



REVIEW ARTICLE

EAACI position paper for practical patch testing in allergic contact dermatitis in children

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Based on consensus, the EAACI Task Force on Allergic Contact Dermatitis in Children produced this document to provide clinical information, the standardization of patch test methodology, and suggestions for future research in the field. No evidence-based consensus guidelines for patch testing in children with suspected allergic contact dermatitis (ACD) exist. This paper is complementary to our recently published review on patient education and prevention of ACD in children (1).

Abstract

Introduction: Allergic contact dermatitis (ACD) in children appears to be on the increase, and contact sensitization may already begin in infancy. The diagnosis of contact dermatitis requires a careful evaluation of a patient's clinical history, physical examination, and skin testing. Patch testing is the gold standard diagnostic test.

Methods: Based on consensus, the EAACI Task Force on Allergic Contact Dermatitis in Children produced this document to provide details on clinical aspects, the standardization of patch test methodology, and suggestions for future research in the field.

Results: We provide a baseline list of test allergens to be tested in children with suspected ACD. Additional tests should be performed only on specific indications.

For the purpose of this paper, we use the term 'allergens' synonymously to haptens to refer to substances causing contact allergic responses. We are not aiming to distinguish different mechanisms of contact allergic reactions.

Allergic contact dermatitis (ACD) in children appears to be on the increase (2), and contact sensitization may already begin in infancy. Patch testing is the gold standard diagnostic test in adults, but at present, there are no consensus guidelines for

patch testing in children (3, 4). The results of particular studies are difficult to compare due to variation in patch test methodology, allergens tested, study population demographics including regional referral patterns and selection criteria for patch testing, and regional differences in exposure to potential allergens (5–10).

The variety of clinical manifestations and allergens causing ACD in children combined with differences in the methodology could lead to incorrect interpretation of results and treatment. It is therefore of great importance that children are patch-tested using a standardized protocol.

Methods

A qualitative and narrative review of the literature on the use of patch test for ADC in children was carried out to account for the diversity and variable quality of relevant studies. This precluded systematization, and an expert panel group discussion method was used. We report in Appendix 1 the search strategies applied. These papers were discussed by a panel of experts in dermatology, pediatrics, and allergology. Apart from those papers we found in these searches, additional literature recognized by members of the Task Force was also included. Each paper was evaluated by at least two experts in the field. Conclusions were evaluated, leading to this consensus paper.

We combined results from this literature with the expert opinion to develop a position paper for practical patch testing in children with suspected allergic contact dermatitis.

As our goal was to focus on practical patch testing, and due to the nature of the literature in the field, it was not our intention to perform a systematic review with evidence grading. So, this paper has been developed on the basis of a thorough literature review and repeated expert group discussions.

Investigation of ACD in children and adolescents

The diagnosis of contact dermatitis requires careful evaluation of a patient's clinical history, physical examination, and various types of skin testing (patch tests, photopatch tests, and repeated open application tests [ROATs]). A thorough knowledge of the clinical features of the skin's reactions to various external substances is important in making the correct diagnosis of contact dermatitis, as well as being able to differentiate other skin conditions, for example bacterial or fungal infections, scabies, endogenous eczema, and the Köbner reactions on the hands of patients with psoriasis, which can mimic both irritant contact dermatitis (ICD) and ACD. Therefore, patch testing is best performed by a clinician with a sound basis in dermatology who has undergone specific training in the investigation and the management of contact dermatitis (11).

Clinical history

A clinician must have a high level of suspicion that the dermatitis has been caused or exacerbated by an external agent. The patient is often convinced of this, but usually thinks it to

be of an allergic nature, whereas most contact dermatitis is caused by skin irritation (12). Moreover, most ICD occurs as a result of cumulative exposure, but the patient only recognizes the final insult after a whole series of irritant exposures. Domestic or leisure activities may be wholly or partly responsible for the dermatitis.

The exposure to irritants may be more damaging in cases with a constitutionally compromised skin, for example, found in atopic subjects. Therefore, the history should include all contributory factors:

- personal history of eczema and other atopic manifestations;
- family history of atopy;
- details of other skin conditions, past and present;
- known allergies;
- hobbies and leisure activities;
- after-school work in adolescents;
- topical and systemic medications used (prescribed and over the counter);
- use of or exposure to cosmetics and skin care products.

