

PREFABRICATED FLAP SIZE LIMITATIONS UTILIZING AN OMENTAL CARRIER

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Several researchers and clinicians have taken advantage of the omentum's rich vascular arcades to support skin grafts. We have previously described an experimental model using the omentum as a vascular carrier for prefabricated free flaps in the rat. In this study, we used this model to compare three different sizes of free flaps using the same size omental carrier. Twenty-four male Sprague-Dawley rats were used for this study. A 2.5 × 4 cm patch of omentum with gastroepiploic vessels and its rich vascular arcades was transferred under a bipediced 2.5 × 6 cm (group I), a 2.5 × 8 cm (group II), and a 4 × 10 cm (group III) right abdominal panniculocutaneous flap. On the seventh postoperative day, the skin pedicles were divided and the skin flap raised as a composite island flap vascularized only by the underlying omental patch. The composite flap was then sutured back in place.

Prefabricated flaps examined 7 days postoperatively demonstrated a dye fluorescence index percent (DFI) of 38.19 ± 7.52 and 98.13 ± 3.72% flap survival (FS) in the 6 × 2.5 cm skin flap group; a DFI of 39.96 ± 6.81% and FS 94.88 ± 7.08% in the 8 × 2.5 skin flap group ($P > 0.05$) and a DFI 29.71 ± 2.85% and FS 57.06 ± 9.52% in the 10 × 4 cm skin flap group ($P < 0.05$). India ink injection study and histologic examination confirmed revascularization of the overlying skin at 7 days. This study confirms that omentum can be used as a vascular carrier for prefabricated flaps. However, there is a limit to the size of the flap. A 10 cm² carrier can support 57% of a 40 cm² (10 × 4 cm) flap for a total area of 22.8 cm², more than twice the area of the carrier.

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In a previous study we demonstrated the use of omentum as a vascular carrier in the rat.^{1,2} A 4 × 2.5 cm omental carrier was used to vascularize a 6 × 2.5 cm panniculocutaneous flap. In this study we used the same sized omental carrier, a 4 × 2.5 cm piece of omentum and its vascular pedicle, to support two larger panniculocutaneous flaps of 8 × 2.5 cm and 10 × 4 cm in size. Survival of the 6 × 2.5 cm, 8 × 2.5 cm, and 10 × 4 cm panniculocutaneous flaps were then compared.

MATERIALS AND METHODS

A total of 24 male Sprague-Dawley rats weighing 350–550 g were studied in three experimental groups of eight each. Intraperitoneal 4% chloral hydrate was used for anesthesia, and the abdominal skin of the rats was shaved and depilated.

In group I, a 2.5 × 4 cm patch of omentum was used to carry a 2.5 × 6 cm abdominal panniculocutaneous flap. In group II, a 2.5 × 4 cm patch of omentum was used to carry

a 2.5 × 8 cm abdominal panniculocutaneous flap, and in group III, the same sized carrier was used to nourish a 4 × 10 cm abdominal panniculocutaneous flap.

A 2.5 × 6 cm (group I) or 2.5 × 8 cm (group II) or 4 × 10 cm (group III) skin flap was elevated on the right side of the abdomen, leaving the flap attached by superior and inferior skin pedicles (marked A and B in Fig. 1). The omentum was mobilized from the transverse colon and separated from the stomach. A surrounding 2.5 × 4 cm patch of the omentum was dissected free and tacked under the skin flaps.

The composite flap with an omental carrier was sutured back in place on the abdominal wall. The composite flap was isolated from the underlying fascia by a thin silastic sheet, allowing blood flow only through the gastroepiploic vascular pedicle.

On the seventh postoperative day, the superior, inferior, medial, and lateral skin pedicles (marked A, B, C, and D, respectively, in Fig. 1) were divided and the skin flap was raised as a composite island flap only supplied by the omental vascular pedicle.

Each group was evaluated by the following procedures.

