

A guide to performing skin-prick testing in practice: tips and tricks of the trade

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Abstract

Atopy can manifest in childhood as infantile eczema (atopic dermatitis), allergic rhinitis and asthma. In practice, it is critical to identify the offending allergen in atopic individuals. This will not only influence therapeutic interventions, but may also have a significant impact on the individual's quality of life. The most common clinical test for allergy detection is the introduction of an allergen directly into the skin in the form of a skin-prick test. Skin-prick testing is recommended in the diagnostic workup for allergies because it is reliable, safe, convenient, inexpensive, minimally invasive, and has the advantage of multiple allergen testing in one, 15- to 20-minute, test. Skin-prick testing can be performed from birth onwards. Although there is a small risk of developing anaphylaxis, the test remains safe to perform in a consultation room or at the patient's bedside. Worldwide, a skin-prick test remains the test of choice for allergy because of its convenience and cost-effectiveness. A globally accepted guideline for skin-prick testing is still lacking and would be beneficial to both patient and physician.

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Introduction

Allergy is defined as an exaggerated immune response to a specific protein allergen in the environment. Atopy is defined as the predisposition of certain allergy-prone individuals to produce specific immunoglobulin E antibodies to environmental allergens. Atopy can manifest in childhood as infantile eczema (atopic dermatitis), allergic rhinitis and asthma.

In practice, it is critical to identify the offending allergen in atopic individuals. This will not only influence therapeutic interventions, but may also have a significant impact on the individual's quality of life. The most common clinical test for allergy detection is the introduction of allergen directly into the skin in the form of a skin-prick test. Skin-prick testing is usually the first choice in the diagnostic workup for allergies because it is reliable, safe, convenient, inexpensive, minimally invasive, and has the advantage of multiple allergen testing in one 15- to 20-minute test.¹⁻⁴ Skin-prick testing is also far less traumatic, particularly to children, compared to venopuncture which is used in radioallergosorbent (RAST) testing, e.g. ImmunoCAP®. There is a good correlation between skin-prick testing and ImmunoCAP® RAST testing of between 85-95%, making skin-prick testing an excellent diagnostic tool.^{2,4,5} It has a positive predictive value ranging from 95-100%.^{3,4,6,7}

Skin-prick tests are used to confirm a diagnosis of both suspected food and/or aeroallergen sensitivities. Commonly tested aeroallergens include house dust mites, pet dander,

pollens and moulds.^{1,3,6-9} Common food allergens in children include cow's milk, hen's egg, wheat, soy, codfish and peanuts, while shellfish, nut and fruit allergies are more common in adults.^{1-3,6-9}

The most important step in allergy diagnosis is obtaining a detailed history. The history provides clues to choosing which allergens should be tested. This should include a detailed medical history of the child and a family history, which must include the history of allergy in first-degree relatives of the individual, e.g. parents and siblings. Skin-prick testing should be used to confirm a suspected allergy. A clinical examination is the next important step. According to clinical findings, certain allergens should be considered for testing (Table I).

Indications for a skin-prick test

Identifying sensitisation to specific allergens is important in the treatment of the patient and enables the physician to institute an action plan. Skin-prick testing is important for the early detection of those at risk of developing asthma, allergic rhinitis or other allergic disease. Early detection of food allergen sensitisation reduces the risk of a patient developing food-related anaphylaxis.⁶ Since skin-prick test results are immediately available, the physician can educate the patient on specific allergy avoidance, treatment, and if indicated, desensitisation. The avoidance strategy of known trigger factors might aid in reducing the frequency of episodes.^{3,8,9} Immunotherapy or desensitisation is usually

Table I: Allergens for testing according to the different age groups^{8,9}

Disease or symptoms	Relevant allergens in relation to age	
Atopic dermatitis	< 3-4 years	> 3-4 years
	<i>Foods:</i> <ul style="list-style-type: none"> Cow's milk Egg white Peanuts, wheat, nuts and fish 	<i>Foods:</i> <ul style="list-style-type: none"> Cow's milk Egg white Peanuts Wheat, nuts and fish
Persistent and intermittent conjunctivitis, rhinitis and/or recurrent wheezing or asthma	<i>Inhalant allergens:</i> <ul style="list-style-type: none"> House dust mites Pollen Cats, dogs and other animals with fur 	<i>Inhalant allergens:</i> <ul style="list-style-type: none"> House dust mites Pollen Cats, dogs and other animals with fur
	<ul style="list-style-type: none"> House dust mites Cats, dogs and other animals with fur Pollen <i>Others:</i> Relevant food allergens, e.g. cow's milk and egg, especially in young children 	

considered in patients with grass pollen, house dust mite, or very occasionally, pet sensitivity, or in those who don't respond to conventional therapies.^{3,6,8-10}