Clinical diagnostic tests

Patch testing

Patch testing is indicated to confirm ACD in cases where ACD is suspected from the pattern or distribution of the eczema (Table 1) as well as to exclude ACD as a complicating factor in persistent cases of eczematous disease, such as atopic dermatitis (AD; syn. atopic eczema) and vesicular hand dermatitis. It is particularly important to suspect ACD in chronic cases of dermatitis that are unresponsive to appropriate treatments, even in preschool children. The child may have developed sensitization to topically applied drugs (e.g., steroids, antibiotics) or excipients (e.g., emulsifying agents/preservatives), and patch test should be considered. It is a relatively inexpensive and safe procedure, but it requires skill and experience to interpret the results and to attribute relevance to any positive findings. Furthermore, negative patch test results do not fully exclude allergic contact dermatitis. False-negative reactions

Table 1 Patterns of dermatitis for which patch testing is indicated

Patterns of dermatitis	Suspected allergens
Facial dermatitis (inc. eyelids)	Cosmetic ingredients: fragrances, preservatives, and medicaments
Chronic otitis externa	Medicaments
Cheilitis	Cosmetic ingredients, flavorings
Flexures	Cosmetic ingredients, textile dyes
Hands	Cosmetic ingredients, rubber chemicals, plant materials
Anogenital	Medicaments and cosmetic ingredients
Feet	Footwear materials including chromate, rubber chemicals
Photosensitive dermatitis	Sunscreens, cosmetic ingredients, medicaments
Airborne dermatitis	Volatile cosmetic ingredients, plant materials

can for instance be due to a 'missed' allergen which may be picked up by detailed history taking.

Selection of patch test materials: The history and clinical examination of a patient will usually provide clues to the possible sensitizers and should guide the choice of patch test materials (see Table 1). Unfortunately, it is not sufficient to patch test with only suspected allergens, as unsuspected ones frequently also turn out to be relevant. A 'baseline series' of allergens most frequent in the given population should be applied in the evaluation of all patients suspected to have ACD.

The current European baseline series for adults is recommended by the European Environmental Contact Dermatitis Research Group (EECDRG) (13, 14, 15, 16).

A range of patch test concentrations for use in children have been discussed in the literature. Most authors use the same concentrations as those in adults. However, the risk of irritant reactions must be carefully considered, particularly when testing infants with metal salts (17, 18, 19).

Many patch test substances are available from suppliers, and others may be made up from the patient's own materials. If the patient's own products are manufactured for direct application to the skin ('leave-on products'), they can be tested 'as is', that is, without dilution. Products that are designated as 'rinse-off' products such as soaps and detergents should be diluted in water to a concentration of 1–10%, or should be tested as individual ingredients according to allergens included in the product.

It is sometimes necessary to obtain constituent ingredients directly from the product manufacturer in order to identify the causative allergen. This way, new sensitizers may be identified for further evaluation. Some non-irritant or highly sensitizing identified plant materials may also be applied directly. These should be 1 cm × 1 cm squares of leaf or 1 cm lengths of stem, root, etc. The sample should be crushed with a pestle. Many plants are irritants, for example, the Brassicaceae family, and patch testing with known plant irritants is not recommended (20).

Testing with materials brought in by the patient/parents requires information on the exposure conditions, composition, sufficient chemical knowledge, and experience to avoid testing with irritants and corrosive compounds. It is mandatory to carefully consider the choice of patch test concentration and vehicle when testing with materials which are not standardized (21–23).

Test technique: The technique involves the cutaneous application of a small amount of the suspected allergen in a suitable concentration and vehicle. A small amount of each test substance dissolved in petrolatum (approximately 50 µg) is deposited from the syringe into the chamber such that it fills the well of the disk, but does not extrude when the patch is fixed on the back. For aqueous-based allergens, small filter papers are placed in the well and will hold around 15 µl of liquid. Micropipetting the liquid allergen is recommended. The adhesive tapes with test allergens are applied on the patient's back (Figure S1) for 2 days. For a small number of test substances, for example, when retesting, the outer aspect of the upper arm is also acceptable. False-negative test results can be obtained when testing on the lower back or on the volar

forearms. Even the sequence of allergens should be carefully selected so that those frequently causing strong, cross- or concomitant reactions are not adjacent to one another.

