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Case Report

Treatment of trunk defects using perforator flaps: A case series introducing suprascapular artery perforator flap

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ABSTRACT

This case series explores the efficacy of freestyle perforator flaps, including the newly introduced suprascapular artery perforator flap (SSAP), in reconstructing trunk defects. Over a five-year period, 24 perforator flap procedures were performed on 19 patients, primarily for defect reconstruction after skin tumor and ulcer resections. Flap design was customized using preoperative doppler ultrasound and they were then transferred to defects in a V-Y or propeller fashion. The most frequently utilized flaps were the dorsal intercostal artery perforator (DICAP) flap and the lumbar artery perforator (LAP) flap. Notably, SSAP flaps were successfully employed for shoulder defects resulting from squamous cell carcinoma resections.

Complications occurred in 29 % of cases, including seroma evacuation, hematoma, and wound dehiscence, with one patient experiencing severe liver failure post-surgery. The versatility of perforator-based reconstruction was demonstrated through the combination of DICAP and LAP flaps for large trunk defects. Additionally, internal mammary artery perforator (IMAP) and lateral thoracic artery perforator (LTAP) flaps were utilized for parasternal and infraclavicular defects, respectively.

The introduction of the SSAP flap expands the options for dorsal shoulder area reconstruction, offering faster healing and superior cosmetic results compared to traditional methods like secondary intention healing or skin grafting. Although this study showcases

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promising outcomes, further research is warranted to validate the effectiveness of SSAP flaps and to explore their applications in a broader patient population.

Background

Reconstruction of larger skin defects is a common task for plastic surgeons, particularly challenging in aesthetically important areas like the upper trunk. Traditional methods like skin grafts and conventional flaps often yield bulky outcomes with a moderate cosmesis.[1,2] Compared to conventional flaps, perforator flaps have gained increasing popularity due to their superior aesthetic results and reduced donor site morbidity.[3,4] Among others, perforator-based flaps, the lateral thoracic artery perforator (LTAP), the internal mammary artery perforator (IMAP), the lumbar artery perforator (LAP) and the dorsal intercostal artery flap (DICAP) have been described in the past for the reconstruction of truncal defects.[5–7] In this case series we share our experience using freestyle perforator flaps for trunk reconstruction and introduce the suprascapular artery perforator flap (SSAP).

Methods

Between 2017 and 2022, 24 perforator-based flaps were performed on 19 patients, with 5 patients undergoing two flaps each. Patient ages ranged from 53 to 92 years (mean 73±13), with 14 male and 5 female patients. Defects arose from skin tumor resections, ulcer resections, or skin infections post-spine osteosynthesis, with one case involving severe necrosis due to extravasation. All procedures were conducted by the same surgeon, with patients admitted consecutively to the department. The series was not reviewed by an ethics committee, but all patients provided informed consent after being fully informed of the procedure's risks, benefits, and alternatives. Preoperative marking of perforators was done using handheld doppler ultrasound, with flap design tailored to defect size and shape. Dissection, either supra- or subfascially, was carried out with loupe magnification until reaching the perforator, followed by further skeletonizing if necessary. Flaps were transferred to defects in V-Y or propeller fashion. A schematic illustration is shown in Figure 1. (Figure 1: SSA_White_T.jpg).

In three cases involving defects after skin tumor ablation in the suprascapular region, handheld doppler ultrasound revealed adjacent perforators. Flap design incorporated the defect, and dissection continued until the perforator merged into the acromial branch of the suprascapular artery, sometimes requiring trapezius muscle dissection for sufficient pedicle length. Donor sites, except one, were primarily closed. Postoperatively, flap monitoring occurred every 2 h for the first 3 days, then daily. Complications were assessed using the Clavien-Dindo classification.

Results

Nineteen patients underwent 24 perforator flap procedures: 12 post-skin tumor resection, 9 post-ulcer resections, 2 following spinal interbody cage fusion, and 1 due to extravasation-induced necrosis. Five patients received two flaps each. With defects either paravertebral or vertebral, DICAP flap was most frequently used (9 cases), followed by LAP (6 cases), IMAP (4 cases located parasternal and pectoral), and LTAP (2 cases, 1 infraclavicular near the axilla, 1 pectoral). Additionally, three medium-sized defects (3 × 3 cm, 4 × 4 cm, and 3.5 × 4.5 cm) around the shoulder were covered with suprascapular artery perforator flaps after squamous cell carcinoma and actinic keratosis resections. Flap sizes ranged from 9 to 120 cm^2 (mean 62 cm^2), distributed across various trunk locations. Flaps successfully covered all defects, with 29 % requiring revision for complications such as seroma evacuation,

