Introducing the Septocutaneous Gluteal Artery Perforator Flap: A Simplified Approach to Microsurgical Breast Reconstruction

Stefania Tuinder, M.D.
Constance M. Chen, M.D., M.P.H.
Marga F. Massey, M.D.
Robert J. Allen, Sr., M.D.
Rene Van Der Huist, M.D.
Maastricht, The Netherlands; New York, N.Y.; and Charleston, S.C.

Background: Consistent septocutaneous perforators exist between the gluteus maximus and medius muscles. The existence of these septocutaneous perforators obviates the need for any intramuscular dissection when elevating a gluteal artery perforator flap. In this study, the authors present their experience with the septocutaneous gluteal artery perforator (sc-GAP) flap for microsurgical breast reconstruction.

Methods: The authors retrospectively reviewed 11 consecutive sc-GAP flaps performed for postmastectomy breast reconstruction in nine patients between February and July of 2008. Patient demographics, risk factors, perforator characteristics, operative technique, operative time, and outcome were analyzed. Preoperative imaging was used for all patients.

Results: Mean patient age was 52 years (range, 44 to 60 years). Mean body mass index was 22.2 (range, 17.2 to 29.1). Of the 11 flaps, five sc-GAP flaps were immediate (45 percent) and six were delayed reconstruction (55 percent); seven were unilateral (64 percent) and four were bilateral (36 percent). Mean operative time was 8.2 hours (range, 6.5 to 11 hours). All patients stayed in the hospital for 5 days. Mean pedicle length was 7.9 cm (range, 5 to 10 cm) and mean flap weight was 499 g (range, 360 to 640 g). Vessel size ranged from 1.8 to 3 mm. Complications included one take-back, one axillary seroma, one donor-site seroma, and one donor-site hematoma. There were no flap losses.

Conclusions: The sc-GAP flap is a viable technique for microsurgical breast reconstruction that may be easier to master than traditional musculocutaneous gluteal artery perforator flap procedures. The authors recommend the sc-GAP flap as a simplified approach to gluteal artery perforator flaps for microsurgical breast reconstruction. (Plast. Reconstr. Surg. 127: 489, 2011.)

In 1975, breast reconstruction entered a new era when microsurgical techniques were first used to create a breast mound in a patient with Poland syndrome.1 The landmark case, reported by Fujino et al., was performed successfully by using a gluteus maximus myocutaneous flap. The following year, the same team again reported using a gluteus maximus myocutaneous flap to perform the first microsurgical breast reconstruction in a patient after a mastectomy.2 The gluteus maximus myocutaneous free flap went on to undergo multiple modifications in its use for breast reconstruction, most notably by Shaw in 1983.3–7 At the same time, however, breast reconstruction was further transformed by the use of the abdomen as a donor site, which provided the surgeon with tissue that was easier and more convenient to use.8–10 In comparison with the abdomen, it became evident that the buttock as a donor site had multiple disadvantages, most notably a short vascular pedicle, a deforming donor-site defect, and the long operative time that was needed to reposition the patient for harvest and inset.

Not until 1995 were the first two problems with the gluteal flap solved by Allen, who intro-
duced the superior gluteal artery perforator (S-GAP) flap. 

As a muscle-sparing method of microsurgical breast reconstruction, the S-GAP flap was significant for preserving the gluteus maximus muscle at the donor site and leaving a longer vascular pedicle with the flap. The technique essentially eliminated the donor-site deformity and made the microsurgical anastomosis and flap inset much more straightforward. The improvements seen in the S-GAP flap led to the development of the inferior gluteal artery perforator (I-GAP) flap. 

With the establishment of the S-GAP and I-GAP flaps, the buttock became a much more viable donor site for microvascular breast reconstruction.

Today, many critics of the S-GAP or I-GAP superior flap voice skepticism about the meticulous intramuscular dissection of the perforators to the vascular pedicle. The dissection must be carried out all the way to the superior or inferior gluteal vessels to harvest a donor artery with favorable size match characteristics. 

At this level, the vein is usually 2 to 3 mm, a factor that has become less important now that vascular coupling devices have entered routine use. To address the concerns of skeptics, preoperative imaging with magnetic resonance angiography and computed tomographic angiography has allowed us to define the intramuscular course of the perforators before flap elevation. 