The basic concept of using allergen mixes (e.g., fragrance mix) instead of single allergens is to save time and space, in case of substances that are chemically related or typically occur in the same sources. The patients should be instructed not to bath or shower for the duration of the test and to avoid exercise that is likely to dislodge the disks or cause excessive sweating.

Patch testing should not be performed under circumstances that may interfere with the results. These are, for example, intensive UV exposure, immunosuppressive or immunomodulating drugs such as glucocorticoids or cyclosporine or acute dermatitis. In general, patch testing at skin sites presenting currently or recently any type of dermatitis should be avoided if possible, to avoid false-positive reactions and/or the excited skin syndrome.

In general, systemic corticosteroids (CS) or immunosuppressive therapy should be discontinued before patch testing, with the time interval depending on the dose and half-life. However, in the literature, little data are available on the effect of immunosuppressive agents and allergic patch test reactions (24, 25), and apart from prednisolone (26, 27), no studies have compared reactions before and during treatment with immunosuppressive drugs. Most suggest that immunosuppression may result in false-negative reactions. While strong positive reactions may remain unchanged despite immunosuppression, weak reactions may be masked. Topical CS has also been shown to weaken the patch test response, depending on the potency, and they should be discontinued at the site of patch tests at least 3 days before testing (28). If allergy is still suspected after negative results, options include retest and readings for late reactions.

Reading patch tests: It is strongly recommended that two readings are carried out, the first after removal of the patches (on day 2) or at day 3 and the second on days 2–5 later (29). Contact sensitizers that frequently cause late positive patch test reactions include neomycin, CS, and sometimes methylchloroisothiazolinone/methylisothiazolinone (30, 31).

If practical or geographical circumstances permit only one reading, then the present accepted compromise is reading on day 3 or 4, that is, 24–48 h after the removal of the patches (32, 33). Patients must also be instructed to report late reactions as these can occur as late as 3 weeks after the test.

The internationally accepted recording system for reading patch tests was originally developed by the International Contact Dermatitis Research Group (ICDRG) (34) and is shown in Table S1. Figure S2 shows a positive patch test result in a child at day 4. Difficulties in distinguishing weak allergic from irritant reactions occur frequently. Such uncertainties should be handled by supplementary tests such as dose-response tests, serial dilutions, and repeat open application tests (35). In the final decision, the interpretation of positive reactions must also be related back to the clinical history.

The next step involves deciding whether the sensitizer is of current relevance to the patient's presenting problem or whether it represents an 'immunological scar' from a previous problem. For example, the patient may have eczema on the

face and be allergic to the preservative in the cream used on the face, which is of current relevance due to the use of the topical preparation(s). The same patient may also have a nickel-positive reaction, which is of past relevance. Sometimes, it is impossible to attribute relevance, and this is then recorded as unknown relevance. Assessing relevance is always the most difficult and intricate part of the test procedure, and the clinician's skill and experience are crucial.

It is not possible to apply absolute rules for determining the relevance of an allergic reaction (36). A practical system of assessing the clinical relevance of a positive patch test is the COADEX scale (Table 2).

Difficulties in interpretation and complications in patch testing: Apart from the difficulties in distinguishing allergic from irritant reactions and ascribing the relevance of an allergic reaction, there are still some additional pitfalls that the investigator should be aware of. Some allergic reactions are 'cross-reactions' to other allergens, for example, paraphenylenediamine, used as a hair dye reagent, may cross-react with other substances that have an amino group in the *para* position such as benzocaine, a local anesthetic or disperse orange 3, a common textile dye. This occurs when the allergenic part of the molecule is similar in different substances and forms a similar allergen that is indistinguishable to the immune system.

