

Precise area determination of skin-prick tests: validation of a scanning device and software for a personal computer

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Summary

When skin-prick tests (SPTs) are used quantitatively, the circumference of the weal and/or the flare is outlined using a felt tip pen, and transferred to paper by adhesive tape. The aim of the study was to develop and validate a procedure, objectively and precisely determining these areas after transfer to paper. A system was developed enabling the drawing of the area of weal or flare to be read by a hand-held scanner and calculated on a personal computer. Areas in the 5–500 mm² range could be determined with day-to-day and interoperator coefficients of variation (CVs) of 3.1% and 1.8%, respectively. Accuracy was determined in two ways: by correlation to cutting/weighing of four times enlarged SPT areas ($r^2=0.999$, $P<0.001$) and by measuring standardized areas (deviations less than intra-assay CV, i.e. 1–2%). For comparison, CVs of alternative methods were also determined: eight different areas (9–76 mm²) were evaluated in quadruplicate using the SPT-scanner (CV=1.4%), by cutting/weighing of paper (CV=2.3%), by digitizing (CV=4.4%) or by measuring longest and orthogonal diameters (CV=13.6%). In conclusion, the scanning device and software provides an objective and reproducible procedure for rapid determination of SPT areas. When areas are determined by scanning, digitizing or cutting/weighing the variations in area determination becomes negligible compared to the variations of the entire skin test procedure.

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Introduction

The skin-prick test (SPT) is one of the most commonly used diagnostic procedures in routine management of allergic patients. For a simple evaluation of IgE sensitization, the size of the allergen-induced weal has been evaluated in relation to a fixed cut-off limit or has been compared with that of a reference weal. A more quantitative approach is essential for a number of research purposes like determination of biological activity of allergen extracts [1,2], monitoring of immunotherapy [3], efficacy and kinetic studies of antihistamines [4], effect of

topical glucocorticoids [5] and systemic glucocorticosteroid treatment [6], and, obviously, methodological studies on skin test procedures [7–9].

Several factors might influence the final outcome of an SPT [reviewed in 10]. Figure 1 summarizes some of the factors influencing the magnitude of the weal and flare reaction in skin test. All these factors may contribute more or less substantially to the overall variability of the SPT, which has been reported to show a reproducibility with a standard deviation of 25–43% [8], depending on the area of the weal reaction and the skin test device used [11]. During the last decade standardization has been made of the paraphernalia of the skin test, i.e. the allergen extracts [12] and the lancets especially designed for skin testing [10,13]. The aim of the present study was to

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hardcopy and files, and by the objectivity of the method. Although we have not performed any comparison between the four methods applied on highly complicated geometrical areas, we anticipate that the reproducibility of the three other methods will decrease. Until now we have not been able to demonstrate any significant change in reproducibility of the SPT-scanner related to the geometrical form of the figure to be scanned. The SPT-scanner has the advantages of being a highly precise device for measuring skin test areas, being easy to use and resulting in an objective quantitation of the area ready for direct computer-based statistical processing. When a high precision of the recording of skin test reactions in scientific studies is crucial, e.g. when evaluating the anti-allergic capacity of drugs, the SPT-scanner seems superior to other devices designed for measuring skin test areas.

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