2. Tofield JJ. Deepithelialization in reduction mammaplasty is an anachronism. *Plast Reconstr Surg* 1993;**91**:1369.

Heval Selman Ozkan
Saime Irkoren
Nazan Sivrioglu
Department of Plastic and Reconstructive Surgery, Adnan Menderes University, Faculty of Medicine, Aydin, Turkey

E-mail address: selman_ozk@yahoo.com

http://dx.doi.org/10.1016/j.bjps.2013.11.009

Preoperative estimation of pedicled latissimus dorsi flap weight for breast reconstruction

Dear Sir,

The latissimus dorsi musculocutaneous (LDM) flap has been commonly used for breast reconstruction since its description in the late 1970s.[1] In Japan, the LDM flap is now a workhorse flap after breast-conservative surgery (BCS) or skin-sparing mastectomy (SSM) in small-breasted patients. However, the elevation of an inadequate flap may require a secondary procedure to compensate for tissue deficiency. Accurately gauging the amount of flap tissue to be harvested before surgery is important for obtaining a good outcome. Nevertheless, no report concerning the precise

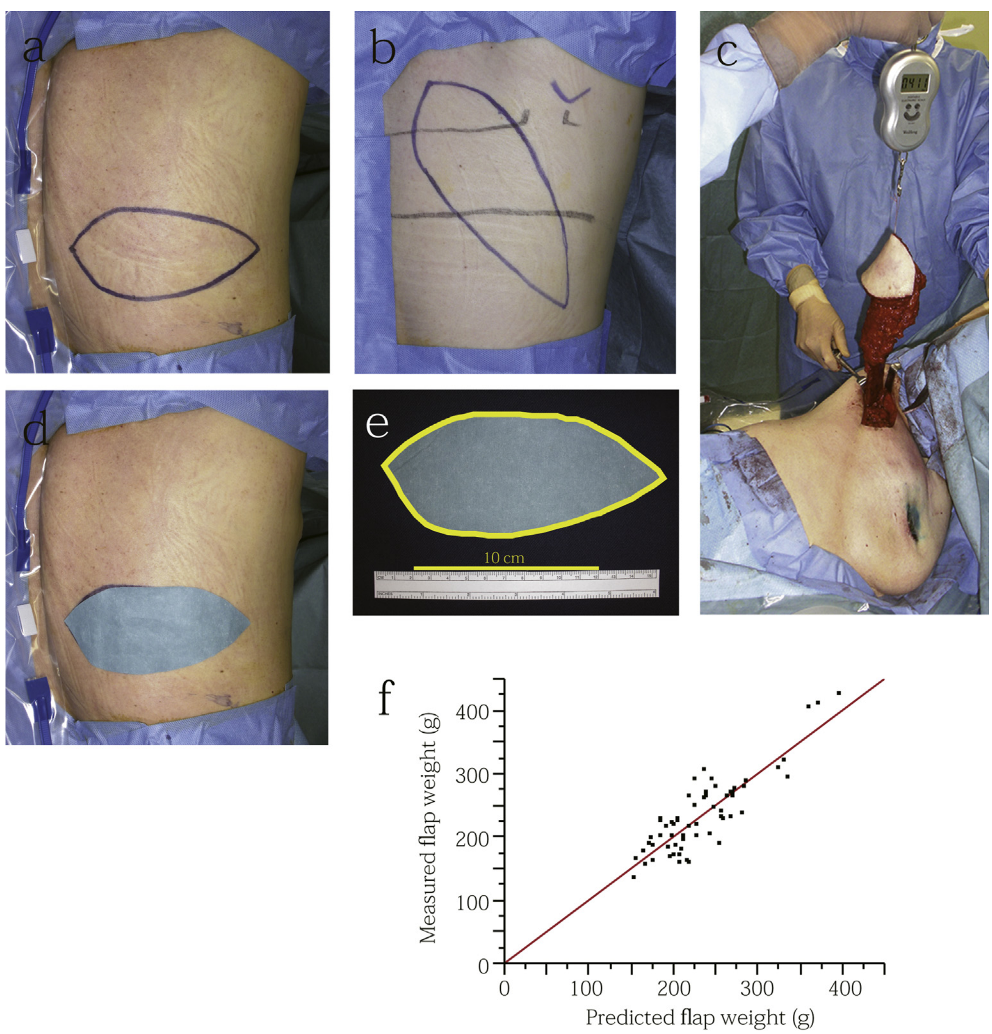

Figure 1 a. Horizontal design. b. Oblique design. c. Intraoperative assessment of pedicled latissimus dorsi musculocutaneous flap weight using a digital suspension scale. d. The outline of the skin paddle is traced on a paper placed on the back. e. The traced paper is spread on a flat surface. The area of the paper is calculated using image J software. The dimensions of this flap were 6.5 $\times$ 15 cm and 72.2 cm^2. The flap weight was 410 g. f. Relationship between the measured flap weight and predicted flap weight.

prediction of LDM flap amount has been previously published. Therefore, we developed a reliable formula for predicting the amount of the LDM flap based on simple and clinically useful measurements.

A total of 65 patients with breast cancer who had undergone LDM flap reconstruction from March 2012 to May 2013, were analyzed. The majority of LDM flap skin paddles were designed horizontally on the back ($n = 49$), where the bra can hide resulting scars (Figure 1a). In cases requiring a larger amount of flap tissue, the skin paddle was designed in an oblique position ($n = 16$) (Figure 1b). All LDM flaps were elevated in the standard fashion, not as the extended LDM flap.[2] Flap dissection first involved the circumferential incision of the skin paddle. Subcutaneous dissection was performed under the deep thoracic fascia over the latissimus dorsi, and the deeper layer of fat was thus harvested along with the entire muscle. The flap was elevated from the distal to the proximal position, and its neurovascular pedicle was dissected. The thoracodorsal nerve was preserved to prevent long-term muscle atrophy. The latissimus dorsi tendinous insertion on the humerus was severed.

