

Validation of a simplified provocation instrument for diagnosis and threshold testing of symptomatic dermographism

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Summary

Background. Symptomatic dermographism is a common urticarial condition, which requires determination of provocation thresholds to confirm diagnosis and allow physicians to individualize management and therapy for optimal control of symptoms. To determine provocation thresholds, we have developed a provocation test device, the FricTest® 4.0. This simple and inexpensive device, which is stroked across the skin to produce a response, consists of a flat plastic comb with four round-ended plastic pins, 3 mm in diameter, and of differing lengths.

Aim. To validate the FricTest® 4.0 by comparison with FricTest 3.0 in determining provocation thresholds in symptomatic dermographism.

Methods. Dermal provocation with the FricTest 4.0 and FricTest 3.0 was performed in parallel on the volar forearm of 30 patients with symptomatic dermographism and 30 healthy controls. The widths of the resulting weals were measured, and weals with a width of ≥ 3 mm were considered positive. Accompanying pruritus was assessed using a 10-point verbal rating scale.

Results. All 30 patients with symptomatic dermographism, but none of the healthy volunteers, showed positive responses to provocation with the strongest trigger strength, showing that FricTest® 4.0 has 100% sensitivity and specificity for diagnosing symptomatic dermographism. Quantitatively, both devices were similar in the number of patients who responded positively to different pin lengths. Results for pruritus were also similar with both instruments.

Conclusions. The FricTest 4.0 is a simple and inexpensive instrument for determining provocation thresholds in patients with symptomatic dermographism. It should find a place in both routine clinical investigation and in therapeutic trials.

Symptomatic dermographism, also known as 'urticaria factitia' or 'dermographic urticaria', is the most common subtype of physical urticaria, with an estimated prevalence of 1.5–5%.¹ Provocation of the skin by shear forces causes the development within seconds to minutes of itchy, strip-shaped weals, which may last for 1.5–2 h.^{2–4} Symptomatic dermographism is

distinguished from simple dermographism, in which transient wealing, but not pruritus, may result from the same stimulus.^{2,5}

Diagnosis of symptomatic dermographism is made by a detailed history and confirmed by provocation testing. The simplest method is to stroke the skin lightly using a wooden spatula or another smooth blunt object, such as a closed ballpoint pen. However, diagnosis was put on a more scientific basis in 1996 by a consensus meeting,⁶ which recommended that a positive diagnosis is made only if a wealing reaction of the skin occurs within 10 min in response to a moderate stroking stimulus of $< 36 \text{ g/mm}^2$ (353 kPa). While this consensus laid the basis for a positive or negative diagnosis of symptomatic dermographism,^{7,8} patients

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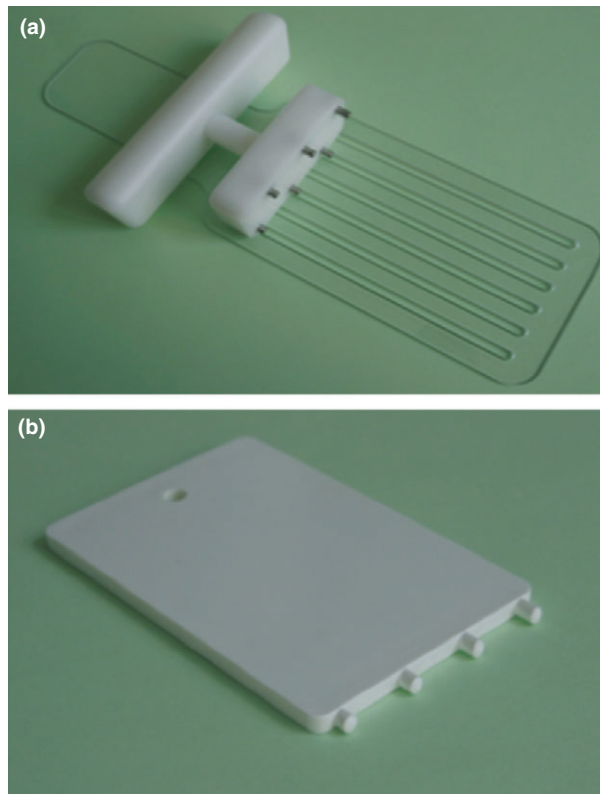