Atopics are also particularly prone to non-specific (erythematous) patch test reactions (37), and irritation occurs quite often, for example, to the metals nickel, cobalt, chromate, wool alcohols (lanolin). However, AD patients develop ACD just as frequently as non-atopics (7–9, 38, 39).

Sometimes, there may be false-positive (Table 3) and false-negative (Table 4) reactions, which are dose dependent. There are also occasional complications from patch testing (Table 5).

Enhanced skin reactivity may be seen in patients with both active dermatitis and strong positive allergic patch test reactions. Mitchell (40) coined the term 'angry back syndrome',

Table 2 The COADEX system for assessing clinical relevance

Code	Meaning
C (current)	Current relevance: The patient has been exposed to the allergen prior to the current episode of dermatitis, improvement of the disease after cessation of exposure
O (old)	Old or past relevance – past episode of dermatitis from exposure to the allergen, but not encountered before present relapse
A (active sensitization)	Actively sensitized – patient presents with a sensitization reaction
D (doubtful)	Relevance difficult to assess, no traceable relationship between the positive test and the disease
E (exposed)	History of previous exposures that did not cause dermatitis
X (cross-reaction)	The positive test is due to a cross-reaction with another allergen that is of clinical relevance

Table 3 Causes of false-positive reactions

Too high concentration of tested allergen
Impure substance (contamination)
Irritant vehicle
Too much test substance applied
Uneven dispersion of allergen in the vehicle
Current or recent dermatitis at the patch test site (refraction phase)
Pressure effect of hard materials (e.g., aluminum disk in Finn Chambers)
Adhesive tape reactions
'Angry back' reaction causing intensification of weak irritants

Table 4 Causes of false-negative reactions

Too low concentration of tested allergen
Insufficient amount applied
Wrong vehicle
Allergen not in an active form, for example, insufficiently oxidized for some fragrance chemicals
Insufficient occlusion
Poor adhesion of patches
Patches applied to wrong site
Degraded test substance
Pre-treatment of the patch test site with UV light, topical corticosteroids (CS), or immunomodulators
Systemic treatment with systemic CS or immunomodulators
Failure to include late readings

Table 5 Possible complications of patch testing

Active sensitization
Irritant reactions from inadequately diluted patient's own products
Flare of dermatitis at site the of patch testing
Flare of dermatitis at previous contact sites
Persistent patch test reactions
Cutaneous hyperpigmentation or hypopigmentation following strong patch test reaction

which describes multiple false-positive patch test reactions that are not reproducible when repeated separately.

The non-reproducibility is blamed on the presence of other strong positive tests and/or inflamed skin elsewhere. As hyper-reactivity is not restricted to the back, 'excited skin syndrome' may be a more appropriate term. A positive patch test reaction may be accompanied by a specific flare of an existing or preexisting dermatitis that was caused by the test allergen.

The term 'compound allergy' is used to describe patients who are patch test-positive to formulated products, usually cosmetic creams or topical medicaments, but test-negative to all the ingredients when tested individually (41). This phenomenon may sometimes be explained by irritancy of the original formulation, but in some cases, it was demonstrated that reactivity was because of the combination of constituent ingredients forming reactive products (42). Another reason may be that the ingredients were patch-tested at concentrations that were too low to elicit a true positive reaction (43). In cases

where there is a strong suspicion of ACD, yet negative patch tests to individual analytical-grade constituents, it may be preferable to obtain the actual manufacturing grade ingredients directly from the company.

One of the most serious adverse reactions from patch testing is sensitization induced by the procedure itself (active sensitization). However, this is considered to be a very rare occurrence. Traditionally, patch test sensitization is detected by a flare reaction at the test site 10 days after application (44). On repeated testing, the reaction is usually already positive by days 2–4. Late reactions appearing after day 7 may also be explained by a delayed immune response (45, 46).

Photopatch tests

Photosensitivity disorders in children are uncommon. Photosensitive dermatitis is defined as a photodistributed eruption that may result from topical or systemic exposures to photosensitizers. Only a few cases of photoallergic contact dermatitis have been reported (47–50). Photopatch tests in children should be strictly limited to cases with high suspicion of photocontact dermatitis.