Pedicled LDM flap weight (FW), age, height, body weight (BW), body mass index (BMI), body surface area (BSA), and skin paddle area (SPA) were recorded from medical charts. FW was measured after complete flap harvesting, using a digital suspension scale as previously described (Figure 1c).[3] SPA of the LDM flap was calculated as follows. The outline of the skin paddle was traced on a paper (Figure 1d), which was then spread on a flat surface, and the area of the paper was measured with image J software developed by the National Institute of Health (Figure 1e). Descriptive statistics are listed in Table 1. Simple linear regression was first used to define the linear relationship between FW and other parameters. Second, all subsets multiple regression analyses were performed as well, to assess whether FW prediction accuracy improves after utilizing multiple variables. The coefficient of determination (R^2 for simple regression and adjusted R^2 for multiple regression) and root mean square error (RMSE) were used as goodness-of-fit parameters. R^2 and adjusted R^2 were used for determining the degree of association. The higher the value of R^2 and adjusted R^2, the more useful the regression equation as a predictive measure and vice-versa. RMSE measures the accuracy of the estimated figure. The smaller its value, the better the estimates and vice-versa. Although assessment of the flap volume is very important, we instead measured the weight of the LDM flap because no precise measurement of pedicled flap volume exists. Water displacement[4] or more accurately, buoyant force measurement,[5] which can gauge free flap volume, cannot be applied to the pedicled LDM flap because of the attached pedicle.

Table 1 Physical characteristics, SPA, and FW of subjects.

($n = 65$)	Mean	Range
Age, yr	46.3	19–74
Height, cm	159.7	148.0–174.5
BW, kg	55.0	39.6–76.5
BMI, kg/m^2	21.5	16.8–30.6
BSA, m^2	1.6	1.3–1.8
SPA, cm^2	63.4	33.7–110.7
FW, g	233.1	135–425

BW, body weight; BMI, body mass index; BSA, body surface area; SPA, skin paddle area; FW, flap weight.