Figure 1 (a) FricTest 3.0 instrument with plastic template and (b) FricTest 4.0 instrument.

differ widely in the severity of their condition and their response to therapy. Consequently, it is desirable to be able to obtain sensitive and reproducible estimates of wealing thresholds for individual patients in order to individualize management and therapy. The first instrument to do this successfully was a spring-loaded dermatographometer, which could be adjusted manually to deliver shear forces caused by scratching with a vertical pressure of 196, 353 and 589 kPa to obtain a quantitative estimate of wealing thresholds.⁹

In 2013, the FricTest[®] 3.0 dermatographometer was reported by Mlynek and co-workers.¹⁰ This instrument consists of a plastic comb with six smooth steel pins numbered 1–6, with lengths of 2.5, 3.0, 3.5, 4.0, 4.5 and 5.0 mm, which are arranged in two horizontal rows (Fig. 1). The instrument is stroked vertically across the skin using a plastic template to ensure the shear pressures are correct. Studies with the FricTest[®] 3.0 indicated that the four longest pins (3.5, 4.0, 4.5 and 5.0 mm in length), which were calculated to produce shear forces corresponding to that caused by

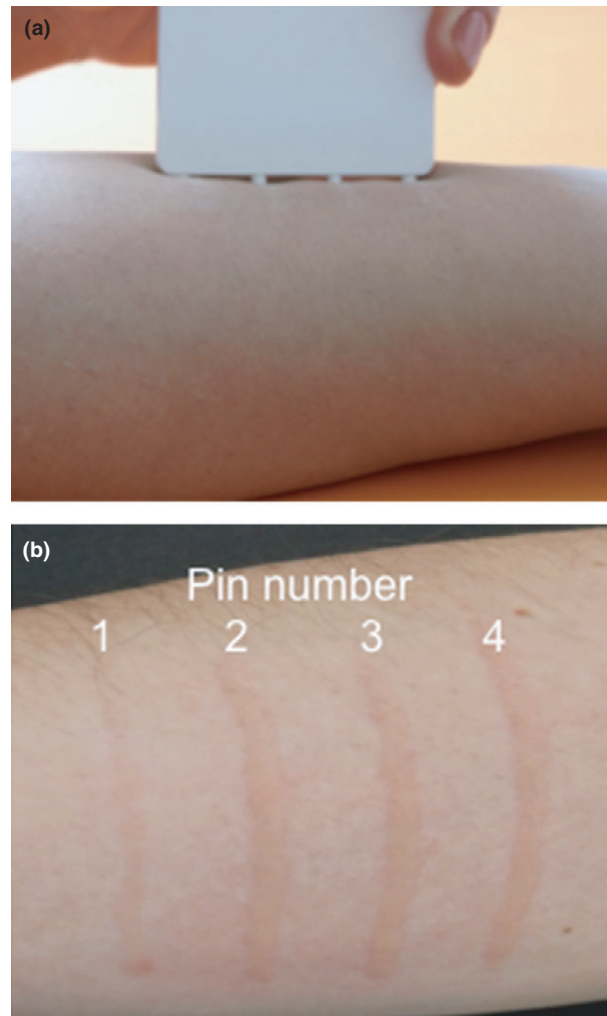
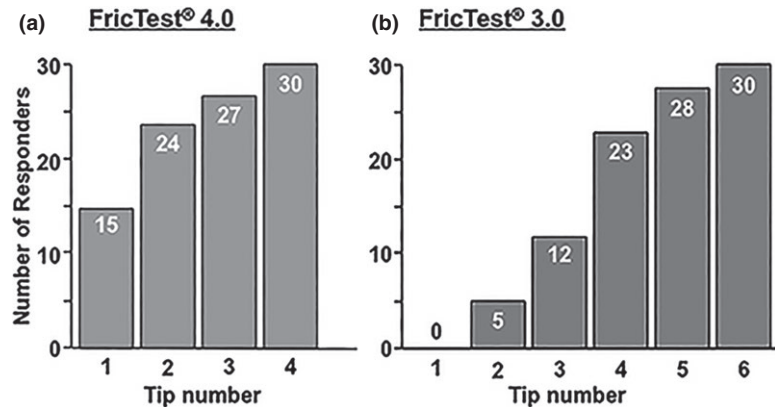