This has allowed us to quickly and accurately identify the size, location, and route of target perforators before the operative procedure.

To further simplify the use of gluteal flaps for microsurgical breast reconstruction, we have recently published an anatomical study demonstrating the consistent presence of septocutaneous perforators between the gluteus maximus and medius muscles. These septocutaneous perforators originate from the superior gluteal artery and are not usually included in a conventional S-GAP flap design. The existence of these septocutaneous perforators obviates the need for any intramuscular dissection when elevating the S-GAP or I-GAP flap. We have named this simplified gluteal artery perforator flap the septocutaneous gluteal artery perforator (sc-GAP) flap. In this study, we present our experience with the sc-GAP flap for microsurgical breast reconstruction. We have found the sc-GAP flap to be straightforward to use, and we introduce it as a simplified approach to gluteal artery perforator flaps for microsurgical breast reconstruction.

PATIENTS AND METHODS

This was a retrospective review of 11 consecutive sc-GAP flaps performed for postmastectomy breast reconstruction in nine patients between February and July of 2008 at three institutions in Maastricht, The Netherlands; Charleston, South Carolina; and New York, New York. A detailed chart review was performed for each patient. We evaluated patient demographics, perforator characteristics, operative technique, operative time, length of hospital stay, and outcome. Risk factors analyzed included age, body mass index, smoking status, timing of reconstruction, and vessel size. Information was compiled regarding the incidence of intraoperative and postoperative flap complications. Preoperative imaging was used for all patients.

Operative Technique

All candidates for a breast reconstruction from the gluteal region underwent preoperative imaging before surgery. In 75 percent of the cases, an acceptable septocutaneous gluteal perforator was identified, and for all these patients, a plan for an sc-GAP flap was made. Preoperative markings consist of an elliptical skin island centered on one perforator within the ipsilateral gluteal region, with marks above the margin of the gluteus maximus muscle (Fig. 1). On average, the perforator is located 12.9 cm from the midline (range, 9.6 to 16 cm) and 5.1 cm from the iliac crest (range, 3.4 to 11 cm). The design of the skin island is more cephalad and lateral than that used in a conventional musculocutaneous S-GAP flap (Fig. 2). In cases of primary reconstruction, the oncologic surgeon performs the mastectomy, after which the reconstructive surgeon prepares the recipient vessels. The patient is then flipped to the prone position to elevate the gluteal artery perforator flap. In cases of secondary reconstruction, patients are placed in the prone position at the start of the procedure for flap harvest.

Dissection starts from the cephalad side of the skin island and continues caudally until the margin of the gluteus maximus muscle is identified and the fascia incised (Fig. 3). The key point of the dissection is the identification of the superior margin of the gluteus maximus. Once the superior edge of the gluteus maximus is identified and the fascia incised, the septocutaneous perforator(s) may be palpated at the inferior edge of the gluteus maximus. The plane between the gluteus maximus and medius muscles is very loose, and if the surgeon puts his or her finger in this plane, it can be moved and the pulsation of the perforators running in the same plane can be felt. A small cuff of fascia around the perforator can be included in

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the flap (Fig. 4). The gluteus maximus and gluteus medius are then separated to expose the septocutaneous perforator (Fig. 5). If more than one septocutaneous perforator exists, all of them may

Fig. 1. Drawings show the relationship of the septocutaneous gluteal artery perforator (Sc-GAP) to the tensor fasciae latae muscle (TFL), the gluteus maximus muscle (G. Max.), and the gluteus medius muscle (G. Med.). (Left) Frontal view; (right) lateral view.

Fig. 2. Preoperative markings for the septocutaneous gluteal artery perforator flap (right) consist of an elliptical skin island centered on one perforator within the ipsilateral gluteal region, with marks cephalad to the margin of the gluteus maximus muscle. The design of the septocutaneous gluteal artery perforator skin island is more cephalad and lateral than that used in a conventional musculocutaneous superior gluteal artery perforator flap (left).