Simple regression analysis showed that BMI has the best correlation with FW ($r = 0.664$). The equation using BMI has the highest R^2 (0.441) and the lowest RMSE (45.037). When the accuracy of the all subsets multiple regression was assessed, the variables selected in the best model include BMI and SPA, as indicated by the highest adjusted R^2 (0.741) and the lowest RMSE (30.445). The multiple regression model showed an increased prediction accuracy compared to that obtained using simple regression, and the following formula provided the best model: FW (g) $= 13.50 \times$ BMI (kg/m^2) $+ 1.67 \times$ SPA (cm^2) $- 163.26$.

The relationship between actual FW and predicted FW is presented in Figure 1f. A plastic surgeon can use this formula to preoperatively estimate the amount of the LDM flap, and to determine whether this amount of tissue will be adequate to cover the defect after BCS or SSM in small-breasted patients. If the flap volume is expected to be inadequate, a much larger skin paddle should be designed, or another reconstructive procedure should be selected.

In conclusion, we have developed a simple and accurate formula for estimating the weight of the pedicled LDM flap in East Asians; this is the first report in which such a formula has been obtained. This formula will aid plastic surgeons to select the most appropriate reconstructive procedure for obtaining optimal results after BCS or SSM in small-breasted patients.

Funding

None.

Conflicts of interest

None.

References

1. Schneider WJ, Hill Jr HL, Brown RG. Latissimus dorsi myocutaneous flap for breast reconstruction. *Br J Plast Surg* 1977;**30**:277–81.
2. Hokin JA. Mastectomy reconstruction without a prosthetic implant. *Plast Reconstr Surg* 1983;**72**:810–8.
3. Summerhayes C, Hurren J. Suspension scale to assist in volume estimation of autologous latissimus dorsi flap. *J Plast Reconstr Aesthet Surg* 2007;**60**:329–30.
4. Minn KW, Hong KY, Lee SW. Preoperative TRAM free flap volume estimation for breast reconstruction in lean patients. *Ann Plast Surg* 2010;**64**:397–401.
5. Fujiwara T, Yano K, Tanji Y, Hosokawa K. Simple and accurate volume measurement of mastectomy specimens. *Eur J Plast Surg* 2013;**36**:275–6.

Takashi Fujiwara
Kenji Yano
Department of Plastic Surgery, Osaka University Graduate School of Medicine, Osaka, Japan

E-mail address: tfujiwara33@gmail.com

Yoshio Tanji
Department of Breast and Endocrine Surgery, Morinomiya Hospital, Osaka, Japan

Shigeyuki Kanazawa
Ko Hosokawa
Department of Plastic Surgery, Osaka University Graduate School of Medicine, Osaka, Japan

http://dx.doi.org/10.1016/j.bjps.2013.11.010

Sequential multi-layered hemostatic sutures for stepwise removal of arteriovenous malformations: The pineapple technique

Dear Sir,

Arteriovenous malformations (AVMs) are a mass of vessels forming abnormal connections between arteries and veins and thus shunting of blood from a high-pressure into a low-pressure system.[1] The presence of AVMs can cause disfigurement and patient distress, tissue destruction, obstruction of vital structures, pain, spontaneous bleeding, ulceration with infection or even sepsis, and rarely cardiac overload and failure.[2]

Treating AVMs is challenging due to the high risk of massive peri-operative blood loss and incomplete excision leading to subsequent recurrence. Usually, preoperative angiography with embolization followed by surgical resection is performed. Although surgery can cure AVMs, complete excision is rarely possible due to their poorly defined margin, tissue penetration and involvement of vital structures. Various methods have been described to facilitate safe surgical resection, such as preoperative embolization, low-pressure anesthesia and auto-transfusion with limited success.

In our series of 8 patients surgical resection was indicated as debilitating or life-threatening symptoms were present such as spontaneous massive bleeding, neurologic symptoms secondary to compression and tissue necrosis. The sequential multi-layered hemostatic suture technique presented produces the visual effect of pineapple skin and facilitates a controlled debulking or complete excision of AVMs while drastically reducing the incidence of uncontrollable intra-operative bleeding. It also expedites surgery significantly. Intra-operative use of Doppler can prevent the insertion of hemostatic sutures through vital structures.