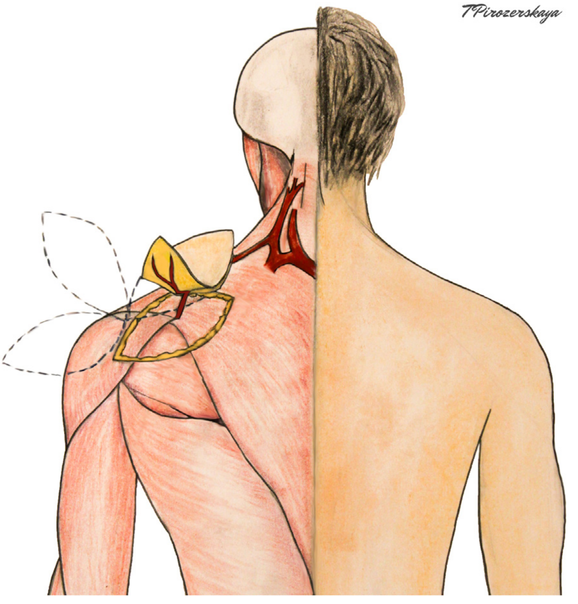

Figure 1. Schematic illustration of SSAP flap.

hematoma, wound dehiscence debridement, or secondary suturing (classified as IIIB complications). One patient with two flaps for defect reconstruction, accounting for 8 % of cases, died due to severe liver failure post-surgery (classified as V complications). See Table 1 for a detailed summary.

Examples of SSAP case reports

SSAP case 1

A 69-year-old man with squamous cell carcinoma above the right acromion underwent wide excision, resulting in a 4 × 4 cm defect. A suitable perforator from the suprascapular artery was identified and a subsequent freestyle perforator flap was rotated into the defect. Verification of the perforator's origin was confirmed by contrast-enhanced computed tomography (Figure 2: Suprascapularis1-bearbeitet.png). Figs. 3-5 illustrate the lesion example and defect reconstruction using the SSAP flap. (Figure 3: IMG_3029_20,181,123,094,412, Figure 4: IMG_3065_20,181,129,110,834, Figure 5: IMG_3731_20,190,218,132,230). The donor site was closed primarily. During the follow up period no complications were observed.

SSAP case 2

An 85-year-old patient presented with histologically confirmed medium to large squamous cell carcinoma lesions—one parasternal on the upper trunk and the other supraclavicular over the shoulder. Both were excised, resulting in defects measuring 7 × 5 cm and 3.5 × 4.5 cm, respectively. Suitable perforators near the lesions were identified for flap coverage. A freestyle flap with 90° rotation, utilizing a perforator of the internal mammary artery, covered the parasternal defect. For the supraclavicular defect, a freestyle flap rotated 180° from a perforator of the acromial branch of the suprascapular artery provided coverage.

Table 1
Summary of flaps and complications.

Patient	Age (years)	Sex	Diagnosis	Location	Defect size (cm)		cm^2	Perforator flap	Flap survival	Complications (Clavien-Dindo)
1	88	m	SCC	Parasternal	6	4	24	IMAP	Complete	0
2	65	m	Melanoma in situ	Pektoral	7	6	42	IMAP	Complete	0
3	87	m	BCC	Parasternal	7	5	35	IMAP	Complete	0
4	79	w	Free fusion cage	Paravertebral	14	8	112	DICAP	Complete	V
5	79	w	Free fusion cage	Paravertebral	14	8	112	LAP	Complete	V
6	66	m	SCC	Pektoral	10	8	80	LTAP	Complete	0
7	86	w	Actinic keratosis	Suprascapular	3	3	9	SSAP	Complete	0
8	72	m	SCC	Suprascapular	4	4	16	SSAP	Complete	0
9	88	m	SCC	Suprascapular	3.5	4.5	15.75	SSAP	Complete	0
10	93	m	Pressure ulcer	Paravertebral	7	5	35	DICAP	Complete	IIIB
11	80	m	Pressure ulcer	Paravertebral	6.5	5	32.5	DICAP	Complete	IIIB
12	80	m	Pressure ulcer	Paravertebral	6.5	5	32.5	DICAP	Complete	0
13	55	m	Pressure ulcer	Paravertebral	19	9	171	DICAP	Complete	IIIB
14	55	m	Pressure ulcer	Paravertebral	19	9	171	LAP	Complete	
15	53	m	Pressure ulcer	Paravertebral	10	8	80	LAP	Complete	IIIB
16	53	m	Pressure ulcer	Paravertebral	10	8	80	LAP	Complete	IIIB
17	70	m	SCC	Paravertebral	6	5	30	DICAP	Complete	0
18	85	m	SCC	Vertebral	7	7	49	DICAP	Complete	0
19	62	w	Extravasate	Pektoral	15	8	120	LTAP	Complete	0
20	89	w	Pressure ulcer	Vertebral	10	9	90	LAP	Complete	IIIB
21	78	m	BCC	Paravertebral	6	5	30	DICAP	Complete	0
22	59	m	MM	Paravertebral	5	8	40	LAP	Complete	0
23	53	w	Pressure ulcer	Paravertebral	8	7	56	DICAP	Complete	0
24	85	m	BCC	Parasternal	5	6	30	IMAP	Complete	0

