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Usefulness of telemedicine with digitized grid reconstruction to improve the value of photo assessment in late patch test readings

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Patch testing with application of allergens under occlusion on the skin under standardized conditions is the standard procedure to diagnose allergic contact dermatitis. Readings are commonly performed on day (D)2, D3 or D4, and around D7. A reading between D5 and D10 is necessary for at least some allergens for which 7%–30% of contact sensitizations will be missed if this last reading is not performed.[1] These timelines may be inconvenient for patients, especially for those with travel and/or work-related difficulties.

Teledermatology is the use of communication technology to provide remote dermatology services, such as the transmission of patient's data and medical information, pursuing educational, diagnostic and therapeutic purposes.[2] Its advantages include accessibility and cost.

A few studies have explored the utility of teledermatology for patch testing.[3–6] We propose the use of telemedicine as a mean of assessment of late reactions to patch tests in order to reduce the number of visits for patients undergoing patch testing. The use of digitized grid reconstruction may help to identify the allergens responsible for late skin reactions.

METHODS

The study has been conducted in 332 patients with an initial diagnosis of eczematous dermatitis who underwent patch testing in the Dermatological Clinic of Bari, Italy, between March 2022 and February 2023. Patients were considered eligible for this study taking into account their technological abilities and the chance to have photos taken by someone else using proper tools (smarthphones with sufficient quality cameras).

Patch tests were occluded for 2 days with allergEAZE patch test chambers (SmartPractice, Phoenix, USA) on Soffix tape (Artsana, Grandate, Italy), and the readings were performed on D2 and D4. After the removal of patch tests, grids were drawn on the backs of the patients using a dermographic pen to separate the different skin areas brought into contact with the patch test allergens. Written informed consent for patch testing and participation in the study was obtained, and a photo of the patients' back was taken with their smartphone. Instructions were given to patients, both verbally and through a paper reminder, on how and when to take the remaining pictures. The patients were asked to take a new photo on D4 and another photo on D6 or D7 in daylight without a flash using the same framing of the first picture taken on D2.

Once the patient-submitted photos were obtained, the grids were reconstructed digitally. The digitized grid was self-created thanks to a standard format of a grid consisting of individual lines that could be edited together or indipendently as needed, initially created with Word's 'insert tool' and then overlaid on top of the photos in a pattern corresponding to the original dermographic draw, taking advantage of permanent landmarks (moles, tattoos, or scars) and comparison with the photo taken on D2.

The images submitted by patients were later compared with those taken on D2. The D6/D7 images were also compared with the intermediate photos taken on D4, thus facilitating the detection of new positivities in the last photographic assessment and the reconstruction of the grid. Based on our previous preliminary experience, at D4 the dermographic pen drawing was generally visible albeit faded, whereas at D6/D7 it was often completely absent, making digital reconstruction of the grids essential for the identification of allergens (Figure 1). In case of suspected positive reactions detected by photographic inspection, patients were invited for a presential follow-up visit on D7. This visit was also requested when the quality of images was insufficient, creating difficulties in reading.

The photos taken on D4 had to be received on D4 and the last photos had to be received within the morning of D7 in order to plan the presential visit at D7 when required. The last photo was sent by the patient on D6 or in the morning of D7 depending on the travel distance to reach the Clinic or other patient's needs. When the received images had a suboptimal quality, the patients were asked to take and send additional photos in a short time. Reading of photos was done by two experienced dermatologists who were blinded to the results of clinical reading on D4 whereas reading at the clinic on D4 was independently performed by another experienced dermatologist in a blinded fashion. A team member was designated to collect and check the received photos, communicating with patients and providing support to them as needed.