From 2004 to 2013, 8 cases of AVMs have been treated using this novel technique. Head and neck, upper and lower limb lesions were treated. We use CT-angiography to delineate the structure of the AVMs, and an MRI scan to visualize soft tissue penetration and its relation to vital structures. The exact part of the lesion which could be safely excised, without endangering any vital structures is noted. Numerous round 3–0 PDS™ hemostatic sutures are placed through the superficial layer of the AVM. The section of the mass surrounded by sutures is excised and new hemostatic sutures are placed on the raw surface. Repeated cycles of debulking and hemostatic suture placement ensure a controlled staged excision of the AVM with a small amount of blood loss. The mass is serially excised from a superficial layer to the deep (Figure 1). Eventually, complete excision of the mass can occasionally be achieved if vital structures are safe. Finally, the base of the wound is carefully reviewed to ensure haemostasis. If required, reconstruction can follow after considering the size, location and cosmetic outcome. Postoperative treatment of residual lesion with embolization or injection with sclerosing agents can be performed if indicated.

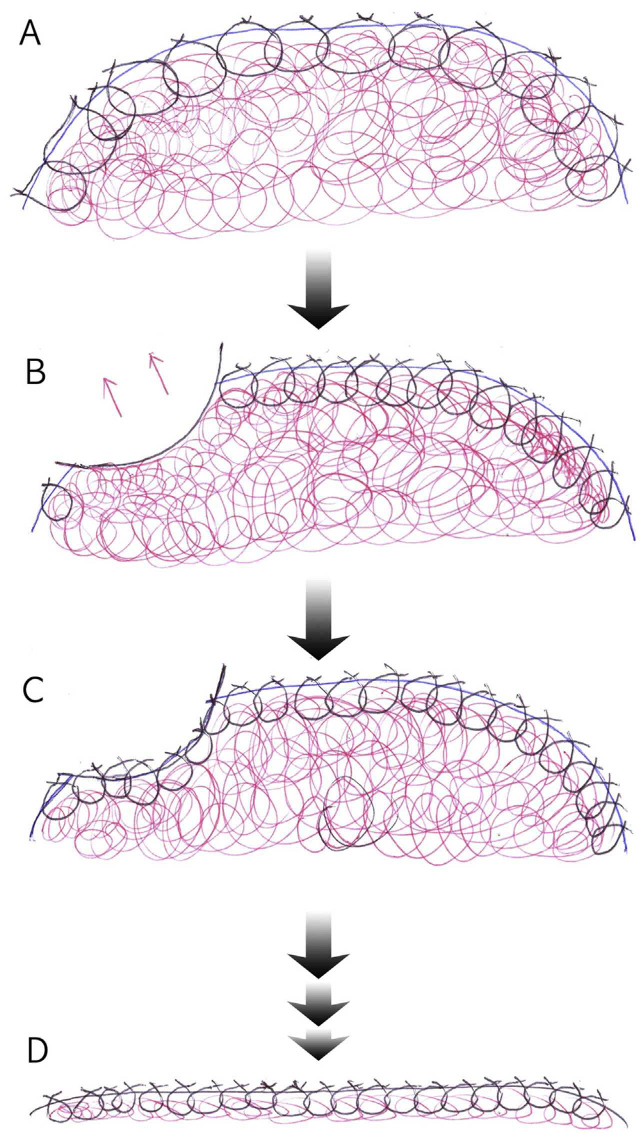

Figure 1 Graphic illustration of suture placement. (A) Dense hemostatic sutures are placed through the superficial part of the AVM. (B) Debulking of part of the AVM. (C) Replacement of hemostatic sutures over the area which has been removed. The above process is repeated until the desirable bulk of the lesion has been excised. (D) Cross sectional view of the final result, with hemostatic sutures controlling any residual lesion.