

A Quick Evaluation of TRAM Flap Viability using Fingerstall-Type Tissue Oximetry

Itaru Tsuge, MD; Tatsuki Enoshiri, MD; Susumu Saito, MD, PhD; Shigehiko Suzuki, MD, PhD

Zone IV, the most distal region of the transverse rectus abdominis musculocutaneous (TRAM) flap, is well known as a region of poor circulation.¹ We routinely use the indocyanine green (ICG) test, which has been widely used for decision-making regarding skin perfusion territory; however, the disadvantages of the test include the risk of an allergic reaction to ICG² and the need for an expensive imaging system. Tissue oximetry, a system measuring the tissue oxygen saturation (StO₂), has shown promise in postoperative flap monitoring.³ Recently, Kanayama and Niwayama⁴ developed a novel tissue oximetry technology, which allows the circulatory condition of the skin to be evaluated using a fingerstall-type StO₂ sensor. Then, the Toccare device (Astem, Japan) was released in 2015⁵. The advantages of this technology include the light weight of the module (0.1 kg), mobility (it works with batteries), and the short sampling time (0.5 s). We investigated the diagnostic potential of the Toccare device on the circulatory condition of TRAM flaps according to the distribution of StO₂ values and the results of ICG tests. The medical ethics committee of our institution approved this study. The investigation covered 2 reconstructive surgeries following breast cancer removal (Fig. 1).



Fig. 1. A Toccare device showing the StO₂ value on its display. The module is light (0.1 kg) and runs on batteries. The sampling time is very short (0.5 s).

From the Department of Plastic and Reconstructive Surgery, Graduate School of Medicine, Kyoto University, Kyoto, Japan.

Copyright © 2017 The Authors. Published by Wolters Kluwer Health, Inc. on behalf of The American Society of Plastic Surgeons.

This is an open-access article distributed under the terms of the Creative Commons Attribution-Non Commercial-No Derivatives License 4.0 (CCBY-NC-ND), where it is permissible to download and share the work provided it is properly cited. The work cannot be changed in any way or used commercially without permission from the journal.

Plast Reconstr Surg Glob Open 2017;5:e1494; doi:10.1097/GOX.0000000000001494; Published online 19 September 2017.

CASE 1

ICG test was performed and the outline of the fluorescence-negative region was marked (see figure, Supplemental Digital Content 1, which displays a right TRAM flap for breast reconstruction, <http://links.lww.com/PRSGO/A534>). Then, StO₂ values were measured at multiple sites on the skin surface of the flap, which were regularly placed at 2-cm intervals. During the measurement, a blue sheet was positioned under the flap so as not to catch any signals from the tissues beneath the flap. We also measured the StO₂ values of the upper abdominal region and excised skin as positive and negative controls, respectively. For each of the 3 longitudinal sites, the StO₂ values were averaged and recorded with a letter and a numeral, according to the side of the body and the distance from the ICG border (e.g., “L3” indicates the site located 3 cm from the border on the left). Sites of decreased StO₂ values located at R1-L1, which corresponded to the location of the outline of the ICG-negative region. Accordingly, the part lateral to the site was excised. The surgery resulted in no flap failure.

CASE 2

The tests were performed in the reverse order (Fig. 2). The boundaries with StO₂ values of 45% and 50% were determined first, and then the ICG test was performed. This determination took less than 5 minutes. The fluorescence-negative region corresponded to the region lateral to the 45% border. The estimated mean StO₂ value on the boundary between the ICG-positive and negative regions was 41.3%. We excised the skin at the ICG boundary; however, blood congestion was found. We therefore further excised the skin to the 45% region. Consequently, we confirmed the absence of blood congestion and flap failure.

Although the methods by which oximetry systems are used require further investigation, we are of the opinion that the Toccare device has the potential to be an alternative to the ICG test.