Skin-prick testing has the following advantages:

- It is inexpensive and cost-effective.
- There is no lower age limit.^{8,9}
- More than one allergen can be tested simultaneously.
- The results are immediately available.
- It is minimally invasive.
- It is safe.
- It is generally more sensitive than ImmunoCAP® RAST.
- It is reliable.
- It is convenient.
- It has good reproducibility.
- It is readily accessible.
- It can be performed in the consultation room.
- It is easy to perform.

Although skin-prick testing has many advantages over ImmunoCAP® RAST testing, there are some drawbacks in that some drugs may interfere with skin-prick testing, and therefore limit its reliability (Table II). There is some controversy in the literature as to whether or not systemic corticosteroids influence the reading of skin-prick tests. Generally, skin-prick tests are attempted, but if the results are negative, the test can be repeated a week or two after the steroids have been discontinued.

Contraindications

Although skin-prick testing is safe to perform on most individuals, there are some disqualifying factors and conditions:

- Severe atopic dermatitis over most of the testing area.
- Dermatographism.
- A severe reaction to nuts, horse hair, latex or a food allergen (unless conducted in an intensive care unit setting).
- Fear of needles. (If handled correctly, most children overcome this).

Table II: Drugs that may interfere with skin-prick testing

Drug	Withhold prior to testing
Antihistamines	
First-generation histamine-1 blocker, e.g. Hydroxyzine®	> 2 days
Second-generation histamine-1 blocker, e.g. Cetirizine® and Loratidine®	7 days
Ketotifen	> 5 days
Histamine-2 blockers	Do not take on the morning of the test
Glucocorticosteroids	
Topical (in the test area)	> 1 week
Systemic or short term	
< 50 mg/day prednisolone-equivalent*	> 3 days
> 50 mg/day prednisolone-equivalent*	> 1 week
Topical calcineurin inhibitors	> 1 week
Other systemic drugs	
Omalizumab	> 4 weeks
Antidepressants	
Doxepin	7 days
Desipramine	3 days

*: There is very little evidence that systemic corticosteroids interfere with skin-prick testing. However, from our experience, they do have an effect⁴

- Pregnancy.
- An incorrectly stored skin-prick testing kit.
- An inexperienced operator.
- Anaphylaxis to certain allergens. (Patients with *spina bifida* are at higher risk of systemic reactions with latex skin-prick testing).

Equipment

The kit

Skin-prick testing kits are not ready prepared or pre-packed, simply because some allergens are not relevant to all geographical areas.

Kits generally consist of allergens that are most common to the area and standardised lancets. Extra items that may be needed in the kit include cotton wool, alcohol swabs, a measuring tape and a paper towel or tissues.

Before ordering a skin-prick testing kit, it is critical for healthcare practitioners to familiarise themselves with the relevant allergens in their area. (See Table III)

Skin-prick kits are available from certain pharmaceutical companies. These kits are relatively cheap and are charged per allergen. The prices differ depending on the allergen requested. Lancets are included when allergens are ordered. A carry case or container can be ordered at an additional cost.

Table III: Relevant allergens according to the specific provinces in South Africa⁷

Regions	Allergens
All regions	House dust mites (Dermatophagoides 1 and 2) Rye and bermuda grass Mould (Aspergillus, alternaria and cladosporium) Cat and dog
Western Cape	Oak, plane pollen and Blomia tropicalis Epicoccium fungal spore Cockroach (Blatella americana)
Gauteng	Tree pollens, including cypress Cockroach (Blatella germanica)
Farming areas	Zea mays pollen Horse Blomia tropicalis (German cockroach)
Healthcare workers	Latex
Grain industry	Storage mite, wheat and rye

Method and technique of skin-prick testing (Figure 1-4)

Before any testing commences, it should be ensured that the parent or caretaker of the patient understands exactly what the test is for, and how it is carried out. It is recommended that written consent is obtained for all skin-prick testing as it is a procedure. Performing skin-prick testing on children requires a certain skill set. Therefore, it is important that the person performing the test is experienced in dealing with children, and knows how to explain the procedure to them and to talk to them on their level. Explaining to the patient what the test is, and how it works, should also be carried out. In order to obtain accurate results, the patient has to cooperate, so reassuring the patient that the test is not painful and that there is no blood involved will ensure this.

