Reconstruction of Complex Soft-Tissue Defects in Buttock Using The Proximally Based Anterolateral Thigh Flap: An Alternative Algorithm

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Abstract

Background

Local and free flaps are most widely used in buttock reconstruction. However, local flaps and free flaps may not be appropriate for all complex soft tissue defects in buttock. In this study, we propose an alternative approach for buttock reconstruction and provide preliminary assessment in clinical efficacy of using a proximally based anterolateral thigh flap for buttock reconstruction.

Methods

In this study, we retrospectively analyzed the data of the patients with medium- to large-sized defects of buttock. All patients underwent buttock defect reconstruction using a proximally based anterolateral thigh flap between August 2012 and December 2020.

Results

Eight pedicled anterolateral thigh flaps were used to reconstruct buttock defects after tumor ablation in six patients, scar revision in one patient, melanocytic nevus resection in one patient. Flap size ranged from 25 × 8 cm to 30 × 12 cm, with pedicle length ranging from 12 to 20 cm. Flaps were elevated based on the distal musculocutaneous perforators from the descending branch of the lateral circumflex femoral artery and completely survived without any perfusion-related complications. We achieved satisfactory results from both the functional and aesthetic point-of-view at the 6-month follow-up in all cases.

Conclusions

The proximally based anterolateral thigh flap can be a valuable reconstructive option with sufficient tissue and a long vascular pedicle for buttock defect reconstruction.

Background

The repair of soft-tissue defects in the buttocks caused by tumors and infectious diseases is often a challenge for surgeons because it usually requires immediate reconstruction with flap transfer [1–3]. Local and free flaps are most widely used in buttock reconstruction [4–7]; however, these may not be appropriate for all kinds of tissue defects, such as large defects without sufficient local healthy tissue or if no recipient vessels are available due to vascular damage from previous surgeries or radiation therapy [8]. In such cases, regional flap reconstruction may be a more alternative option for tissue defects in buttocks. Alternative regional flaps have been reported to repair defects in the buttocks, including the deep inferior epigastric perforator (DIEP) [3], transverse rectus abdominis myocutaneous (TRAM) flap [9], profunda femoral artery perforator (PAP) flap [10], posterior thigh (PT) flap [11], anterolateral thigh (ALT) flap [12], and tensor fascia lata (TFL) flap [8].

The appropriate regional flap for buttock reconstruction must have reliable blood supply, a long vascular pedicle, a large potential size, versatility in tissue components, and minor donor deformities. The ALT flap was first described by Song et al. in 1984 and has become a workhorse flap for various defects reconstruction [13]. With a long vascular pedicle, the ALT flap has a wide rotation arc and can be used for defect reconstruction in various anatomic sites, such as the trochanteric region, groin, perineum, abdomen, ischium, and even the contralateral groin [14, 15]. The mean length of the vascular pedicle ranges from 8 to 20 cm [16]. Therefore, proximally based ALT flap was chosen for buttock reconstruction in the present study.

Although pedicled ALT flap is an ideal option for buttock reconstruction, reports on its application are rare, lack a detailed description of surgical technical tips, and often have limited cases [12, 17–20]. The purpose of this study is to present our clinical experience in using proximally based ALT flaps for buttock reconstruction. To our knowledge, this is the largest series to report on using proximally based ALT flaps for buttock reconstruction.

Methods

This was a retrospective case series study conducted in the Department of Plastic and Reconstructive Surgery, Plastic Surgery Hospital, Chinese Academy of Medical Sciences between August 2012 and December 2020 in eight patients who had undergone buttock reconstruction using proximally based ALT flaps. Treatment protocols were conducted after obtaining approval from the institutional ethics

committee, in conformance with the tenets of the Helsinki Declaration and in strict adherence to the STROBE guidelines. All the patients provided written surgical consent. Patient data were collected, including age, defect location, defect size, perforator classification, flap size, pedicle length, closure method of donor-site and postoperative outcome. The patients were followed up through outpatient visits for more than six months. All photographs in this article are of cases performed by the senior author.

Surgical Techniques

Prior to the surgery, the dimension of the potential defect was estimated and outlined (Fig. 1). Preoperative computed tomographic angiography (CTA) of the thigh was performed, and the overall characteristics of the lateral circumflex femoral artery (LCFA) were assessed (Fig. 2a). All perforators are distributed along the AP line (a line connecting the anterior superior iliac spine and the superolateral border of the patella). According to Yu et al.'s ABC system [21], perforator C (the distal perforator) were explored using a Doppler ultrasound probe and marked on the skin (Fig. 2b). We preferentially chose perforator C as the vascular pedicle of the flap because the longest vascular pedicle could be obtained. Then, the flap was designed along the AP line, with the perforator located eccentrically at the distal portion of the flap to obtain a wider arc of rotation.

