OPEN

PRS GLOBAL OPEN

CASE REPORT
Reconstructive

Boomerang-shaped Lateral-to-back Flap Utilizing Multiple Thoracodorsal Artery Perforators around the Lateral Border of Latissimus Dorsi Muscle for Reconstruction of Large Circular Defect

Yu Kagaya, MD
Masaki Arikawa, MD
Takuya Sekiyama, MD
Satoshi Akazawa, MD

Summary: We herein report the successful reconstruction of an extensive circular skin defect of the elbow region using a boomerang-shaped lateral-to-back muscle-sparing latissimus dorsi myocutanous flap utilizing multiple thoracodorsal artery perforators around the lateral border of the latissimus dorsi. The patient was a 74-year-old woman who presented with pleomorphic sarcoma in the left elbow region. The tumor was extensively resected and the skin defect was 13.5 × 12 cm. The boomerang-shaped lateral-to-back muscle-sparing-latissimus dorsi myocutanous flap was transferred as a free flap with the pedicle vessels anastomosed to the brachial artery and vein. The 2 wings of the boomerang were bent in a U shape to completely cover the skin defect. The donor site was closed primarily. This flap can be a versatile option for reconstructing extensive skin defects in various areas with little donor-site morbidity. *(Plast Reconstr Surg Glob Open 2020;8:e2644; doi: 10.1097/GOX.0000000000002644; Published online 6 February 2020.)*

When covering a large circular skin defect using a flap, there is a high probability of needing a skin graft at the donor site. However, a skin graft at the donor site can cause not only poor aesthetic results but also functional disabilities due to wound contracture.

Many articles have reported ideas for flap design that achieved both coverage of a large defect and primary closure of the donor site; among them, some proposed the boomerang-shaped flap design using pectoralis major myocutaneous,[1] rectus abdominis myocutaneous,[2] or anterolateral thigh (ALT)[3] flaps. The boomerang-shaped design of the flap has 2 symmetrically flexed long and thin wings and needs a reliable vascular source to ensure a sufficient blood supply to the distal area. The above-mentioned flaps have a wide range distribution of cutaneous perforators, and the distal wing of the flap has sufficient perfusion from distal perforators. Regarding the latissimus dorsi myocutanous (LDMC) flap, the main cutaneous perforators have been reported to be located around 2 areas: a proximal area around the lateral border of the LD[4], and a distal area around the 10th intercostal region.[5]

We herein report the successful reconstruction of an extensive circular skin defect of the elbow region using a boomerang-shaped lateral-to-back LDMC flap utilizing multiple thoracodorsal artery perforators (TDAPs) around the lateral border of the LD. This flap design enabled the transfer of a well-vascularized large skin paddle and primary closure of the donor site.

CASE REPORT

The patient was a 74-year-old woman who presented with pleomorphic sarcoma in the left elbow region. Preoperative radiation therapy of 50 Gy was performed, and the tumor was extensively resected. The skin defect was 13.5 × 12 cm according to the preoperative incision design but widened after resection (Fig. 1).

A pedicled LDMC flap was initially considered for reconstruction; however, the distal edge of the defect was too far from the root of the vascular pedicle to be reached by the pedicled LDMC flap. Therefore, a boomerang-shaped flap was designed from the lateral thoracic regions to the middle back region utilizing TDAPs around the lateral border of the LD (Fig. 2), with the intention of avoiding the need for a skin graft at the donor site. The TDAPs had been detected preoperatively using color Doppler ultrasonography, and the vertical wing of the flap was designed to include all of the TDAPs. The flap was elevated as a muscle-sparing

From the Department of Plastic and Reconstructive Surgery, National Cancer Center Hospital, Tokyo, Japan.

Received for publication October 18, 2019; accepted December 17, 2019.