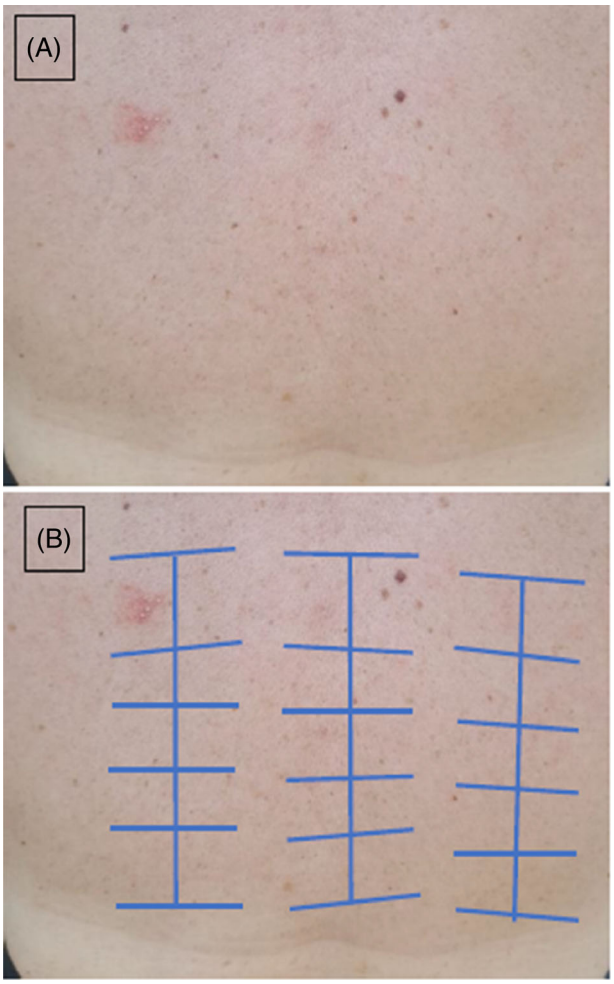

FIGURE 1 (A) Patient's photo on D6 without digital reconstruction of the grid. (B) The same photo with digitized grid reconstruction which allows to recognize the allergen responsible for the late skin reaction.

RESULTS

The photos on D4 and D6/D7 were sent by 317 out of 332 (95.5%) participants. Figure 2 contains an example of the photographic assessment of patch test reactions using the digitized grid.

One hundred eighty patients had a total of 354 positive patch test reactions until D7. Among the patients enrolled, 46 were recalled for a presential follow-up visit at D7 but 7 of them did not attend this visit due to personal problems or because they were lost to follow-up. Of the 39 patients who underwent clinical assessment on D7, 31 were not diagnosed with an actual new positivity. Most of them had been invited for a recheck on D7 because they were unable to provide good quality images. In 8 patients 14 new positive reactions (3.95% of all positive reactions) were found by the clinical reading on D7, whereas new positive reactions observed in photos at D6/D7 were 16. Therefore, in-person assessment did not confirm two of the new positivities detected by photographic reading at D6/D7.

DISCUSSION

The study confirms the need to perform additional readings of patch tests at D7 as the absence of this leads to the loss of some positivities,[6] and in our study 3.95% of the positive reactions were present at D7 only. Telemedicine used for the detection of delayed and late skin reactions can be useful in reducing outpatient visits. Digitized grid reconstruction was helpful to recognize the allergen responsible for any telematically identified late skin reaction.

The overall results of our study appear to be quite positive in terms of rate and quality of submitted images, and adherence of patients to the study procedures. This was possible also thanks to a careful selection of the patients enrolled in the study and a close cooperation between the patients and a team member responsible for supervising and coordinating study aspects of crucial importance.

However, there are several limitations in this study. Firstly, the results can be influenced by the quality of the photos taken by the patients and not all the patients are eligible for this type of follow-up assessment. Secondly, we did not compare the data with a control group, aimed at estimating the sensitivity and specificity of the telematic assessment. Moreover, the D7 clinical assessment was not performed in all participants.