Repeated Open Application Tests

These are very useful when patch tests with suspected allergens (or complex products, e.g., cosmetics) continue to yield negative results despite a suggestive history, or when the relevance of a patch test reaction is in question (16). In this test, substances are applied twice daily for 10–14 days (up to 3 weeks), on the flexor aspect of the forearm near the cubital fossa, unless dermatitis appears earlier (51). The test is positive if a clinical dermatitis develops (16, 52).

Advice and counseling

Patients require a clear explanation on any allergies, where the allergen is likely to be encountered. Patient information sheets on the more common sensitizers and sources of exposure may often be helpful. Patients may also need advice on alternative products that they can use safely and on complicating factors. For example, atopic children and those with recent AD will need to understand their continuing susceptibility to irritants.

Which allergens to test for

Recommendations for patch testing in children have been controversial. Compared to adults, children are exposed to a different array of products. When selecting of allergens for testing in pediatric patients, one must conduct intensive thorough investigation of the child's environment (53). Optimal patch test procedures for evaluating children with ACD have yet to be standardized.

In 1999, Roul et al. (54) recommended testing 17 major allergens in children up to 6 years of age, while in older children using a restricted European Standard series excluding primin, quinoline, benzocaine, clioquinol, and salol, as these appeared to be not relevant in their experience.

The frequency of sensitization to the most common sensitizers in children (6–12 year) and adolescents (13–18 year) was evaluated by the German dermatology departments (German

Contact Dermatitis Research Group) to formulate guidance for patch test series in children in 2004 (55). The frequency of sensitization to the top 10 sensitizers was partly comparable and partly quite different between the age-groups. The most frequent positive patch test results in children were thimerosal, benzoyl peroxide, phenylmercuric acetate, gentamicin sulfate, nickel II sulfate, ammoniated mercury, cobalt II chloride, fragrance mix, bufexamac, compositae mix, propylene glycol and the solvent oil of turpentine. In children, the frequency of positive patch test results in this study to benzoyl peroxide, phenylmercuric acetate, gentamicin sulfate, ammoniated mercury, cobalt chloride, and bufexamac was remarkably higher than in the older age groups, whereas the frequency of sensitization to p-phenylenediamine was low in younger children (56).

The recommendation for patch testing in children and extra patch testing in children, according to clinical history and allergen exposure by the EAACI Task Force Allergic Contact Dermatitis in Children is summarized in Table 6a,b.

Supplementary patch tests are advised to be undertaken on indication. Consider adding methylisothiazolinone (MI), Lyral on its own, cetostearyl alcohol especially in cases of suspected medicament allergy. Lanolin is a good emulsifier. It is particularly useful in the manufacture of pharmaceutical and cosmetic formulations. Lanolin may be the cause of ACD in children using formulations with this emulsifier (1).

Consider, for example, oxidized limonene linalool, tea tree oil, benzalkonium chloride added to many bath emollients, carba mix from shoes too, methylisothiazolinone (baby wipes a.o). Leave-on products can be tested 'as is', rinse-off products have to be diluted to prevent irritating reactions. These products should be tested in at least five controls to help evaluate any positive reactions.

Differential diagnosis of ACD in children

Most important differential diagnoses involve other kinds of dermatitis (eczema; the term eczema/dermatitis is being used synonymously), but sometimes non-eczematous dermatoses that have clinical features similar to those in contact dermatitis can mimic contact dermatitis too. The long list of differential diagnoses of ACD is best considered in the context of specific sites. Further clues to delineate other important dermatoses are summarized in Table S2.

Other important considerations in ACD in children

Neither sex nor the presence or the absence of AD seemed to influence the individual risk of ACD in children.

Factors that may influence early contact sensitization in children are atopy, in particular AD, other factors inducing skin barrier defects, and contact at an early age with several allergens that are able to sensitize children. Recently, the key role of the protein filaggrin (FLG) in maintaining an effective skin barrier against the external environment was reported. Individuals with FLG mutations appeared to have an increased risk of nickel sensitization. Most likely, similar associations will eventually be seen for some other contact allergens (57–60).