Fluorescein Skin Perfusion

Sodium fluorescein (1.5 mg/kg) was injected into the femoral vein of each rat. Using a fluoroscan surface monitor, the skin surface fluorescence was measured 30 minutes

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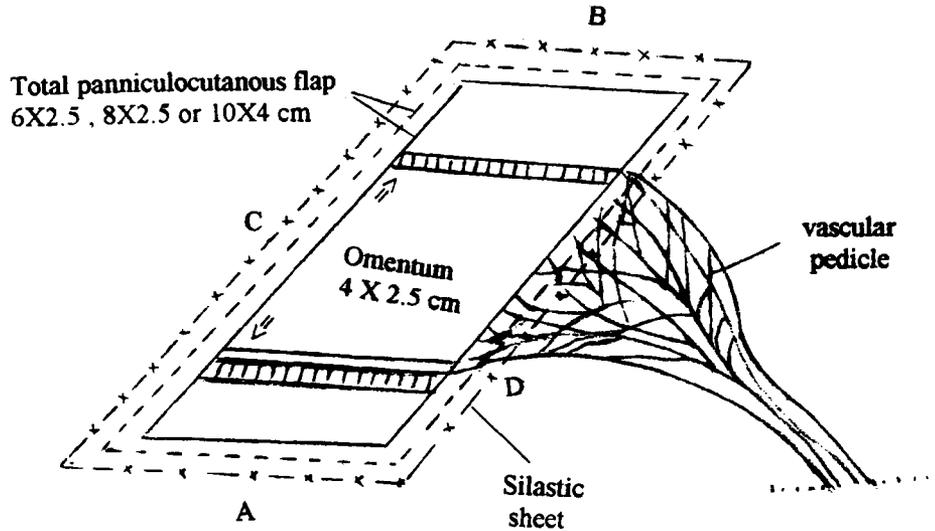


Figure 1. A 2.5 × 4 cm patch of omentum was transferred under a 2.5 × 6 cm, 2.5 × 8 cm, or 4 × 10 cm panniculocutaneous flap. Dashed line indicates lines of division of panniculocutaneous flap at day 7. Dashed lined with x indicates silastic sheet, which is larger than panniculocutaneous flap. Solid line demarcates boundary of panniculocutaneous flap.

after skin pedicle division and resuturing. The index of dye fluorescence (DFI) was calculated by Graham’s method.³

Observation of Omental Flap Survival

The percentage of flap survival after skin pedicle division and resuturing 7 days following elevation was compared with the total area of the elevated flap. The percentage of flap survival was calculated by Zhang’s method.¹

India Ink Injection and Histology

At 1 week after skin pedicle division and resuturing, the flaps were injected with 1 ml India ink. A 0.5 × 0.5 cm size sample of the composite omental panniculocutaneous flap was preserved in 10% formalin solution and taken for histological examination using H&E stain.

The rats were sacrificed after this study. New York University Medical Center guidelines for use and care of experimental animals were followed throughout.

RESULTS

The average background dye fluorescence indices for the composite flap were: group I, 38.19 ± 7.52%; group II, 39.96 ± 6.81%; and group III, 29.71 ± 2.85%. Results are tabulated in Table 1.

Composite skin and omental flaps in our three experimental groups raised 7 days following prefabrication with an omental carrier demonstrated that there was no significant difference in survival between the 6 × 2.5 cm and 8 × 2.5 cm skin flaps supplied by the same size (4 × 2.5 cm) omental carrier (98.13% and 94.88% survival, respec-

Table 1. Dye Fluorescence Index (DFI) Percent and Survival Area Percent of Fabricated Flaps.

Group	No.	DFI (%)	SD (%)	Survival (% area)	SD (%)
I	8	38.19	7.52	98.13	3.72
II	8	39.96	6.81	94.88	7.08
III	8	29.71 ^a	2.85	57.06*	9.52

^aOnly half of the group was used for DFI study.

*The Newman-Kuels multiple comparison test was used; analysis of variance, P < 0.05 was reported.

tively). However, the 4 × 10 cm flap group had only a 57.06% survival (Table 1).

Histological examination of flap survival areas 7 days after division of the pedicles and injection with India ink demonstrated nearly normal skin with appendages. Vascular communication between the skin flap and the omentum had been established, as India ink was observed in the vessels of the omentum and flap (Fig. 2).

CONCLUSIONS AND DISCUSSION

In this study, we conclusively demonstrated that a 4 × 2.5 cm patch of omentum used as a carrier can equally support 15 cm² (6 × 2.5 cm) and 20 cm² (8 × 2.5 cm) abdominal panniculocutaneous flaps in the rat. However, there is a limit to the size of the flap. The same 10 cm carrier can support only 57% of the 40 cm² (4 × 10 cm) flap for a total supportable area of 22.8 cm², more than twice the area of the carrier. These results have potential for future experimental study and clinical use.

