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# Improved quantification of skin erythema pattern by color analysis of highly standardized photographic images

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## Introduction

Visual scoring is the time-honored approach for quantification of erythema. With appropriate training visual scoring can be done efficiently, however with only moderate precision and considerable inter-grader variability. Measurements with chromameters are device-based alternatives with greater precision and objectivity. They have, however, their own limitations. First, they are not truly operator-independent. Second, the measurement area is limited to approx. 1 cm<sup>2</sup>. Third, complex pattern of erythema as present in most diseases cannot be quantified satisfactorily with chromameters. Usually chromameters integrate over the entire area measured and the intense redness of patchy areas or teleangiectasia are averaged with skin parts without any erythema. Erythema evaluation by quantitative image analysis on highly standardized photographs can overcome these limitations.

## Objective & Methods

For advanced color measurements on images the photographic device must provide correct and highly reproducible illumination in terms of color temperature and light intensity. Further all geometric parameters as distance to skin, magnification and angle of illumination must be kept constant.

In this investigation we compare measurements on images obtained with a handheld professional camera system with a distance holder and flash illumination (Canon EOS 5D Mark II with Elinchrom RQ Ringflash ECO) to color measurements with a chromameter (Minolta Chromameter CR400) and visual scoring. Erythema spots of 1 cm<sup>2</sup> of different intensity were induced on volar forearm skin of six subjects with a solar simulator. Erythema was measured in the L\*a\*b\*- color system with the chromameter and in parallel by quantitative image analysis in photographs.

In a second step facial skin of Rosacea Type I patients displaying teleangiectasia was evaluated by visual scoring, chromametric measurements and image analysis. After that an unobtrusive camouflage product was applied and the assessments were repeated.

## Results & Conclusions

The erythema data obtained from the photographs on 1 cm<sup>2</sup> erythematous spots induced by UV-light showed a good correlation ( $r > 0.9$ ) with visual scoring as well as with chromameter



measurements. These results showed that the erythema quantification from photographs had a satisfying precision.

The measurements of camouflage effects on teleangiectatic areas revealed the advantage of the photographic method. The camouflage efficacy derived from the chromameter measurements were not well in line with the visual clinical observation. In the color assessment from the photos not only the average redness but also the variation of red blood vessels and the unaffected surrounding skin were taken into account and the blood vessels were measured separately from the surrounding skin. As a result the measurements from photographs matched much better with the clinical observations.

In summary, erythema quantification from photographs showed a good correlation with chromametry when the area of interest showed homogenous erythema. In areas with uneven color distribution the color quantification of photographs had the clear advantage because erythema intensity, could not only be over averaged over the whole area but also quantified selectively and hence with greater sensitivity in areas/structures of interest, e.g. teleangiectasias.

