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The Scarbase Duo[®]: Intra-rater and inter-rater reliability and validity of a compact dual scar assessment tool



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ABSTRACT

Objective scar assessment tools were designed to help identify problematic scars and direct clinical management. Their use has been restricted by their measurement of a single scar property and the bulky size of equipment. The Scarbase Duo[®] was designed to assess both trans-epidermal water loss (TEWL) and colour of a burn scar whilst being compact and easy to use.

Twenty patients with a burn scar were recruited and measurements taken using the Scarbase Duo[®] by two observers. The Scarbase Duo[®] measures TEWL via an open-chamber system and undertakes colorimetry via narrow-band spectrophotometry, producing values for relative erythema and melanin pigmentation. Validity was assessed by comparing the Scarbase Duo[®] against the Dermalab[®] and the Minolta Chromameter[®] respectively for TEWL and colorimetry measurements.

The intra-class correlation coefficient (ICC) was used to assess reliability with standard error of measurement (SEM) used to assess reproducibility of measurements. The Pearson correlation coefficient (r) was used to assess the convergent validity.

The Scarbase Duo[®] TEWL mode had excellent reliability when used on scars for both intra- (ICC = 0.95) and inter-rater (ICC = 0.96) measurements with moderate SEM values. The erythema component of the colorimetry mode showed good reliability for use on scars for both intra- (ICC = 0.81) and inter-rater (ICC = 0.83) measurements with low SEM values. Pigmentation values showed excellent reliability on scar tissue for both intra- (ICC = 0.97) and inter-rater (ICC = 0.97) with moderate SEM values.

The Scarbase Duo[®] TEWL function had excellent correlation with the Dermalab[®] ($r = 0.93$) whilst the colorimetry erythema value had moderate correlation with the Minolta Chromameter ($r = 0.72$).

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Abbreviations: TEWL, trans-epidermal water loss; ICC, intra-class correlation coefficient; SEM, standard error of measurement; r , Pearson correlation coefficient.

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The Scarbase Duo[®] is a reliable and objective scar assessment tool, which is specifically designed for burn scars. However, for clinical use, standardised measurement conditions are recommended.

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1. Background

Survival after severe burns and trauma has dramatically improved over the last decade but this has not always been paralleled with a similar increase in quality of life. Patients have to contend with the sequelae of scarring, which can lead to an array of appearance-related, psychological and functional problems. Scars represent a significant challenge to the multidisciplinary care team and a large burden on the resources of health care systems. Research into the area of improving treatment options for scarring is relevant both on an individual and a societal level [1].

Scar assessment tools are used for monitoring the quality of scars against time, the effect of treatments and for comparing scars. The ideal scar assessment tool needs to be reliable (error of measurement), valid (measures what it is meant to measure) and feasible (easy to administer with minimal patient burden). Scar assessment can be achieved via subjective or objective methods. Subjectively, scars can be assessed by patients, clinicians/medical professionals and third party observers. However, subjective scales can be unreliable due to a great variability in interpretation [2]. Various assessment scales have been created but the most commonly used are the Vancouver Scar Scale (VSS) and the Patient Observer Scar Assessment Scale (POSAS) [3–5].

Objective scar assessment has an advantage over subjective assessment because the reliability of measurements between observers tends to be greater [6]. Objective scar assessment tools can provide a quantitative measurement of physiological or physical scar parameters. Physiological properties include trans-epidermal water loss (TEWL), hydration, perfusion and trans-cutaneous oxygen level. Physical properties include colour, elasticity, topography and planimetry [6].

TEWL is an important physiological marker to measure the efficiency of the human skin barrier to retain water [7]. The hydration and water content of skin is important as it helps to maintain normal skin turgor and texture and is strongly related to TEWL. TEWL can be used as an indirect measurement of the barrier function of skin because when skin is damaged, as is the case during scarring, TEWL increases [8]. Open chamber devices are the most common method of measuring TEWL. They detect the water vapour gradient near the surface of the skin based on the principle of Fick's law of diffusion [9].

Scar colour is a key physical property because its comparison to uninjured, surrounding skin is correlated with relative patient satisfaction and reflects biological processes within the scar [10]. Colour assessment forms a component of subjective scar assessment scales because patients commonly

are dissatisfied with a mismatch of scar colour compared to their surrounding skin. Clinically, colour assessment is useful as an indicator of the scar maturation and as an early, quantifiable index of the likelihood of the scar becoming hypertrophic [11,12]. The colour of a scar is a complex physical property that is contributed to by three main components (brown melanin pigment, red oxyhemoglobin and yellow bile). Colorimetry tools commonly assess the colour of scars via tristimulus reflectance colorimetry (the level of light reflected from the scar surface) or narrow-band spectrophotometry (the absorption of light in the scar) [6].

Objective scar assessment tools have predominantly tested a single characteristic of the scar and their use has largely been restricted to the research settings due to their bulky, impractical size. Anthonissen et al. were the first authors to report about the utility of a dual scar assessment device called the Dermalab[®] (Cortex Technology, Hadsund, Denmark); this measures both elasticity and TEWL via a single central unit [7]. A new device called the Scarbase Duo[®] (Courage + Khazaka, Cologne, Germany), calculating TEWL and colorimetry, has been designed to be small, easy to use and affordable.

The aim of this study was to assess intra- and inter-rater reliability, validity and feasibility of the Scarbase Duo[®] for use in research and clinical application.

2. Methods

This study was designed in accordance with the Guidelines for reporting reliability and agreement studies [13].

2.1. Patients and observers

Patients were recruited from the OSCARE Centre (Burns and Scar Aftercare Centre) in Antwerp, Belgium over a three week testing period. Patients were eligible when they were at least 16 years old with scars in the active phase of healing after complete wound closure. Previous treatment for these scars followed a clinical protocol and was recorded in each patient. Patients who were unable to provide consent due to a language barrier or psychiatric disorder were excluded. Scars had to be situated on the upper or lower limbs with the exclusion of the hands, feet, trunk or head and neck. These chosen sites have been shown to have lower and more consistent rates of TEWL [14]. Contralateral areas of healthy skin were used for comparison and in cases where these too were scarred, adjacent healthy skin was tested. The two observers collecting the data were a clinician and physiotherapist. The study protocol was approved by the ethics committee of the Hospital Network Antwerp (ZNA), Belgium (Ethical committee 009OG031, study number EC4549).

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