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Impact of body mass index, gender, and smoking on thickness of free soft tissue flaps used for orofacial reconstruction

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ABSTRACT

Donor-site selection may play an important role in the reconstruction of large orofacial defects. The thickness and structure of transplanted tissue has to fit those of the recipient site to achieve a satisfactory outcome. To evaluate the thickness of free flaps that are frequently used for orofacial reconstruction and its association with body mass index (BMI), gender, and smoking, a prospective study was conducted. A total of 122 volunteers were included in the study, and their data regarding BMI, gender, and tobacco use were documented. Ultrasonography was used to evaluate the thickness of the radial and ulnar forearm flaps (RFFF and UFFF, respectively), the scapular and parascapular flaps (SF and PSF, respectively), the anterolateral thigh flap (ALT), and the free fibular flap (FF). Correlation and regression analysis were performed to assess any relationship among parameters and to investigate their effect on flap thickness.

The UFFF showed the lowest thickness (0.65 ± 0.16 cm), followed by the RFFF (0.83 ± 0.20 cm). The FF showed a comparable thickness (0.82 ± 0.26 cm), followed by the SF (0.99 ± 0.13 cm) and the PSF (1 ± 0.14 cm). The ALT flap displayed the greatest thickness (1.42 ± 0.42 cm) and correlated especially with BMI and gender, whereas the UFFF was the thinnest with relatively constant values, regardless of potential influential factors.

1. Introduction

Microvascular reconstruction of the orofacial soft tissue using free tissue transfer has become routine in recent years. For large defects following ablative surgery in cancer patients, donor-site features may play an important role when choosing the appropriate transplant. The thickness and structure of the transplanted tissue has to fit that of the recipient site, and mimic its color and appearance as well as hairiness in order to achieve a satisfactory outcome.

Although mismatched color and hairy skin can be simply managed, initial flap thickness plays a crucial role when choosing the donor site. This is especially true when dealing with defects in the orofacial region, ranging from superficial defects to reasonably deep midface/orbital defects.

General recommendations for choosing the donor site are frequently provided, mostly based on long experience (Disa et al., 2001); however, only a few studies have considered this aspect in a systematic analysis. Available reports have evaluated the thickness of some free flaps using ultrasonography as a non-invasive method (Salmi et al., 1995; Nakayama et al., 2002; Sieg et al., 2003) or computed tomography (Seth et al., 2011).

Therefore we investigated the thickness of different free soft tissue flaps routinely used for orofacial reconstruction, including the radial and ulnar free forearm flaps (RFFF and UFFF, respectively), the scapular and parascapular flaps, the anterolateral thigh flap (ALT flap), and the skin island of the free fibula flap using ultrasonography in healthy volunteers. Additionally, regression analysis among potentially influential factors such as age, gender, body mass index (BMI), and smoking was carried out, and correlations of these individual factors with flap thickness were assessed.

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2. Material and methods

2.1. Collective and study design

A total of 122One hundred and twenty-two volunteers (60 male and 62 female), aged 22–78 years (mean ± SD 39.58 ± 15.64 years) were randomly recruited from the hospital staff of the study site and included in the study after signing an informed consent. Measurements were integrated in a database along with their corresponding age, gender, BMI, and tobacco use (non-smoker or medium-to-heavy smoker [≥15–24 cigarettes per day]) (Hurley, 2014). BMI amounted to 24.95 ± 5.25; it was interpreted as defined by the World Health Organization (1995) and calculated as follows: BMI = mass (kg)/height (m^2).

The skin flap thickness of the radial, ulnar, scapular, parascapular, ALT, and fibular flaps on both sides was measured in each volunteer via ultrasonography.

For evaluation of both radial and ulnar flaps, four regions along the course of the radial/ulnar artery were measured, beginning at 4 cm proximally from the scaphoid/pisiform bone as described for flap harvest (Song et al., 1982; Lovie et al., 1984) (Fig. 1).

For the scapular and parascapular flaps, three regions along the course of both the cutaneous scapular branch and cutaneous parascapular branch of the descending branch of the circumflex scapular artery were evaluated (Hamilton and Morrison, 1982; Nassif et al., 1982) (Fig. 2).

For assessment of the ALT flap, a longitudinal line was drawn from the anterior superior iliac spine (ASIS) to the superolateral corner of the patella. Centered on the midpoint of this line, a skin flap extending up to 6 cm proximally and distally was outlined, and the thicknesses of four skin regions along the descending branch of the lateral circumflex femoral artery (LCFA) were measured (Song et al., 1984) (Fig. 3).

