Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.elsevier.com/locate/burns

Case report

Using a 3D tool to document and determine graft loss: A mini-review and case report

Nicole C. Benjamin [a], Paul Wurzer [a,b,*], Charles D. Voigt [a], Debra A. Benjamin [a], David N. Herndon [a]

[a] Department of Surgery, University of Texas Medical Branch and Shriners Hospitals for Children®—Galveston, 815 Market Street, Galveston, TX 77550, USA

[b] Division of Plastic, Aesthetic and Reconstructive Surgery, Department of Surgery, Medical University of Graz, Auenbruggerplatz 29, 8036 Graz, Austria

ARTICLE INFO

Article history:
Accepted 1 September 2015

Keywords:
BurnCase 3D
Software
Total body surface area
Graft loss
Burns

ABSTRACT

In severe burns, accurate determination of burn wound size and areas of debridement and graft loss is challenging. In this case report, we describe the use of 3D wound measurement software (BurnCase 3D, RISC Software GmbH, Hagenberg, Austria) in a 29-year-old patient with burns covering 92% of the total body surface area. BurnCase 3D was used to assess burn and monitor all surgical interventions. The software allowed us to calculate areas of graft loss and graft take throughout the acute hospitalization (until 90% of the wounds were covered with homografts). It also enabled preoperative planning for wound coverage and blood loss. Thus, BurnCase 3D appears to be a useful tool for accurate determination of burn wound areas and preoperative planning. However, whether the benefit of more efficient preoperative planning overcomes the disadvantage of the additional time needed to document the wound using the software needs to be evaluated further.

1. Introduction

Accurate burn size estimation is challenging, even for experienced burn care providers [1–3]. Underestimation or overestimation of the actual total body surface area (TBSA) burnt is possible, leading to inappropriate burn care due to miscalculation of initial burn fluid resuscitation volumes, inadequate calculation of nutritional support, or unnecessary admission to dedicated burn centers [3]. Implementation of digital photo documentation, 3D software tools, 3D cameras, and even smartphones might be useful for improving initial burn size estimations [4–7].

Severe thermal injuries (burns covering more than 60% of the TBSA) utilise multidisciplinary care involving nurses, physicians, dieticians, and occupational therapists so that morbidity and mortality can be reduced [8]. Because of this, accurate and adequate burn care documentation is necessary. Burn survivors undergo multiple surgical interventions, starting with the initial burn eschar excision and being followed by skin harvesting and grafting of full-thickness wounds and later, reconstructive procedures during the

* *Corresponding author at:* Shriners Hospitals for Children®—Galveston, 815 Market Street, Galveston, TX 77550, USA. Tel.: +1 409 770 6974; fax: +1 409 770 6919.
E-mail address: wurzer_paul@gmx.at (P. Wurzer).

http://dx.doi.org/10.1016/j.burns.2015.09.002
0305-4179/

rehabilitation process. Providing an overview of these multiple interventions for medical as well as forensic purposes is challenging. To the best of our knowledge, there have been no reports on the use of computer-assisted software for documentation of burn surgery, graft take, and graft loss. Here, we used a 3D computer-based estimation system to document and calculate burn as well as excision, grafting, graft take, and graft loss throughout the intensive care unit stay of an adult burn patient.

2. Case report

2.1. Methods

For estimation of the actual burn size, digital images were collected at admission and during every operation until 90% of all wounds were covered with homografts. After each photo documentation, we imported the pictures into BurnCase 3D (RISC Software GmbH, Hagenberg, Austria), a software program that provides a library to document patient-specific pictures linked to surgical procedures. The pictures were overlaid onto a 3D representation of the patient that was modeled based on characteristics such as gender, age, weight, and height. From these overlaid photographs, the software generated renderings of the burn as well as areas of debridement and grafting. In addition to demarcating every surgical site on the 3D model, it calculated the areas (cm^2) of these sites.

Of note, BurnCase 3D has a large collection of 3D models that can be modified according to age, gender, height, and weight to allow for accurate estimation of burn and wound surface area, regardless of body composition. Within the program, a 3D model can be translated, rotated, and scaled along three axes. Pictures of the patient can be superimposed onto this 3D-model, allowing the burn practitioner to trace the margins of burned areas; the program can subsequently utilize this information to automatically calculate burned and grafted surface areas. In addition, every area on the 3D model can be labeled with the type of burn and type of graft that has been used.

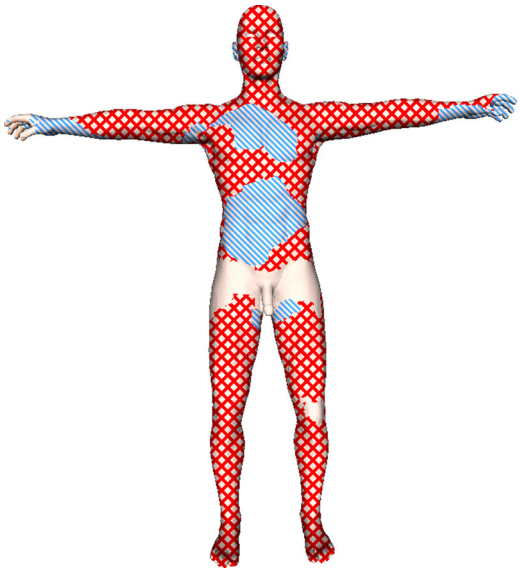

Fig. 1 – *Initial burn diagram of a 29-year-old male with flame burns*. The patient had 92% TBSA burns (highlighted in red and blue), of which 74% (red) were full-thickness burns.

2.2. Results

A 3D model of a 29-year-old male with flame burns covering 92% of the TBSA was created (Fig. 1). Next, a unique color and design was given to every diagnosis, treatment, surgical procedure, and dressing (Figs. 2–5). The unique markings allowed every event to be summed and ordered in a chronological manner. In this way, the areas of the burn at admission as well as the areas of debridement, grafting, donor sites, and healing were individually calculated (Table 1). The extent of third-degree burn was determined based on the calculated debrided area. Also, the area of homografting was compared between operations to determine graft loss as well as for the preoperative evaluation of the amount of grafts planned. Throughout four operations, the patient suffered

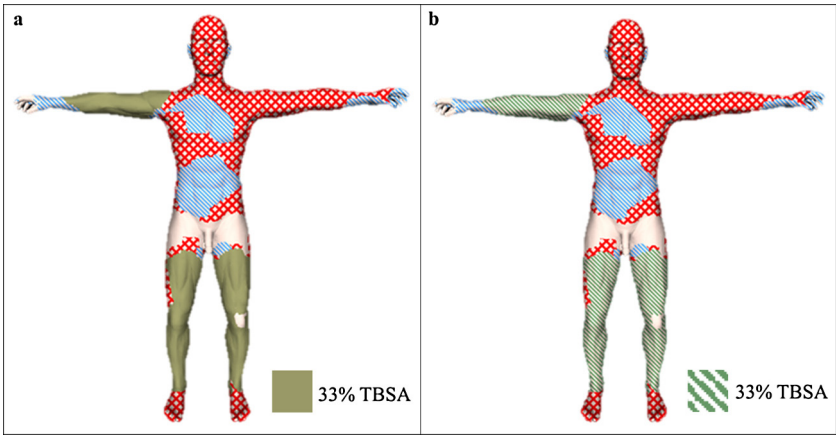

Fig. 2 – *First oepration*. (a): Excision and debridement of the right upper extremity and bilateral lower extremities (solid green marking). (b): Homografting (diagonal green lines).