Table 6 Recommendation for (a) standard series of patch testing in children (EAACI Task Force Allergic Contact Dermatitis in Children) (b) additional patch testing in children, according to clinical history and allergen exposure (EAACI Task Force Allergic Contact Dermatitis in Children)

Recommended allergens to be tested as standard series in children	Test concentration
Nickel sulfate	5.0% Pet
Thiuram mix	1.0% Pet
Colophonium	20% Pet
Mercaptobenzothiazole	2.0% Pet
Fragrance mix I	8.0% Pet
Fragrance mix II	14.0% Pet
Mercapto mix	1.0% Pet
Chlor-Methylisothiazolinone (Methylchloroisothiazolinone/ Methylisothiazolinone)	100 ppm Aq
Sesquiterpene Lactone Mix	0.1% Pet

Recommended allergens for additional patch testing in children, according to clinical history and allergen exposition	Test concentration (%)
p-tert-butylphenol formaldehyde resin*	1.0 Pet
Potassium dichromate*	0.5 Pet
Wool alcohols*	30 Pet
p-Phenylenediamine*	0.5 Pet
Disperse blue 106*	1.0 Pet
Tixocortol pivalate*	1 Pet
Budesonide*	0.1 Pet
Bufexamac*	5.0 Pet
Neomycin*	20 Pet
Dibromodicyanobutane (Methylidibromo glutaronitrile)*	1.0 Pet
Compositae mix*	2.5 Pet
Hydroxymethylpentylcyclohexenecarboxaldehyde (Lyrall)*	5 Pet

*Test mainly indicated when history suggests exposition to:
 -shoe allergens (p-tertiary-Butylphenol-formaldehyde resin, potassium dichromate)
 -skin care products (Wool alcohols (lanolin component), hydroxymethylpentylcyclohexenecarboxaldehyde)
 -topical corticosteroids (Tixocortol pivalate, Budesonide)
 -clothing (Disperse blue)
 -henna tattoos (p-Phenylenediamine)
 -plants (compositae mix)
 -cosmetics (Dibromodicyanobutane), Methylidibromo glutaronitrile (Dibromodicyanobutane = Methylidibromo glutaronitrile)
 -exposure in history (Bufexamac, Neomycin)

The role of contact allergy in AD patients is frequently underestimated. Many of the ingredients in emollients are potential contact sensitizers. Systematic patch testing is a necessity in children with moderate-to-severe AD whose condition is refractory to treatment or whose history is suggestive of ACD. Moreover, given the high prevalence of sensitization to the same allergens a decade later, prevention through exposure avoidance from an early age to the most

frequent contact sensitizers, especially fragrances in patients with AD, is very important. Topical treatment of AD is associated with cutaneous sensitization, although the prevalence is not high (61, 62).

In cases of persistent foot eruptions or sharply demarcated dermatitis on lower legs, ACD because of allergens in shoes or shin guards should be considered. However, identifying the presence of sensitizers in footwear remains a challenge. There are no legislative measures to force manufacturers to disclose constituents of footwear, and the final assembler of the footwear may not have information regarding specific ingredients. Rubber additives and potassium dichromate are the most frequently identified causes.

It is important to patch test children with dermatoses affecting the feet, including the soles. A history of atopy or a diagnosis of juvenile plantar dermatosis (JPD) should not deter investigation.

Reports of true allergy to shin guards are sparse. Irritant contact dermatitis is in most cases mentioned as the cause of the sharply demarcated dermatitis on the lower legs. However, some of the irritant suspected patients also showed true sensitization. In the shin guards, rubbers and thioureas are the most common allergens.

Children's clothes are usually of a brighter color than adult's garments. The most common allergens present in children's textile dermatitis are disperse dyes.

Toys are another potentially important source of allergen exposure in children (53, 63, 64) and also toy-cosmetic products, such as perfumes, lipstick, and eye shadow.

It is important to also point out the potential of 'connubial' dermatitis: facial eczema caused by mothers cosmetics or fine fragrances when the child is being carried and there is cheek to cheek contact.

Clinical relevance and prognosis

The interpretation of patch test results is challenging, as false positive and false negatives occur, in addition to true positives that are not relevant in the context of the presenting skin complaint.