This study highlights how teledermatology may have the potential to diminish costs, lower the burden of travel for patients and increase access to skin patch testing services in certain circumstances. Future prospects may be the creation of a protocol to standardize the use of

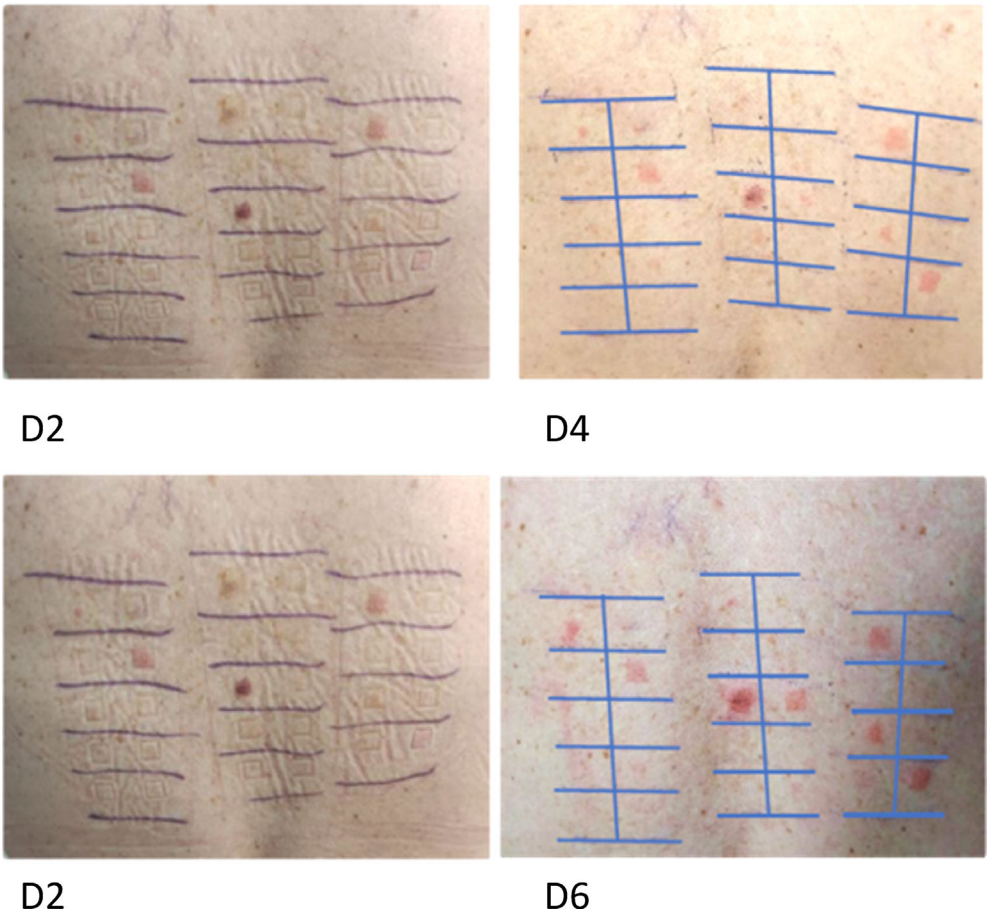

FIGURE 2 Comparison of the photos sent by the patient on D4 and D6 (using digital grid reconstruction) with the one taken on D2. Patient positive to fragrance mix-1 and fragrance mix-2 on D2. Then, late positivities were identified to nickel sulphate, Kathon CG, potassium bichromate, paraphenylenediamine and methylisothiazolinone.

telemedicine as well as automated grid reconstruction, which could be based on the use of artificial intelligence.

AUTHOR CONTRIBUTIONS

Caterina Foti: Conceptualization; methodology; supervision. **William Andrew Rosato:** Investigation; writing – original draft; data curation. **Nicoletta Cassano:** Writing – review and editing; validation; supervision. **Gino Antonio Vena:** Validation; writing – review and editing; supervision. **Gabriele Fanigliulo:** Investigation; writing – original draft; data curation. **Cosimo Castronovi:** Data curation; writing – original draft; investigation. **Francesca Ambrogio:** Investigation; writing – original draft; data curation. **Domenico Bonamonte:** Conceptualization; writing – review and editing; supervision. **Paolo Romita:** Conceptualization; writing – review and editing; investigation; supervision.

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CONFLICT OF INTEREST STATEMENT

All authors have no interests to report.

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