Fig. 3. Dissection starts from the cephalad side of the skin island and continues caudally until the margin of the gluteus maximus muscle and the perforators are identified and the fascia is incised. G. Max., gluteus maximus muscle; G. Med., gluteus medius muscle; TFL, tensor fasciae latae; Perf., septocutaneous perforator pedicle of the septocutaneous gluteal artery perforator.
be preserved if possible; otherwise, the most lateral one may be preserved and dissected underneath the gluteus maximus to the origin of the superior gluteal artery (Figs. 6 and 7). Once the vessels are identified and the flap is harvested, the donor site is closed primarily. The patient is then turned supine for inset. In this series, the internal mammary artery and vein were used for the microsurgical anastomoses in all patients.

RESULTS

From February to July of 2008, 11 consecutive sc-GAP flaps were performed for postmastectomy breast reconstruction in nine patients. Mean patient age was 52 years (range, 44 to 60 years). Mean body mass index was 22.2 (range, 17.2 to 29.1). One patient was a smoker. All patients underwent preoperative imaging. Of the nine patients, four underwent computed tomographic angiography (44 percent) and five underwent magnetic resonance angiography (56 percent). One patient underwent prophylactic mastectomy and bilateral sc-GAP reconstruction because of testing positive for the BRCA2 gene (Fig. 8). Of the 11 sc-GAP flaps, five were performed as immediate reconstruction (45 percent) and six were performed as delayed reconstruction (55 percent); seven were unilateral (64 percent) and four were bilateral (36 percent); six were from the right buttock (55 percent) and five were from the left buttock (45 percent). The buttock was selected as a donor site in 10 flaps.
because of low body mass index and insufficient abdominal adipose tissue above the rectus abdominis muscle (91 percent); one patient had undergone previous abdominal surgery (9 percent). Patient and flap characteristics are listed in Table 1.

The mean operative time was 8.2 hours (range, 6.5 to 11 hours). All patients stayed in the hospital for 5 days. The mean pedicle length was 7.9 cm (range, 5 to 10 cm) and the mean flap weight was 499 g (range, 360 to 640 g). Vessel size ranged from 1.8 to 3 mm; 9-0 or 10-0 Ethilon (Ethicon, Inc., Somerville, N.J.) was used for arterial anastomosis, and couplers were used for venous anastomosis. When two or more septal perforators were located, the branches were dissected until they joined in the septum and followed until they reached adequate pedicle length and caliber.

There were no flap losses. One intraoperative complication occurred (9 percent) in which the venous anastomosis had to be performed a second time as a result of venous kinking. There was one take-back because of arterial occlusion (9 percent), in which the arterial and venous anastomoses had to be redone. There was also one axillary seroma (9 percent), one seroma at the gluteal donor site (9 percent), and one hematoma at the gluteal donor site (9 percent) that was aspirated in the clinic. Major and minor complications are summarized in Table 2.

**DISCUSSION**

Most microsurgeons who perform autologous tissue breast reconstruction select the abdomen as their first choice for the donor site. We agree with this preference; we also prefer the abdomen as our

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**Table 1. Patient and Flap Characteristics**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value (%)</th>
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<tbody>
<tr>
<td>No. of patients</td>
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</tr>
<tr>
<td>Age, yr</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>52</td>
</tr>
<tr>
<td>Range</td>
<td>44–60</td>
</tr>
<tr>
<td>BMI</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>22.2</td>
</tr>
<tr>
<td>Range</td>
<td>17.2–29.1</td>
</tr>
<tr>
<td>Tobacco use</td>
<td>1 (9)</td>
</tr>
<tr>
<td>CT angiography</td>
<td>4 (44)</td>
</tr>
<tr>
<td>MR angiography</td>
<td>5 (55)</td>
</tr>
<tr>
<td>sc-GAP flaps (n = 11)</td>
<td></td>
</tr>
<tr>
<td>Immediate reconstruction</td>
<td>5 (45)</td>
</tr>
<tr>
<td>Delayed reconstruction</td>
<td>6 (55)</td>
</tr>
<tr>
<td>Unilateral sc-GAP</td>
<td>7 (64)</td>
</tr>
<tr>
<td>Bilateral sc-GAP</td>
<td>4 (36)</td>
</tr>
<tr>
<td>Right sc-GAP</td>
<td>6 (55)</td>
</tr>
<tr>
<td>Left sc-GAP</td>
<td>5 (45)</td>
</tr>
<tr>
<td>Internal mammary recipient</td>
<td>11 (100)</td>
</tr>
</tbody>
</table>

BMI, body mass index; CT, computed tomographic; MR, magnetic resonance; sc-GAP, septocutaneous gluteal artery perforator.