The lesion was resected, and the resultant defect was evaluated (Fig. 3). First, the medial margin of the flap was incised, and dissection was performed below the deep fascia. Then, the lateral intermuscular septum was identified and opened. The overall characteristics of the LCFA were observed. The perforators were identified as the dissection proceeded laterally. The most distal perforator that had a sizable caliber with visible pulsation and a good accompanying vein was selected as the pedicle of flap (Fig. 4). The dissection proceeded proximally along the descending branch of the LCFA until the rectus femoris branches (RFBs) were encountered. The distal RFBs were ligated and cut to increase the pedicle length after these vessels were temporarily blocked with a vascular clamp to ensure vascularity of the muscle. Additional pedicle length could be procured by further dividing the branches to the vastus intermedius muscle and the transverse branch of the LCFA (Fig. 5). Then, a faciocutaneous or musculocutaneous flap was elevated and transferred to the recipient site through either an open incision or a subcutaneous tunnel. The donor site was closed primarily or with skin grafting (Fig. 6).

Results

Eight patients (four females and four males) were included in this study. The mean age was 44 (range, 27–71) years. Six patients had recurrent soft-tissue sarcoma, one had a post-burn scar, and one had congenital melanocytic nevus. No recipient vessels were available for a microvascular flap transfer in any of the patients. The size of the buttock defects ranged from 18 × 10 cm to 20 × 15 cm. Preoperative flap expansion was performed in one patient to obtain sufficient flap width. The dimension of the flaps ranged from 25 × 8 cm to 30 × 12 cm. Perforators on which the flap was based were all musculocutaneous perforators that originated from the descending branch of the LCFA. Seven flaps were based on perforator C, and one was based on perforator B, according to Yu's ABC system. The mean pedicle length was 16.4 cm (range, 12–20 cm). Detailed characteristics of the ALT flaps are summarized in Table 1. Six donor sites were closed primarily and two were skin-grafted. All flaps survived completely without any perfusion-related complications. The patients were satisfied with the functional and aesthetic outcomes. Tumor recurrence was noticed in one patient. The tumor was resected again, and the resultant wound was reconstructed with a pedicled DIEP flap. Tumor recurrence was not observed in the remaining patients in the follow-up period ranging from 6 to 24 months.

Typical cases

Case 1

A 37-year-old man underwent wide resection surgery to remove a metastatic nasopharyngeal carcinoma on his right pelvis (Fig. 1). Primary wound closure was performed under great tension. Wound infection and dehiscence occurred postoperatively. Preoperative CTA and ultrasound Doppler probe were used to detect the perforators. The potential length of the proximally based ALT flap based on the distal perforator was calculated (Fig. 2). After debridement, the prosthetic implant was exposed and a defect measuring 29 cm × 7 cm was identified on his right buttock (Fig. 3). A proximally based ALT musculocutaneous flap based on the distal perforator from the descending branch of the LCFA was transferred to reconstruct the buttock defect. One RFB was ligated and cut to increase the pedicle length. The pedicle length of the flap was 18 cm. The flap completely survived without any major complications (Fig. 4, 5 and 6).

Case 2

A 43-year-old woman presented with a malignant peripheral schwannoma of her left buttock. She received radiotherapy treatment preoperatively (Fig. 7a). No recipient vessels were found suitable for a free flap transfer. The tumor was removed, and the resultant defect

was repaired by using a 20×10 cm² pedicled ALT flap. No complications occurred in both the donor and recipient sites postoperatively. The buttock contour was largely preserved, and the patient was satisfied with the reconstructive outcomes. (Fig. 7b,c).

Discussion

Although various regional flaps have been reported to reconstruct defects of the buttocks, including the DIEP [3], TRAM [9], PAP [10], PT [11, 22], ALT [12, 17–20], and TFL flaps [8, 23–25], no consensus has been made on how to select the more appropriate regional flap according to the characteristics of the defect. In the present study, we reported our clinical experience in applying proximally based ALT flaps for buttock reconstruction.

Several regional flaps have been proposed for reconstructing a complicated buttock defect. Although the pedicled TRAM, DIEP, TFL, and ALT flaps can provide a large amount of well-vascularized tissue for buttock defect reconstruction, these flaps have their own indications. For pedicled TRAM and DIEP flaps, it is difficult to reconstruct a defect at the lower and medial buttock because of their limited pedicle lengths [3, 9]. The TFL flap is based on the ascending branch of the LCFA and has a relatively short pedicle. For buttock defect reconstruction, a long skin island of the TFL flap is required. However, the TFL flap usually becomes unreliable 8–10 cm proximal to the knee joint, and necrosis of the distal portion of a long TFL flap has been frequently reported [24]. Muramatsu et al. proposed that the TFL flap is best suited for the reconstruction of a buttock defect inferior to the sciatic foramen [25].