Choosing the test site that is right for the patient is critical. Very difficult children won't sit still for long enough to be tested on the arms, so the back may be an easier test site. Children who are very active and inquisitive normally sit still when the test is performed on the back. The upper thigh can also be utilised in children with severe extensive atopic dermatitis. While drawing the lines, ask the patient to count.

This may be a useful distraction and will help the patient to relax. As the droplets of allergen are applied, tell him or her what is being tested and where it is found (in or around the house). The parent or guardian should instruct the child not to scratch the skin-prick testing area.

The following steps must be followed:

- Choose the most convenient site for the test and clean it with an alcohol swab. The back or the volar side of the forearm can be used.
- Use a ballpoint pen and draw lines at 2 cm intervals from one another (approximately a thumb-width).
- Carefully place the allergen drops next to the lines, and not on the lines.
- Use a lancet to prick the skin beneath every drop. Hold the lancet at an angle of approximately 30-40 degrees to prevent drawing blood from the prick site. A new lancet can be used for every prick, but wiping the lancet clean between pricks is more cost-effective and may save time.
- The testing area can be dried using a paper towel or tissue paper. Care must be taken to blot, and not to wipe, the area dry, and to avoid the cross-contamination of allergens.
- Instruct the patient not to scratch should any of the sites start to itch.
- Read the test within 15-20 minutes.
- The wheal should be measured in three dimensions. A measurement of the flare should also be noted.

A useful tip is to place the negative control first, then the allergens, and only then the positive control. This eliminates the possibility of contaminating either the negative control or the allergens.

Results and measurements

The positive (histamine) control should be measured to ensure the reliability of the test. The wheal must measure 3 mm or more in order to rule out any interfering factors. The negative (saline) control should be measured next to exclude the presence of dermatographism. This reaction must be completely absent.

Aeroallergens are relatively easy to read. Any reaction measuring ≥ 3 mm than the negative control is considered to be positive for sensitivity. The size of the wheal does not relate to the severity of sensitivity to a specific allergen.^{4,6}

Table IV: Cut-off points for food allergens^{6,7,12-14}

Skin-prick testing: 100% positive predictive value for food allergy		
Food allergens	Children < 2 years (wheal diameter), mm	Children > 2 years (wheal diameter), mm
Cow's milk	6	> 8
Egg	5	> 7
Peanut	4	> 8