**Table 2. Complications**

<table>
<thead>
<tr>
<th>Complications</th>
<th>No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>11</td>
</tr>
<tr>
<td>Major</td>
<td></td>
</tr>
<tr>
<td>Flap loss</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Take-back (arterial occlusion)</td>
<td>1 (9)</td>
</tr>
<tr>
<td>Intraoperative venous reoperation</td>
<td>1 (9)</td>
</tr>
<tr>
<td>Minor</td>
<td></td>
</tr>
<tr>
<td>Axillary seroma</td>
<td>1 (9)</td>
</tr>
<tr>
<td>Donor-site seroma</td>
<td>1 (9)</td>
</tr>
<tr>
<td>Donor-site hematoma</td>
<td>1 (9)</td>
</tr>
</tbody>
</table>

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Fig. 8. One patient underwent prophylactic mastectomy and bilateral septocutaneous gluteal artery perforator reconstruction because she tested positive for the BRCA2 gene. (Left) Preoperative view; (right) postoperative view.
primary donor site for autologous tissue breast reconstruction. Furthermore, our second-choice donor site for microsurgical breast reconstruction is the medial thigh. Like the abdomen, the medial thigh donor site does not require positioning changes during the operative procedure. The patient can remain supine for both flap harvest and inset, which minimizes the anesthesia time for the patient. Despite the advances that have been made with the S-GAP and I-GAP flaps, the buttock remains our third-choice donor site for microsurgical breast reconstruction. Unlike the abdomen and medial thigh, the buttock as a donor site for microsurgical breast reconstruction requires positioning changes for flap harvest and inset. Furthermore, the intramuscular dissection of the gluteal artery perforator can be difficult, and a significant size mismatch between the superior gluteal artery and the internal mammary artery is always a concern.

As microsurgeons, however, we are committed to performing microsurgical breast reconstruction, and there are inevitably times when our first two donor-site choices are unavailable. At this time, our preference is to use the sc-GAP flap as described in this series. We find the harvest of the sc-GAP flap to be simpler and faster than a conventional S-GAP or I-GAP harvest, because the intramuscular dissection is avoided. In addition, when the most lateral septocutaneous perforator is used, the pedicle is longer than a traditional S-GAP or I-GAP flap. The septocutaneous perforator flap does have one potential drawback in that the vessels are often surrounded by adipose tissue, which can make the perforators appear stiffer than conventional intramuscular vessels. We hypothesize that the less flexible vessels may make the septocutaneous vessels more prone to kinking than an intramuscular perforator.

As described in this series, the sc-GAP flap also has other advantages. The skin island is positioned higher and more lateral than in a conventional S-GAP or I-GAP flap. Although the scar itself may be more visible in low-cut pants or a bathing suit, it is more easily camouflaged in other types of clothing because the higher positioning minimizes contour changes in the buttock, particularly with regard to projection (Fig. 9). This results in a postoperative appearance that is comparable to a gluteal lift: the contour of the gluteal region is nice, but the infragluteal fold is a little bit higher than the contralateral one. Finally, patients report minimal pain at the donor site. Anecdotally, they seem to ambulate and mobilize earlier than patients who undergo abdominal flap harvest.

The introduction of the sc-GAP flap has been made possible by the improvement of preoperative imaging techniques. Developments in radiographic imaging have supported preoperative flap design and planning. The ability to identify septocutaneous perforators preoperatively has decreased the level of difficulty for perforator flaps. Intraoperative flap elevation is now more predictable and straightforward, which makes dissection faster and easier. Hypothetically, easier perforator flap dissection should also lead to a lower complication rate. We feel that the sc-GAP flap is a viable technique for autologous tissue breast reconstruction that may be easier to master than the traditional S-GAP and I-GAP procedures. In conclusion, we recommend the sc-GAP flap as a simple and reliable approach to gluteal artery perforator flaps for microsurgical breast reconstruction.

Stefania Tuinder, M.D.
Department of Plastic and Reconstructive Surgery
University Hospital Maastricht
Maastricht, The Netherlands
nervofaciale@yahoo.it

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