in the living epidermis and a reduced threshold concentration for eliciting an allergic reaction (19). Hence, one may expect a higher percentage of stronger patch test reactions, as reflected in higher RIs and lower PRs. Indeed, a tendency for there to be lower PRs was noted in the intervention group with most standard patch test substances, except for mercapto mix, mercaptobenzothiazole, epoxy resin, formaldehyde, *p*-tert-butylphenol formaldehyde resin, and cetearyl alcohol (Table 4). In contrast, higher and lower RIs seemed to be much more evenly

distributed between the two groups. RIs of fragrance mix II and *M. pereirae*, however, were significantly lower in the intervention group. Additionally, the PR of *M. pereirae* was significantly lower in this group. This means that the strip patch test with these two test substances elicits more questionable reactions than the conventional patch test, and that, with *M. pereirae*, there are more strong positive reactions among the total of positive reactions in the strip patch test. The lower RIs might indicate, at least, non-specific irritation caused by repeated tape stripping. However, fragrance mix II is commonly cited in the literature as a borderline irritant (20).

With all other standard patch test substances, the evaluation parameters RI and PR were not significantly affected by tape stripping. Eighteen test substances in the intervention group and 16 in the historical control group had good reaction profiles, which means they had a low percentage of weak positive reactions among all positive reactions, and low relative proportions of questionable, follicular or irritant reactions. In other words, they showed a good discriminatory power (21) between allergic and unclear reactions. The remaining test substances did not have such good reaction profiles in either the intervention group or the historical control group (Table 4). This information is helpful for physicians who are less experienced in patch test scoring, because these substances require more caution in interpreting their reactions and evaluating their clinical relevance (14, 22, 23). However, the RI and the PR do not, in themselves, make the assessment of an individual patch test reaction automatic (21).

Astonishingly, little work has been published on the penetration of patch test substances into the living epidermis (24). Hitherto, the permeation characteristics of nickel salts seem to have been best investigated (25, 26). Nickel ions penetrate the intact stratum corneum slowly and poorly. In our study, nickel sulfate, cobalt chloride and potassium dichromate uniformly showed a lower PR in the intervention group. In addition, potassium dichromate showed a considerably increased RI. These results indicate that there may be higher bioavailability of metal ions in tape-stripped skin.

When we compared RIs and PRs of the historical control group patch tested conventionally with data from the literature from Germany (27) and the United States (22), we saw no significant differences. Hence, we can largely exclude any bias caused by special reading habits in our clinics.

We also conducted subgroup analyses to determine whether skin irritability at the time of patch testing, as indicated by a positive irritant control test result with

SLS, or atopic dermatitis status modify the reaction profiles. It was remarkable that significantly more patients had an irritant reaction to SLS in the historical control group than in the intervention group. One might have expected the opposite, that is, more irritant reactions in test areas with an epidermal barrier that was pre-damaged by tape stripping. A possible explanation for this phenomenon is that the effective monomer concentration of SLS in the stratum corneum is reduced considerably by tape stripping (28). Because of the binding of SLS to keratin, a higher monomer concentration may be available in the intact stratum corneum, producing more noticeable irritant effects. Additionally, there are epidemiological data in the literature (29, 30) providing evidence that SLS reactivity is increased by cold and dry air during the winter. However, from our data – both study periods comprised 2.5 years, and therefore covered winters in a comparable manner – we assume that any influence of seasonal variations on irritant control testing with SLS is comparable between both groups, that is, negligible for the overall outcome. When we compared patch test results of patients with and without irritant reactions to SLS, we found no significant differences in either the intervention group or the historical control group. There was only a trend towards lower RIs and higher PRs, respectively, in patients with a positive SLS test result, which is in line with data from the literature (21, 31). In patients with past or present atopic dermatitis, follicular patch test reactions, most likely of an irritant nature, are commonly described for the metal salts nickel sulfate, cobalt chloride, and potassium dichromate (23). However, we could not see any significant decreases in RIs for these patch test substances in atopic dermatitis patients in either group. Obviously, these follicular reactions do not occur frequently enough to affect the statistical analysis of our data.

We acknowledge some potential limitations of this study. First, it was not feasible to perform a conventional patch test and a strip patch test synchronously in the same patient. We are aware that this would have been perfect for a direct comparison of reaction profiles. Second, although the study groups were rather large, the effective sample sizes, that is, patients with non-negative reactions, were rather small, resulting in large 95% CIs of RIs and PRs, thus hampering the detection of significant differences.

In conclusion, according to our results, the discriminatory power (21) of patch test substances of the DKG baseline series is not, generally, substantially increased by tape stripping the skin prior to patch testing. In contrast, with fragrance mix II and *M. pereirae*, more unwanted reactions must be expected. Therefore, general use of the more

time-consuming strip patch test in routine screening cannot be recommended. However, if conventional patch test results are presumed to be false-negative, the strip patch test can be recommended, independently of the standard patch test substance.

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