DOI: 10.1097/GOX.0000000000002644

Disclosure: *The authors have no financial interest to declare in relation to the content of this article. The Article Processing Charge was paid for by the authors.*

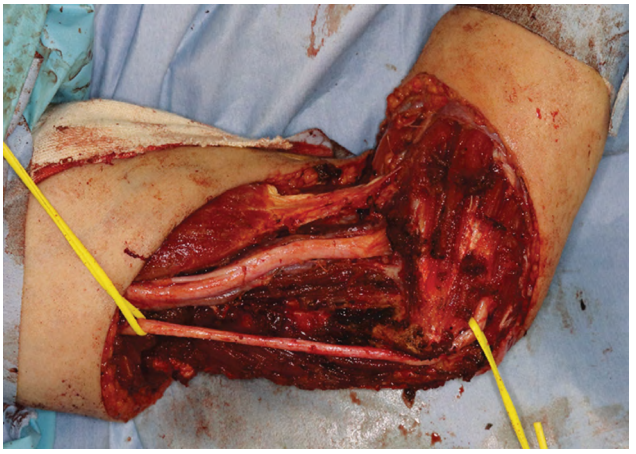

Fig. 1. The intraoperative appearance of the defect in the left elbow region. The skin defect was 13.5 × 12 cm according to the preoperative incision design, but widened after resection. The triceps brachii muscle and pronator teres muscle were partially resected; however, all of the main vessels and nerves were preserved.

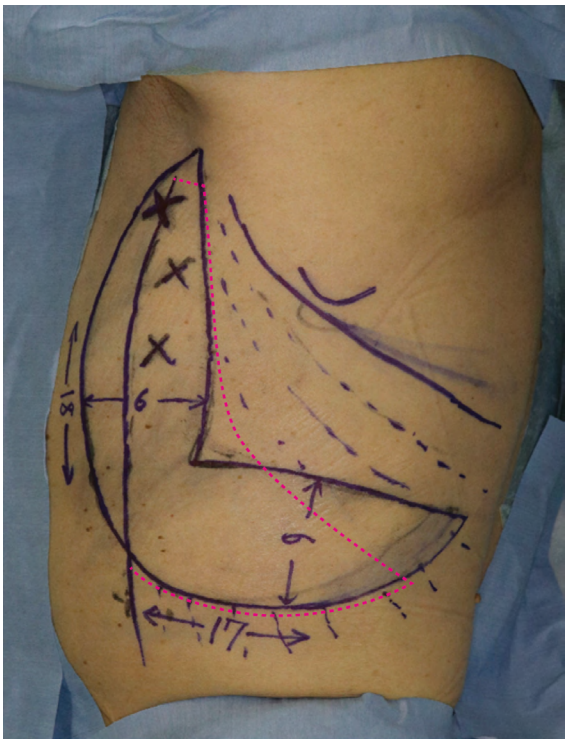

Fig. 2. The flap design in the left lateral thoracic to back region. The TDAPs had been detected preoperatively using color Doppler ultrasonography and marked on the skin surface. The top cross mark was the TDAP-sc of the circum-muscular route, and the lower 2 cross marks were the muscle-perforating TDAPs. The vertical wing of the flap was designed to include all of the TDAPs, so the anterior margin of the flap design was almost along the anterior axillary line of lateral thoracic region. From the anterior skin incision, dissection just above the serratus anterior muscle naturally reached under the LD, automatically including all of the TDAPs in subcutaneous fat, and then the flap was elevated as a muscle-sparing-LDMC flap based on the descending branch of the thoracodorsal artery. The pink dotted line was the cutting line of the LD muscle. The lateral branch of the thoracodorsal nerve was preserved.

Fig. 3. The appearance of the recipient site just after the operation. The flap was transferred as a free flap with the pedicle vessels anastomosed to the brachial artery and vein (end to side). The 2 wings of the boomerang were bent in a U shape to completely cover the skin defect.

LDMC flap based on the descending branch including all of the proximal TDAPs, and transferred as a free flap with the pedicle vessels anastomosed to the brachial artery and vein (end to side). The 2 wings of the boomerang were bent in a U shape to completely cover the skin defect (Fig. 3). The donor site was closed primarily.

The postoperative course was uneventful. There was no partial necrosis of the flap or donor site. Seven months later, the patient was alive without recurrence, and the aesthetic results of the recipient and donor sites were satisfactory (Fig. 4).

DISCUSSION

The proximal area around the lateral border of the LD includes many TDAPs based on the descending branch of the thoracodorsal artery.[4] Half of all cases have a "TDAP-septocutaneous (sc) type," which runs a circum-muscular course without penetrating the LD.[6] When elevating a traditional LDMC flap, the first step is to identify the lateral border of the LD[7]; however, the TDAP-sc is frequently encountered before reaching the LD, especially from the anterior approach, so the TDAP-sc is ligated or coagulated to identify the lateral border of the LD. In the present case, we preoperatively detected 3 TDAPs, including 1 TDAP-sc, using ultrasonography. From the anterior skin incision, dissection just above the serratus anterior muscle naturally reached under the LD, so the TDAP-sc was automatically included in the anterior fat.