Compared to the TRAM, DIEP, and TFL flaps, the ALT flap not only provides an adequate volume of well-vascularized tissue but also has a pedicle with a sufficient length. An 800-cm² ALT flap can be safely elevated with a robust blood supply [26], and a 750-cm² pedicled ALT flap has been reported for a successful buttock defect reconstruction [17]. The size of the proximally based ALT flap used in our series ranged from 25 cm × 7 cm to 30 cm × 12 cm. The ALT flap can be harvested with a long vascular pedicle and offers a wide arc of rotation for buttock defect reconstruction with more freedom than other regional flaps. The mean length of the vascular pedicle ranged from 8 to 20 cm [16], and the longest ALT pedicle was around 37 cm [14]. The mean pedicle length in this series was 16.4 cm (range, 12–20 cm).

In addition, some surgical technique can be used to improve the pedicle length of the ALT flap. First, the distal perforator should be selected as the pedicle of the ALT flap if possible and placed eccentrically in the flap. In our cases, seven proximally based ALT flaps were elevated based on the distal perforator from the descending branch of the LCFA. Second, the pedicle of the ALT flap can be further elongated by ligating the RFB of the LCFA. Using these maneuvers, the rotation arc of the flap can be greatly improved. We found that with such a long pedicle, the proximally based ALT flap can reach more medial defect of the buttock compared to other regional flaps and can be used for the reconstruction of nearly total unilateral buttock defects. In our case series, one flap reached the medial buttock region and another flap was used to reconstruct a nearly total unilateral buttock defect.

Another advantage of the ALT flap is its versatility in tissue components. A part of the vastus lateralis muscle can be harvested within the flap to obliterate the dead space, add bulkiness to recontour the buttock, and provide reliable tissue coverage for an infectious wound or an exposed implant [19, 27, 28]. For patients who undergo pelvic tumor resection, an extensive dead space inevitably results and is associated with a high incidence (40–65%) of postoperative complications [29]. Compared to the ALT flap, a large buttock dead space cannot be fully covered with the TFL flap because the TFL muscle is located only along the proximal portion of the TFL flap [30]. Although the TRAM flap carries the rectus abdominis muscle and may provide bulky tissue to fill the dead space, abdominal bulge, laxity or weakness, and hernia may occur after the flap harvest [31].

In our study, the proximally based ALT musculocutaneous flap was used in seven of the eight patients. Six patients had tumor recurrence and underwent wide resection, which resulted in an extensive deep wound. Among these patients, three had wound infection and one had an exposed implant. All flaps completely survived with successful wound healing, which implicated that the ALT flap, with its well-vascularized muscular components, can be used to reconstruct a complicated buttock defect.

However, there are some limitations when using the proximally based ALT flap to reconstruct buttock defects. First, there are anatomic variations of the ALT flap regarding the number and location of the perforators. If the distal perforator is of a small-sized caliber or inadvertently injured, a competent pedicle may not be obtained for a proximally based ALT flap. Therefore, preoperative CTA is highly recommended when a proximally based ALT flap surgery is performed. CTA can reveal the overall characteristics of the LCFA and predict the potential pedicle length of ALT flap. Second, if an ALT flap with a width exceeding 8 cm is harvested from the anterolateral thigh, skin grafting is frequently required to close the donor site [12]. The pre-expansion technology may be a solution to aid direct closure of the donor site for patients with benign lesions or less urgent elective operation. According to our experience, the donor site could primary close after harvested a 24 × 14 cm² proximally based ALT flap using pre-transfer donor-site expansion technique. No wound dehiscence or obvious scar hyperplasia occurred at the donor site. Finally, to improve the pedicle length, ligating one or two RFBs of the LCFA is usually

necessitated. It remains controversial whether this may compromise the blood supply of the rectus femoris muscle (RFM) [32–34]. Based on cadaveric-based anatomical studies, the RFM is also supplied proximally by the superficial circumflex iliac artery and distally by the superior lateral genicular artery [35, 36]. Thus, ligation of one or two RFBs of the LCFA should be relatively safe. To date, necrosis of the RFM has not been observed in our cases because the RFBs were cut.

Conclusions

The proximally based ALT flap can provide sufficient tissue, versatile components, and a long pedicle, allowing efficient reconstruction of a complicated, extensive buttock defect. When local tissue and recipient vessels in the buttock region are unavailable, the proximally based ALT can be a valuable reconstructive option.