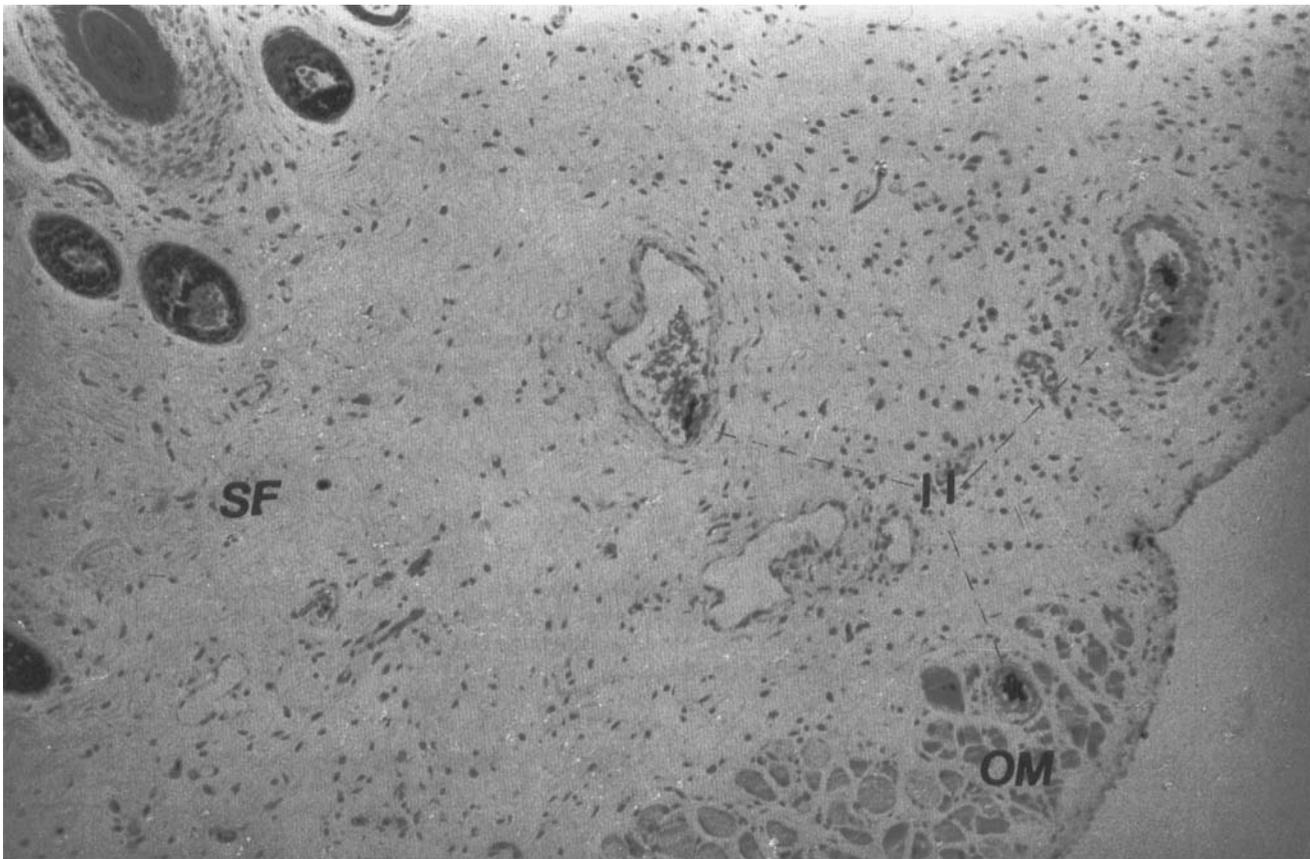


Figure 2. India ink fills the vessels of both the omentum and flap at 7 days. SF, skin flap; OM, omentum; II, India ink. H&E stain, $\times 75$.

The added morbidity of entering the abdominal cavity to harvest omentum is recognized. However, the use of omentum as a vascular carrier needs to be compared with the more orthodox fasciovascular or musculovascular pedicles.⁴⁻⁶

The rich vascular network and demonstrated ability of omentum to cover a large scalp defect,⁷ to neovascularize random skin flaps,⁸ to repair wounds,⁹ and to reconstruct the breast¹⁰ justifies further study of the omentum as a vascular carrier.

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