Itaru Tsuge, MD

Department of Plastic and Reconstructive Surgery
 Graduate School of Medicine
 Kyoto University
 54 Shogoin kawahara-cho
 Sakyou-ku
 Kyoto 606-8507
 Japan
 E-mail: itsuge@kuhp.kyoto-u.ac.jp

Supplemental digital content is available for this article. Clickable URL citations appear in the text.

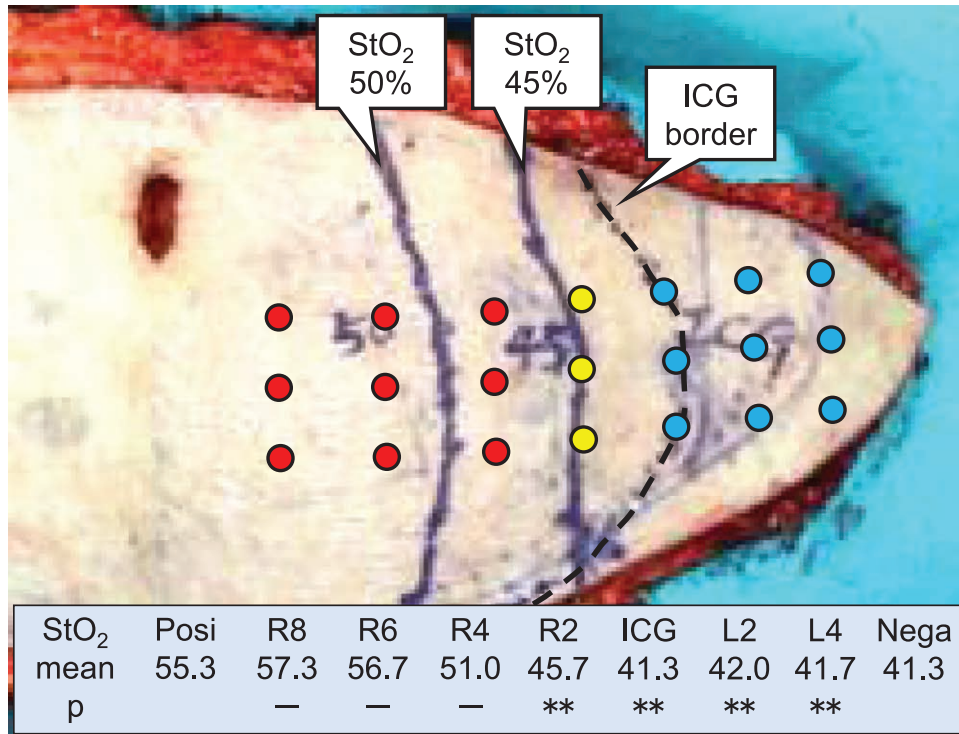


Fig.2. Case 2: A right TRAM flap for breast reconstruction. The boundaries of the ICG border, StO₂ 45% and 50% are marked on the flap. The StO₂ values significantly decreased from 2 cm on the right side (R2) of the ICG border (n = 3). **p < 0.01 on a t test.

DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article. The Article Processing Charge was paid for by the authors.

REFERENCES

- Schefflan M, Dinner MI. The transverse abdominal island flap: part I. Indications, contraindications, results, and complications. *Ann Plast Surg.* 1983;10:24–35.
- Benya R, Quintana J, Brundage B. Adverse reactions to indocyanine green: a case report and a review of the literature. *Cathet Cardiovasc Diagn.* 1989;17:231–233.
- Lin SJ, Nguyen MD, Chen C, et al. Tissue oximetry monitoring in microsurgical breast reconstruction decreases flap loss and improves rate of flap salvage. *Plast Reconstr Surg.* 2011;127:1080–1085.
- Kanayama N, Niwayama M. Examiner’s finger-mounted fetal tissue oximetry. *J Biomed Opt.* 2014;19:067008.
- Uchida T, Kanayama N, Kawai K, et al. Craniofacial tissue oxygen saturation is associated with blood pH using an examiner’s finger-mounted tissue oximetry in mice. *J Biomed Opt.* 2016;21:40502.