To our knowledge, this report is the first to describe the boomerang-shaped LDMC flap. One reason no

Fig. 4. The postoperative appearance of the surgical site 7 months after the operation. The aesthetic results of the recipient and donor sites were satisfactory, with no contracture at either site.

such flaps have been considered before is because the dominant perforators of the proximal (TDAP) and distal (10th intercostal perforator) regions are located distant from each other, and it is difficult to distribute the 2 dominant perforators on the 2 wings. In the present case, the 10th intercostal perforator was not included in the flap, but multiple proximal TDAPs were included, and partial necrosis did not occur as a result. Koonce et al.[8] reported that an extended transverse skin paddle on a muscle-sparing-LD flap using proximal TDAPs was viable. The multiple proximal TDAPs are considered to provide a sufficient blood supply to the distal area of the boomerang-shaped flap.

One problem with the present flap design is that closure of the vertical wing can cause breast deformity. However, our patient showed good understanding and acceptance of the procedures with no complaints about this issue. Another problem is that the vascular pedicle tends to be short because all of the proximal TDAPs are included in the flap. The usual option for the reconstruction of the defect of the present case is considered an ALT flap,[3,9] as it is associated with less donor-site deformity and a long pedicle. The possibility of using an ALT flap was considered; however, the fat and skin of the thigh area were very thin in the present case and were considered inappropriate for the reconstruction of the defect after radiation therapy. In contrast, the lateral thoracic to back area in the present case had moderate fat and soft skin, which were features considered favorable for achieving safe coverage and primary closure.

In general, the present flap design resulted in good wound healing, good contours, and few complications at the recipient or donor sites.

CONCLUSIONS

The boomerang-shaped lateral-to-back flap utilizing multiple TDAPs around the lateral border of the LD showed a stable blood supply to the distal area of the flap and was able to cover a large circular defect without skin grafting or wound margin necrosis at the donor site. This flap can be a versatile option for reconstructing extensive skin defects in various areas with little donor-site morbidity.

Yu Kagaya, MD
Department of Plastic and Reconstructive Surgery
National Cancer Center Hospital
5-1-1 Tsukiji, Chuo-ku
Tokyo 104-0045, Japan
E-mail: mkagayakson@yahoo.co.jp

REFERENCES

1. Azuma S, Arikawa M, Miyamoto S. The boomerang-shaped pectoralis major musculocutaneous flap for reconstruction of circular defect of cervical skin. *Plast Reconstr Surg Glob Open.* 2017;5:e1579.
2. Yamamoto Y, Nohira K, Minakawa H, et al. "Boomerang" rectus abdominis musculocutaneous free flap in head and neck reconstruction. *Ann Plast Surg.* 1995;34:48–55.
3. Barreiro GC, Fioravanti AB, Borges LHS, et al. The boomerang thigh flap: optimizing the donor site for an extended skin island flap. *J Reconstr Microsurg.* 2018;34:658–668.

4. Mun GH, Lee SJ, Jeon BJ. Perforator topography of the thoracodorsal artery perforator flap. *Plast Reconstr Surg.* 2008;121:497–504.
5. Watanabe K, Kiyokawa K, Rikimaru H, et al. Anatomical study of latissimus dorsi musculocutaneous flap vascular distribution. *J Plast Reconstr Aesthet Surg.* 2010;63:1091–1098.
6. Miyamoto S, Arikawa M, Kagaya Y, et al. Septocutaneous thoracodorsal artery perforator flaps: a retrospective cohort study. *J Plast Reconstr Aesthet Surg.* 2019;72:78–84.
7. Strauch B, Yu HL. *Atlas of Microvascular Surgery: Anatomy and Operative Approaches.* 2nd ed. New York, NY: Thieme; 2006:585–589.
8. Koonce SL, Barnavon Y, Newman MI, et al. Perfusion zones of extended transverse skin paddles in muscle-sparing latissimus dorsi myocutaneous flaps for breast reconstruction. *Plast Reconstr Surg.* 2019;143:920e–926e.
9. Weise H, Naros A, Blumenstock G, et al. Donor site morbidity of the anterolateral thigh flap. *J Craniomaxillofac Surg.* 2017;45:2105–2108.