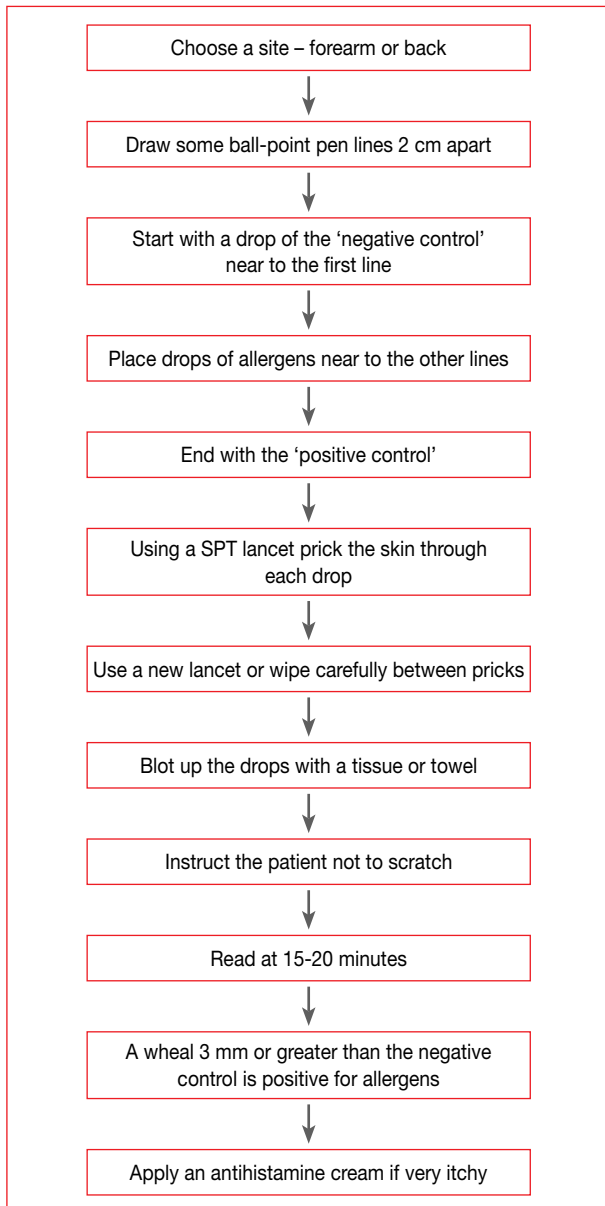


Figure 1: An Approach to Skin Prick Testing

Food allergens are easy to measure, but should be interpreted by taking the patient's age into consideration, as well as considering cut-off points determined from positive predictive values from randomised double-blind food challenge testing by Sporik et al (Table IV).^{11,12} These cut-off points simply eliminate the need for food challenge testing, but if not met, do not exclude clinically relevant sensitisation.

Muscle relaxants and opioids may result in false positive reactions. Therefore, it is important to obtain a complete drug history in the history taking. Falsely diagnosing a patient with allergies can have a major negative impact on the patient and his or her family.



Figure 2: SPT on the forearm



Figure 3: SPT on the back



Figure 4: SPT reactions

Indications for referral to an allergy specialist

Although skin-prick testing can be performed and allergies treated by a general practitioner, certain individuals might need referral to a specialist allergy clinic or allergologist.

Indications include:

- Uncertainty about the allergy diagnosis.
- The unavailability of specific tests required in relation to an individual.
- Difficulty in interpreting the results.
- When complex or multiple allergies are suspected.
- When there has been a previous anaphylactic reaction.
- In the case of severe angioedema.
- In the event of suspected anaesthetic- and drug-related allergies.
- When there is a need for food and/or respiratory challenge testing.

Controversies in the literature

Although skin-prick testing is widely available, there are still some areas of controversy in the literature and a lack of standardised guidelines for skin-prick testing. The age from which skin-prick testing can be safely performed is a topic of controversy. Potter and Morris state that around three or four months of age is appropriate, but Heinzerling et al and Host et al both agree that there is no lower age limit for the performance of skin-prick testing.^{3,4,6,8,9} Most studies accept that a wheal of 3 mm greater than the negative control is a positive reaction, while the allergy section of the Canadian Paediatric Society places this value at 2 mm.^{3-4,15-17}

The use of the lancet, and whether or not it should be wiped clean, or a new lancet used between allergens is an area of controversy. Heinzerling et al recommend the use of a new lancet with each allergen, to avoid cross-contamination and reduce the risk of infection for the person performing the testing.⁴ The Canadian Paediatric Society's subcommittee of the allergy section gives the person performing the test the choice of using a clean lancet for each allergen, or of wiping the lancet between pricks.¹ Gordon BR et al recommend the use of alcohol swabs to clean the lancet between pricks.¹⁶ The angle of the lancet during testing should be at 90 degrees. Some authors recommend that the skin is penetrated to a depth of 1 mm,⁶ but there is no universal recommendation on the depth needed. However, universally, all authors recommend that blood should not

be drawn.¹⁴ Some authors also suggest that the lancet should be held in place for one second.⁶ There is no uniform recommendation on the type of lancet to be used.

Finally, recommendations on the performance of skin-prick testing in pregnancy are contradictory. Some authors state that skin-prick testing is contraindicated in pregnancy, while others report that it is not.⁴⁻⁶

Conclusion

Skin-prick tests are cheap, easy to perform, reliable, sensitive and have the benefit of delivering results that are immediately available. Although the risk, however small, of developing anaphylaxis is still a possibility, the test remains safe to perform in a consultation room or at the patient's bedside. Worldwide, skin-prick testing remains the test of choice because of its convenience and cost-effectiveness.

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