Estimation of Profunda Artery Perforator Flap Weight Using Preoperative Computed Tomography Angiography

Nicolas Greige B.S.[1], David Nash M.D[1]., Ara A. Salibian M.D.[2], Steven M. Sultan, M.D.[1],Vishal D. Thanik M.D.[2], Katie E. Weichman M.D.[1]
[1]Albert Einstein College of Medicine, Montefiore Medical Center, Division of Plastic Surgery, Bronx, NY
[2]NYU Langone Health, Hansjörg Wyss Department of Plastic Surgery, New York, NY

Background

- The preponderance of autologous breast reconstruction is abdominally-based[1]
- Factors that preclude the use of the abdomen in breast reconstruction include:
  - History of abdominoplasty
  - Low subcutaneous abdominal adiposity
  - Poor abdominal perforators
  - Previous abdominally-based reconstruction
- The profunda artery perforator (PAP) flap has become increasingly popular as an alternative donor-site since its use in breast reconstruction was first described in 2012[2]
- Thigh-based flaps are limited by their relatively small size as compared to abdominally-based flaps, and may be stacked to match native breast size[3-6]
- Given the relatively small size of thigh-based flaps and the possible necessity for a multi-flap reconstruction, it is imperative to arrive at an accurate estimation of flap weight during preoperative planning
- Several methods have been described for flap weight estimation in abdominally-based free flaps, however no such studies exist for PAP flaps[7,8]
- Our objective was to develop a novel technique for the preoperative estimation of PAP flap weight

Methods

- A retrospective review of all patients that underwent PAP flap breast reconstruction at two institutions between 2014 and 2019 was performed
- Patients were included if they had a preoperative computed tomography angiography (CTA) scan available for review, had undergone a transverse PAP flap, and had a recorded flap weight
- Subcutaneous tissue thicknesses were measured on each CTA scan by a single investigator at the following predetermined points both in the plane where the dominant profunda artery perforator pierced the deep fascia and 4.5 cm caudal to the gluteal fold:
  - Lateral border of the long head of biceps femoris
  - Junction of adductor magnus and gracilis
  - Posterior border of sartorius
- The distance from the inferior gluteal fold to the dominant profunda artery perforator was also recorded
- A forward stepping multiple linear regression analysis was performed to determine the parsimonious prediction formula

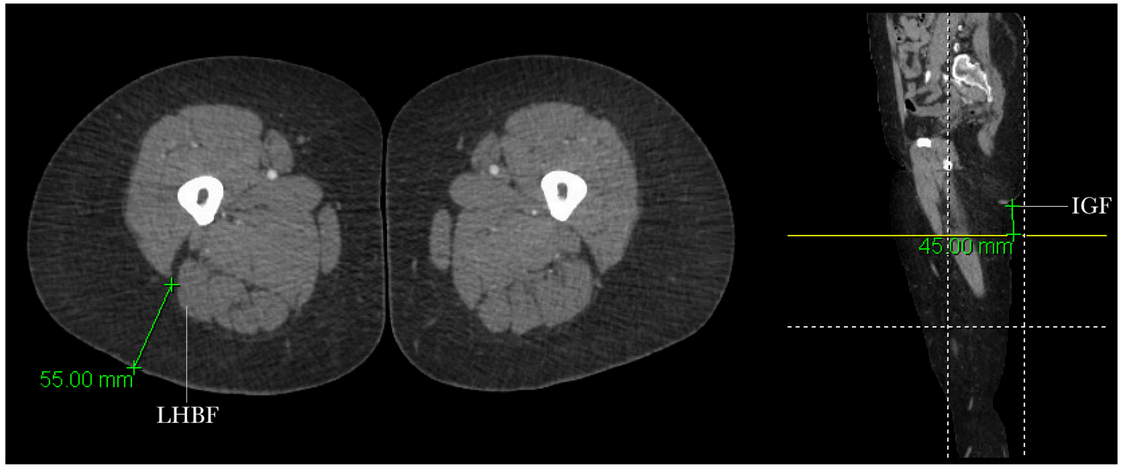

Table 1. Patient and flap characteristics.

	Summary statistic
Age, yr	47.0 (42.0 – 53.0)
BMI, kg/m²	25.4 (21.9 – 31.5)
Actual flap weight, g	299 (235 – 408)
Estimated flap weight, g	305 (234 – 402)
Percent error*	10.5 (6.1 – 16.2)

N = 18 patients, 32 flaps.
Reported as median (IQR). *BMI*, body mass index.
*Absolute difference between estimated and actual flap weight divided by actual flap weight.

Table 2. Linear regression for flap weight prediction.

	Regression coefficient (95% CI)
Subcutaneous thickness lateral to LHBF, cm*	77.9 (62.0– 93.8)
Distance from IGF to dominant perforator, cm	33.8 (20.9 – 46.7)
Supine position during CTA scan (reference: prone)	43.4 (7.5 – 79.3)
Constant	-254.3

R^2 = 0.80, N = 32 flaps.
LHBF, long head of biceps femoris, *IGF*, inferior gluteal fold, *CTA*, computed tomography angiography.
*Measured at the level 4.5 cm caudal to the IGF.

Results

- 18 patients (32 flaps) were analyzed
- Median flap weight was 299 (range: 188 – 539) (Table 1)
- The parsimonious flap weight prediction formula was described by $77.9x + 33.8y + 43.4z - 254.3$ (Table 2), where:
  - x is subcutaneous tissue thickness (cm) at the lateral border of long head of the biceps femoris at a level 4.5 cm caudal to the inferior gluteal fold
  - y is distance (cm) from the inferior gluteal fold to the dominant profunda artery perforator
  - z has a value of 1 if the patient was scanned in the supine position or 0 if prone
- The median percent error between actual and estimated flap weight was 10.5 (IQR: 6.1 – 16.2)

Discussion

- PAP flap weight can be preoperatively estimated over a wide range of flap weights using CTA scans
- Flap weight estimation depends on subcutaneous tissue thickness, distance of the perforator from the inferior gluteal fold, and patient positioning during CTA scan
- These findings are limited by the small sample size, lack of internal and external validation methods, and retrospective study design; further studies are required to validate this prediction model

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