The thickness of the skin paddle of the fibular flap was measured for potential flap localization beginning at 8 cm cranially to the lateral malleolus (Wei et al., 1986, 1994). Four regions along the septum between the soleos/gastrocnemius muscles and the peroneus longus/brevis muscles were investigated (Fig. 4).

The study was performed after approval by the local Ethics Committee of the University of Luebeck, Germany, and was conducted according to the principles of the Declaration of Helsinki.

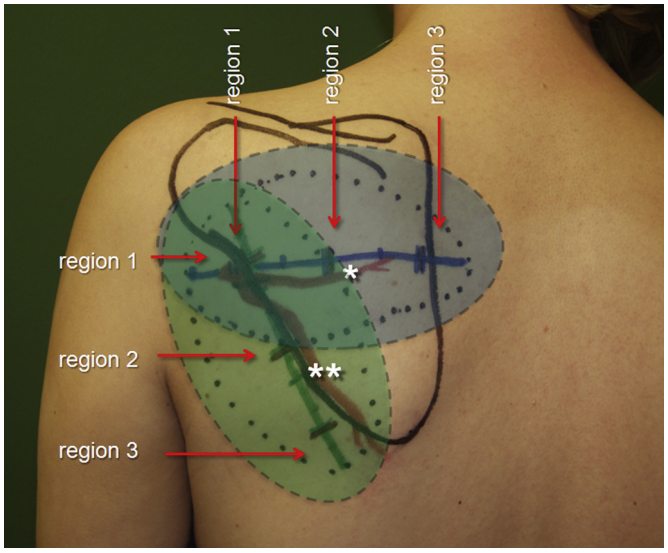

Fig. 2. Investigated donor sites for thickness of the scapular and parascapular flaps. Single asterisk marks horizontal cutaneous scapular branch; double asterisk marks descending branch of circumflex scapular artery.

2.2. Ultrasonography

Ultrasonography was always performed by the same investigator using the same ultrasonic unit (Logiq P6, GE Healthcare, Madison, WI, USA) and probe (13-MHz linear B-scan ultrasound probe). Compression of the skin surface by the ultrasound probe was avoided using an overproportional gel layer.

Measurements were performed directly after freezing ultrasound images, and values were documented separately. All regions of each flap design were measured three times to minimize bias, and the resulting values were documented as mean ± standard deviation or median ± median absolute deviation.

2.3. Statistical evaluation

After data collection, regression analysis to investigate the relationship among the various parameters and Spearman

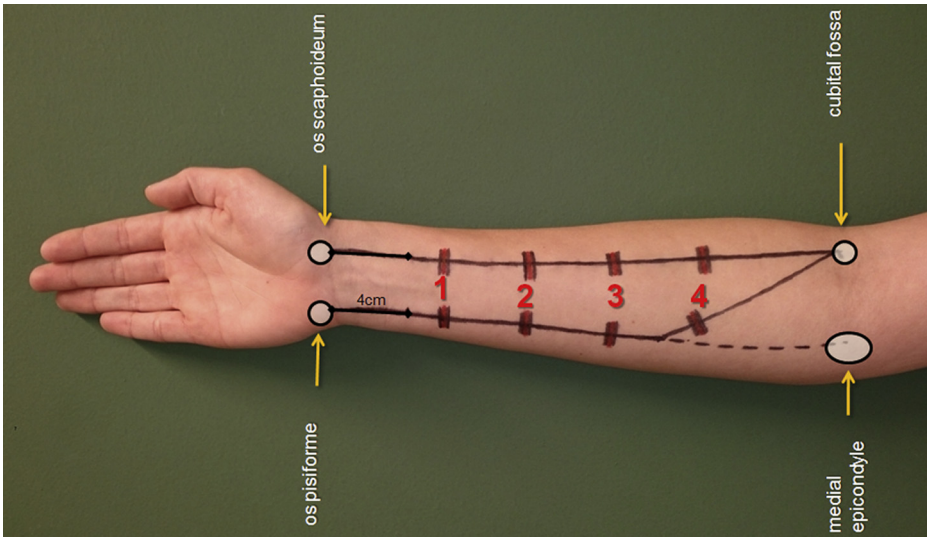

Fig. 1. Investigated donor sites for thickness of the radial and ulnar forearm flaps.