Abbreviations

DIEP

Deep inferior epigastric perforator; TRAM:Transverse rectus abdominis myocutaneous; PAP:Profunda femoral artery perforator; PT:posterior thigh; ALT:anterolateral thigh; TFL:and tensor fascia lata; CTA:computed tomographic angiography; LCFA:lateral circumflex femoral artery; AP line:A line connecting the anterior superior iliac spine and the superolateral border of the patella; RFBs:Rectus femoris branches; OB, oblique branch.

Declarations

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Not applicable

Authors' contributions

Conception and design: DY Wang, MQ Zang, B Chen, YB Liu; Administrative support: YB Liu; Provision of study materials or patients: YB Liu; Collection and assembly of data: DY Wang, YB Liu; Data analysis and interpretation: DY Wang, YB Liu; Manuscript writing: All authors; Final approval of manuscript: All authors.

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Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

This study was approved by Peking Union Medical College institutional review board. Informed consent was obtained from all patients included in this study.

Consent for publication

Not applicable

Competing interests

The authors declare that they have no competing interests.

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Tables

Table 1
Detailed Characteristics of the Patients

No	Sex/age (y)	Side	Cause of Defect	Defect Location	Defect Size (cm)	Perforator Classification*	Flap Size (cm)	Pedicle Length (cm)	Length of the AP Line (cm)	Donor-site Closure	Outcome
1	F/50	Left	Malignant peripheral shchwannoma	Superior buttock	18 × 10	Pc	20 × 10	18	39	Skin grafting	Survival
2	F/26	Right	Post-burn scar contracture	Lateral buttock	23 × 13	Pc	23 × 13	13	38	Direct closure	Survival
3 [#]	F/4	Right	Congenital melanocytic nevus	Total buttock	24 × 14	Pc	24 × 14	12	27	Direct closure	Survival
4	F/73	Right	Liposarcoma	Superior Buttock	33 × 9	Pb	33 × 9	12	42	Direct closure	Survival
5	M/20	Left	Invasive fibrosarcoma	Lateral buttock	25 × 8	Pc	25 × 8	15	40	Direct closure	Survival
6	M/45	Right	Angiosarcoma	Superior buttock	26 × 11	Pc	26 × 11	19	45	Skin grafting	Survival
7	M/37	Right	Metastatic nasopharyngeal carcinoma	Superior buttock	25 × 7	Pc	29 × 8	18	50	Direct closure	Survival
8	M/71	Left	Pelvic sarcoma; Wound infection	Superior buttock	30 × 12	Pc	30 × 12	20	42	Skin grafting	Survival

Abbreviations: *, The perforators are classified according to Yu's ABC system; #, Pre-transfer expansion of the donor site was performed.

Figures

Figure 1

A 37-year-old man presented a metastatic nasopharyngeal carcinoma on his right pelvic bone.

Figure 2

(a) Preoperative computed tomographic angiography revealed the overall characteristics of the lateral circumflex femoral artery; (b) The vascular signal from the distal perforator was identified using an ultrasound Doppler probe and marked on the skin. DB, descending branch of the lateral circumflex femoral artery; OB, oblique branch of the lateral circumflex femoral artery.

Figure 3

After the first surgery, *pseudomonas aeruginosa* infection occurred in the operation area. After wound debridement, the prosthesis was exposed and a well-vascularized flap was required to cover the prosthesis and wound.

Figure 4

Intraoperatively, the descending branch was found to travel along the medial margin of the vastus lateralis muscle for a long distance. Two rectus femoris branches and one oblique branch originated from the descending and transverse branches of the lateral circumflex femoral artery, respectively. DB, descending branch; RFB, rectus femoris branch; OB, oblique branch.

Figure 5

A proximally based anterolateral thigh musculocutaneous flap was elevated based on the distal perforator from the descending branch. The distal rectus femoris branch was ligated and cut to further increase the length of the pedicle, while the proximal one was preserved. DB, descending branch; RFB, rectus femoris branch.

Figure 6

The flap was transferred to the defect through an open wound with primary closure of the donor site. The flap survived postoperatively and the pelvic infection was completely controlled after a 6-month follow-up.

Figure 7

(a) A 43-year-old woman presented with a malignant fibrous histiocytoma at her left buttock; (b, c) Postoperatively, the flap completely survived and the donor site was reconstructed using a split-thickness skin graft. Eight months after the initial surgery, tumor occurrence was noticed. A pedicled deep inferior epigastric artery perforator flap was chosen to be used for defect reconstruction following the resection of the recurrent tumor.