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A pilot study of a hand-held camera in a busy burn centre: Prediction of patient length of recuperation with wound temperature

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ABSTRACT

Aim: The aim of our study was to evaluate temperature differences of burns looking at their prognostic ability to predict healing at the 21 day mark.

Materials and method: Thirty two burns in 26 patients aged 1–71 years old were photographed with a FLIR T650 camera. Environment, reflected, and body core temperature of the patients were measured. Skin emissivity was constant 0.98. Pictures were analyzed with R&D FLIR Software. Minimal and average burn temperatures and skin temperature in 255 pixel squares were measured. Patients were divided into healed and not healed groups. Statistical analysis was performed with SPSS 20 (IBM Armonk, USA) and $p < 0.05$ was significant.

Results: There were 25 healed and 7 non-healed burns at 21 days. Healed burns were significantly warmer than non-healed burns ($p < 0.05$). There was a statistically significant strong, negative correlation between the difference of minimal burns temperatures and healthy skin temperatures with days needed to heal the burns ($p = 0.001$; rho = −0.564).

Conclusion: Infrared camera seems to be useful equipment in predicting burns' healing time. However further clinical studies need to be done.

1. Introduction

While differentiation between superficial and full thickness burns is quick and easy for an experienced plastic surgeon there are some shades of grey in between. The differentiation of these shades is very important because it implies further delayed surgery or increased morbidity for the patients, which also add to the economic burden in view of increased outpatient attendance and theatre costs. Burns

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that spontaneously heal within 21 days usually are less likely to become hypertrophic. They are usually treated conservatively. The superficial and superficial partial thickness burns (I and IIa) are considered to be such burns. On the other hand there are deeper burns such as deep dermal (IIb) and full thickness burns. They tend to heal later than 21 days and leave a permanent functional and aesthetical impairment. They are best managed surgically [1,2]. Currently there are several devices developed to help clinicians with differentiating superficial partial thickness from deep partial thickness wounds (e.g. Laser Doppler imaging, near infrared spectroscopy) [3]. Infrared thermography (IRT) imaging of burns is one of the possible methods and since the first reports of its application in burns technology has advanced to a hand-held solution [4–7]. The usage of all stationary devices requires a certain level of compliance from the patient and takes time. While in adult cases this does not pose a problem, it could be an obstacle in paediatric cases, where children are usually anxious due to pain and the hospital environment. Evaluation of hand-held device for the feasibility and clinical reliability should help pave way for the regular use of these devices in clinical practice. In our study we have tried to evaluate usefulness of a hand-held infrared camera in differentiating between burns spontaneously healing within 3 weeks and ones that do not.

2. Methods and material

We photographed all the burns of all the patients admitted to the regional burns centre as well as all patients referred to outpatient clinic between 9th and 26th July 2013. Conscious consent was obtained from all patients. As a clinical evaluation study that has no direct impact on the treatment process the ethical committee approval was not required. Patients were photographed with FLIR T650 infrared camera with Fol25 lenses (FLIR, Willsonville, OR) with photographer standing approximately at 60° angle to the photographed surface. All pictures were taken after the debridement of the burn and at fixed distance of 1 m from a wound. The piece of crushed tin foil was placed in the background of each picture for further thermographic analysis. The body core temperature of the patients and the room temperature were measured. Young children were allowed to stay with parents during photography. Infrared pictures and digital pictures were marked and stored. Basic demographic data and Fitzpatrick scale were stored for further analysis (Figs. 1 and 2).

Thermographic analysis was performed with R&D FLIR Software (FLIR, Willsonville, OR; Fig. 1). Skin emissivity was constant 0.98. To assess the reflected temperature we used a tin foil average temperature in 255 pixel square with tin emissivity set to 1.0 and distance set to 0 m. Minimal and average temperatures of burns and average temperature of healthy skin were measured within 255 pixel square. Healthy skin measurements were obtained from skin separated from the burn. Temperatures were measured in degrees centigrade, burns themselves were examined by plastic surgery fellows and the pictures were clinically evaluated by a plastic surgery research fellow.

FLIR assessment was performed at the initial evaluation only. Further follow-up was based only on clinical diagnosis.

Burns were divided into two groups: healed in 21 days, not healed in 21 days. For the purpose of this study only superficial partial thickness and deep dermal burns were evaluated.

Statistical analysis was performed with SPSS 20 (IBM Armonk, USA) and $p < 0.05$ was considered significant. The end point of the study was an assessment of a burn with two levels (healed and not healed after 21 days). Kolmogorov–Smirnow test was used to test normality; *t*-test for independent samples and Spearman-rho correlation were used to analyze data.

3. Results

In this feasibility study we evaluated 26 patients (aged 1–71 years old; mean age 22.7 years, SD 19.11) suffering from 32 separate burns either superficial partial thickness or deep

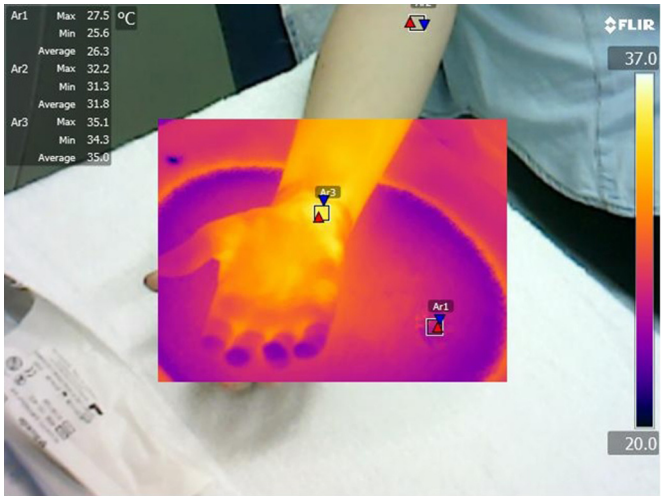

Fig. 1 – Image acquisition and analysis in FLIR R&D Software. Picture of the deep dermal burn of the wrist taken with FLIR camera with picture-in-picture mode. The results of the burn temperature measurements are visible. Places of measurements are marked with squares.