Prognosis

In a study to follow the course of nickel allergy and clinically relevant nickel dermatitis over 15 years from adolescence to adulthood, a high prevalence and a high incidence rate of nickel allergy have been found in the study population, despite implementation of the nickel regulation in Denmark. Most reactions from childhood could be reproduced and were clinically relevant, indicating persisting allergy (65, 66).

Table 7 Indications for patch testing in children

Suggestive history
Suggestive clinical distribution of skin lesions
Severe eczema, especially if unresponsive to topical therapies
Hand or foot eczema
Therapy-resistant (atopic) dermatitis

Recommended indications for patch testing in children

The Grading of Recommendations Assessment, Development and Evaluation (short GRADE) guidelines are the accepted standard guidelines in every field of clinical medicine. However, the traditional consensus-based guidelines are acceptable. This is in particular true in a field where research has been developed only in the last few years, as in the field of allergic contact dermatitis in children. With this limitation in mind, the EAACI Task Force on Allergic Contact Dermatitis in Children produced this document based on consensus.

Children should be tested strictly based on the indication, using a standardized procedure, keeping in mind the limited surface available and the potential risk of active sensitization. In Table 7 indications for patch testing in children are summarized.

Conclusion

A diagnosis of allergic contact dermatitis requires careful evaluation of a patient's clinical history, physical examination, and various types of skin testing (patch testing, photopatch testing, repeated open application tests (ROATs)). The history and the examination of a patient will usually provide clues on

the possible sensitizers and should guide the choice of patch test materials. Children should be tested strictly based on the indication using a standardized protocol. Patch testing may best be performed by a clinician with a sound basis of dermatology who has undergone specific training in the investigation and the management of contact dermatitis. It is very important to remember that ACD in children is not rare, and should always be considered when children with recalcitrant eczema are encountered. Based on consensus, the EAACI Task Force on Allergic Contact Dermatitis in Children produced this document to help standardize clinical activity, standardize patch testing methodology, and to help guide future research in the field. In this paper, we present a basic list of allergens that are advised to be tested in children with suspected allergic contact dermatitis, partly dependant on suspected history. Additional tests should be performed only on indication (clinical history or clinical findings, age). It is advisable to adjust the baseline series to the exposure patterns and epidemiology in a given country or region. In each country, the list should be extended with country-based common allergens.

More studies in unselected populations are still necessary to obtain more information on the population-based burden of ACD in children, using a standardized methodology.

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Appendix 1

Electronic Search Strategies: this strategy returned 576 items

MEDLINE (Ovid)

Date of search: November 30, 2014

- 1 Contact dermatitis/
- 2 Allergic contact dermatitis/
- 3 Contact allergy.tw.
- 4 Contact hypersensitivity.tw.
- 5 Hand eczema.tw.
- 6 Infant eczema.tw.
- 7 1 or 2 or 3 or 4 or 5 or 6
- 8 infants.mp.
- 9 newborns.mp.
- 10 paediatrics.mp.
- 11 child.mp.
- 12 8 or 9 or 10 or 11
- 13 Diagnosis/
- 14 Differential diagnosis/

- 15 Diagnosis treatment/
- 16 Diagnosis criteria/
- 17 human/
- 18 13 and 14
- 19 13 and 14 and 15 and 16
- 20 13 not 16
- 21 14 not 16
- 22 Patch test.tw.
- 23 Patch tests.tw.
- 24 Patch testing.tw.
- 25 Atopy patch test.tw.
- 26 Atopy patch tests.tw.
- 27 Patch test results.tw.
- 28 Contact dermatitis patch test.tw.
- 29 Patch test food.tw.
- 30 Patch test atopic.tw.
- 31 Patch test contact.tw.
- 32 Patch test children.tw.
- 33 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32

Supporting Information

Additional Supporting Information may be found in the online version of this article:

Figure S1. Child with patch tests on the back.

Figure S2. Positive patch test result in a child at day 4.

Table S1. Recording of patch test reactions according to the International Contact Dermatitis Research Group.

Table S2. Delineation of differential diagnoses in children with suspected Allergic Contact Dermatitis (ACD).