Figure 2 (a) For provocation tests, the FricTest 4.0 was held perpendicular to the skin of the volar forearm, and sufficient pressure was applied so that all pins make complete contact with the skin and are almost, but not completely, invisible. The instrument was then stroked across the skin for a distance of approximately 100 mm. (b) Positive weal responses, with width of ≥ 3 mm measured 10 min after provocation, were seen with pins 2–4 but not pin 1.

scratching with a vertical pressure of 275, 441, 647 and 912 kPa, respectively, were most effective in producing weals.

Using this information, a new version, the FricTest[®] 4.0, was designed. This instrument has a simplified design and consists of a flat plastic comb, 85 × 55 mm in size, with four round-ended plastic pins 3 mm in diameter, numbered 1–4, with lengths of 3.0, 3.5, 4.0 and 4.5 mm (Fig. 1). The aim of this study was to validate the use of the newer FricTest 4.0 by comparison with the older FricTest 3.0.

Figure 3 Provocation thresholds of patients with symptomatic dermographism with cut-off values for weals of ≥ 3 mm at 10 min after provocation using (a) FricTest 4.0 and (b) FricTest 3.0.



Report

The study was performed under the umbrella Charité ethics approval for diagnostic procedures during routine clinical practice, and all participants gave signed informed consent.

In total, 30 patients with a confirmed diagnosis of symptomatic dermographism and 30 healthy volunteers were recruited from the Department of Dermatology and Allergy (Charité-Universitätsmedizin, Berlin).

Provocation tests in the patients with symptomatic dermographism were performed during their routine diagnostic examination in our specialist urticaria outpatient clinic. None of the participants had taken systemic corticosteroids or applied topical antihistamines, corticosteroids or mast-cell stabilizers for 2 weeks, and had stopped oral antihistamines at least 72 h prior to assessment. No participant had performed physical exercise, smoked, or ingested xanthines or alcohol for at least 4 h prior to the test.

To perform the tests, participants were seated in a draught-free room at ambient temperature (20–22°C),

and allowed to acclimatize for 20 min before the tests. Patients were included only if the skin of the test site (the volar surface of the forearm) was unbroken and free of obvious signs of infection.

For comparison purposes, provocation of symptomatic dermographism was performed in parallel on both volar forearms of each individual, one instrument being used on the right arm and the other on the left. The FricTest 4.0 (Moxie, Berlin, Germany) was held perpendicular to the skin of the volar forearm without using a plastic template. Sufficient pressure was applied so that all pins made complete contact with the skin, and were almost, but not completely, invisible (Fig. 2). The instrument was stroked across the skin for a distance of approximately 100 mm. Provocation with the FricTest 3.0 dermatographometer (Biomedizinische Werkstatt der Charité Berlin, Germany) was performed as previously described.¹⁰ Briefly, the instrument was stroked once from left to right across the volar surface of the forearm for a distance of approximately 60 mm perpendicular to the long axis of the arm, using a 2-mm thick plastic template to

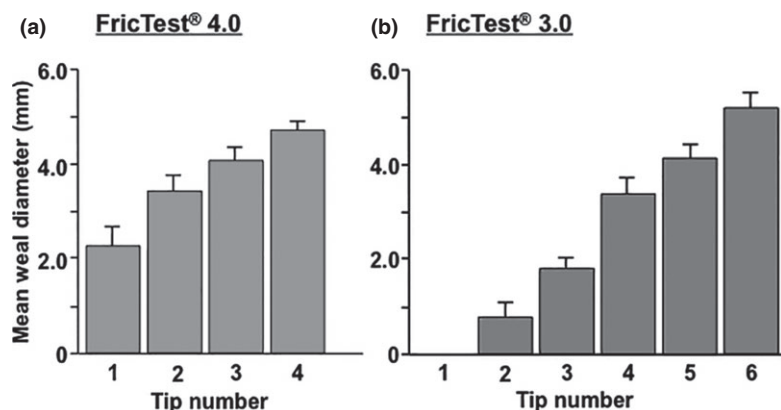


Figure 4 Weal widths (mean $\pm$ SEM) for the different pin lengths of (a) FricTest 4.0 and (b) FricTest 3.0 ($n = 30$).