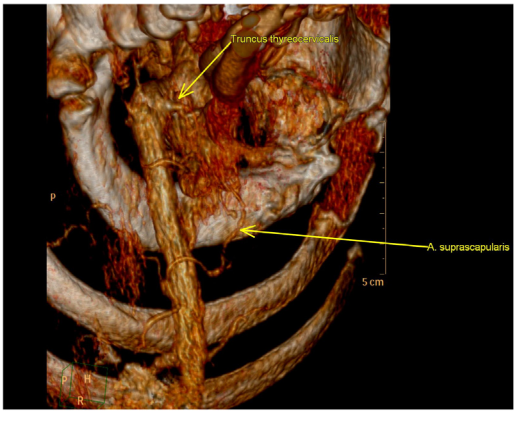

Figure 2. Computed tomography of suprascapular artery perforator.

Discussion

In our series, the majority of flaps (9) consisted of dorsal rami perforators of the posterior intercostal artery (DICAP), followed by LAP flaps totaling 6. Their versatility for back defect repair has been affirmed by previous studies, suggesting superior outcomes in terms of partial flap necrosis, need for reoperation, and wound dehiscence.[8,9] While LAP flaps have been utilized for breast reconstruction, their relatively short pedicle length may necessitate vascular graft usage.[10] Conversely, in paraspinal trunk reconstruction, LAP flaps present a valuable asset due to their adequate pedicle length for local

Figure 3. 4 × 4 cm defect of right acromion.

Figure 4. Intraoperative planning of SSAP flap.

defect coverage.[11] Another perforator-based option for cervical paraspinal defects is the pedicled flap of the dorsal scapular artery.[14]

Furthermore, we demonstrated the versatility of perforator-based reconstruction by combining two DICAP or one DICAP and one LAP flap to address very large trunk defects, ranging from 160 cm^2 to 342 cm^2 in size.

In addition, we performed four IMAP and two LTAP flaps for parasternal and infraclavicular defects, respectively. While the internal mammary artery is commonly employed as a recipient vessel for free tissue transfer in breast reconstruction, LTAP flap clinical applications have predominantly focused on partial breast reconstruction and axillary defect reconstruction after hidradenitis suppurativa. Alternatively, the TDAP flap provides a valuable reconstruction option in cases where the LTAP flap is not feasible.[7,12]

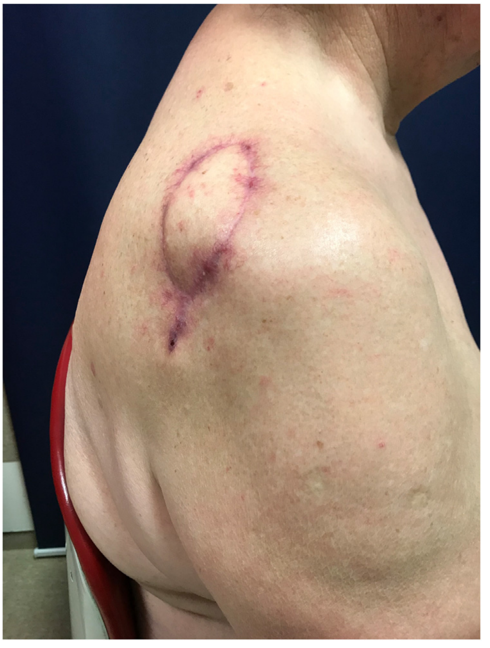

Figure 5. Inset of SSAP flap.

This case series is the first to introduce and evaluate the suprascapular artery perforator flap for defect reconstruction following skin tumor ablation. To our knowledge, previous studies have primarily explored the anatomical aspects of the suprascapular artery's origin and its terminus in an acromial branch, which gives rise to perforators utilized in the SSAP flap.[13]

In contrast to Kitazawa et al., we found the suprascapular artery perforator to be a consistent and reliable vessel for perforator-based reconstruction in the dorsal shoulder area. This holds significant interest as there have been limited options for defect reconstruction in this region. Previously, similar defects were managed through secondary intention healing or skin grafting. Our method offers notable advantages, ensuring faster and more substantial healing with superior cosmetic results. This is achieved by employing thin, pliable tissue from the surrounding area, aligning with the "replace like-with-like" principle.

Despite being a department specializing in plastic surgery with a notable volume of upper trunk defects, the total number of defects reconstructed in this specific shoulder area remains limited. Consequently, further studies are warranted to reinforce our findings.

Declaration of generative AI and AI-assisted technologies in the writing process

This scientific manuscript has been primarily written by human authors, with the involvement of AI-generated technologies only for the purpose of shortening the text. While Generative Artificial Intelligence (AI) and AI-assisted technologies have been utilized to streamline the text and enhance its clarity, the substantive content, conceptualization, and interpretation have been exclusively carried out by human researchers.

Ethical approval

Not required.

Declaration of competing interest

None declared.

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