ensure the correct pressure on the skin. Responses were assessed at 10 min after provocation as in our previous study.¹⁰ Provocation responses were documented as positive if the weal width was 3 mm (the diameter of the FricTest pins) or greater (Fig. 2). Additionally, patients were asked to assess the strength of pruritus using a verbal rating scale (VRS) from 0 to 10 for each provocation site.

As the data were normally distributed, mean $\pm$ SEM were calculated, and the significance of differences between responses in patients was assessed using Student *t*-test for paired data.

All 30 patients with symptomatic dermographism showed positive responses to provocation with the strongest trigger strength with both the FricTest 3.0 and 4.0 devices (Fig. 3). No healthy volunteers developed weals or itching 10 min after provocation using either device.

There was a similar gradation in the number of patients producing a positive wealing response with differing pin size with both devices, with similar responses seen for pins 1–4 of FricTest 4.0, (length 3.0–4.5 mm) and pins 3–6 of FricTest 3.0 (length 3.5–5.0 mm) (Fig. 3).

In addition, both devices produced a similar graded response in weal diameter depending on the length of the pin (Fig. 4). The mean weal diameter produced by the longest pin of FricTest 4.0 (4.67 ± 0.17 mm) was statistically significantly ($P < 0.05$) smaller than the mean diameter of 5.20 ± 0.29 mm for FricTest 3.0.

The severity of pruritus provoked by the two devices was similar, with the mean scores being 3.53 ± 0.40 and 3.73 ± 0.43 for FricTest 4.0 and FricTest 3.0, respectively. There was no statistically significant difference between these scores ($P = 0.59$).

The FricTest 4.0 instrument was validated by comparison with FricTest 3.0 in terms of response rates, weal diameters and pruritus in patients with symptomatic dermographism and healthy controls. The observation that all 30 patients with symptomatic dermographism but no healthy volunteers showed positive responses to provocation with the strongest trigger strength shows that FricTest 4.0 has 100% sensitivity and specificity for diagnosing symptomatic dermographism. In addition, the gradation of response with different pin lengths indicates that changes in provocation thresholds for individual patients allows physicians to individualize management and therapy for optimal control of symptoms. Furthermore, the use of this simple and inexpensive instrument for determining provocation thresholds in patients with symptomatic dermographism will allow investigators, in

either single or multiple centres, to collaborate in investigations to assess the activity and natural course of the disease and to conduct therapeutic trials.

Learning points

- Symptomatic dermographism, also known as urticaria factitia or dermographic urticaria, is the most common subtype of physical urticaria, with an estimated prevalence of 1.5–5%.
- The condition is characterized by itching and/or burning skin with strip-shaped weals that can be provoked by shear forces to the skin, and is distinguished from simple dermographism, in which transient wealing, but not pruritus, may result from the same stimulus.
- Diagnosis of symptomatic dermographism is made by a detailed history and confirmed by provocation testing.
- The simplest method is to stroke the skin lightly using a wooden spatula or another smooth blunt object, such as a closed ballpoint pen.
- Determination of provocation thresholds of symptomatic dermographism is necessary in order to individualize patient management and therapy.
- This article introduces the FricTest 4.0, a simple flat plastic comb with four round-ended plastic pins, 3 mm in diameter and of differing lengths, which may be stroked across the skin to produce a response that can be used to determine provocation thresholds.
- Validation against FricTest 3.0 showed that FricTest 4.0 had 100% sensitivity and specificity for diagnosing symptomatic dermographism.
- Determination of provocation thresholds by FricTest 4.0 will allow individualization of patient management and therapy.

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