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The versatile use of revisited de-epithelialization concept in superficial circumflex iliac and anterolateral thigh perforator free flap for head and neck reconstructions

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Background: Although the perforator free flap is now a standard choice for head and neck reconstruction, problems such as microvascular complications, insufficient volume support for the defect, and fistula formation occur. We revisited a de-epithelialized concept for superficial circumflex iliac artery and anterolateral thigh perforator free flap to overcome these problems.
Methods: We applied the de-epithelized perforator free flaps in 35 cases among 761 microsurgical head and neck reconstructions and investigated flap characteristics (length gain of pedicle, flap size, and volumetric analysis) and outcomes (flap failure, partial flap necrosis, hematoma, infection, and fistula).
Results: Satisfactory results were achieved regarding flap survival, volumetric compensation, and fistula formation. Flaps were transferred successfully in all patients, although 1 patient underwent revisional operation due to venous congestion. Transferred flap volume was significantly higher than the resected tumor volume ($p < 0.01$), which suggests volume augmentation in the destroyed neck envelope and a protective role against adjuvant radiation. Minor dehiscence and bleeding were seen in two cases, and no other complications were identified.
Conclusion: The de-epithelialization concept for perforator free flap is helpful to overcome obstacles related to traditional free flaps in terms of flap survival and volumetric augmentation in head and neck reconstructions.

1. Introduction

The perforator free flap has become the most popular standard choice in head and neck reconstruction owing to its reliability and versatility (Chang et al., 2016; Chen et al., 2016). However, problems related to the application of free tissue transfer in head and neck reconstruction still occur, such as short length pedicle in frozen neck, perforator kinking or bulked flap, especially in oro- and hypopharyngeal reconstructions (Yu et al., 2009). Because of the complex anatomical features made up of convex surfaces in the oro- and hypopharyngeal region, precautions regarding flap design and insetting have long been emphasized (Yoon et al., 2015).

Generally, de-epithelialized flaps are used when needed for the coverage of various soft tissue defects beneath the skin in which dead space is anticipated (Moon et al., 2015). Soft tissue coverage of this wound can be critical as failure to obliterate dead spaces can result in secondary complications. Regarding head and neck reconstruction, wide ablation of the tumor and radical neck dissection can provoke dead space formation. Furthermore, insufficient soft tissue coverage of these spaces can result in salivary fistulas, which leads to life-threatening complications such as carotid artery rupture (Chen et al., 2015).

Wei et al. described the de-epithelialization technique in his experience of anterolateral thigh perforator free flap with regard to the concept of dead space filling (Gedebou et al., 2002; Wei et al., 2002) We revisited a de-epithelialization concept to reduce some obstacles in head and neck reconstructions in superficial circumflex iliac and anterolateral thigh perforator free flap. Despite the numerous reports regarding the application of the perforator free flaps, investigation of their efficacy in terms of the application of

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de-epithelialization concept seems to be rare. This article revisited the versatile use of the de-epithelialization concept in head and neck reconstruction and studied the outcomes related to the complications.

2. Materials and methods

2.1. Retrospective

The study was approved by the Institutional Review Board of our institution. Among 761 cases of microsurgical head and neck reconstructions between 2005 and 2016, we conducted a retrospective review of 35 cases of head and neck reconstructions using the de-epithelialized perforator free flap between March 2012 and August 2015. Twenty-three anterolateral thigh (ALT) perforator free flaps and twelve superficial circumflex iliac artery perforator (SCIP) free flaps were included in this study. The patient characteristics that were assessed included age, sex, body mass index (BMI), smoking status (nonsmoker vs. current smoker or ex-smoker), T and N stage (tumor size and lymph node metastasis), history of preoperative chemotherapy or radiotherapy, length of hospital stay and comorbidities (diabetes mellitus, ischemic heart disease, peripheral vascular disease, and renal failure). The primary tumor site was categorized as oral (tongue, buccal mucosa, floor of mouth, or tonsil) and laryngopharynx (hypopharynx, oropharynx, nasopharynx, or larynx) regions.

2.2. Surgical procedure

Preoperatively, the relevant dimensions of the skin and soft tissue defect were measured on the imaging studies. If the patient had locally advanced cancer, a large volume defect would be anticipated, including tumor size and radical lymph node dissection.

Intraoperatively, the oropharyngeal and hypopharyngeal defects, including the transverse and longitudinal dimensions and necessary soft tissue volume defects, were precisely measured following the resection. Visual inspection of the ablated tumor and lymph nodes can be helpful for predicting the required soft tissue volume.

The oropharyngeal defects were simulated using a rubber sheet and insetted into actual oropharyngeal defects that were reorganized into the imagined configuration (Fig. 1). The total flap area was designed according to the necessary volume as mentioned in the previous paragraph. The proximal portion near the perforator was allocated for the territory of de-epithelialization, and a skin paddle was designed at the distal portion (Fig. 2). When determining the extent of the de-epithelialized area, estimation of the soft tissue defects, including the original tumor size and dissected lymph nodes around the tumor bed is important. In terms of volume augmentation, the de-epithelialized area allowed the obliteration of dead space that could otherwise be a potential space for fluid collection. The skin paddle was designed with a multilobed pattern as we presented in a previous study for 3-dimensional reconstruction of the oropharyngeal region (Choi et al., 2013). This helped to minimize the need for revisional procedures during the insetting (Fig. 2).

The location of perforator was marked preoperatively using computed tomography angiograms and hand-Doppler tracing. The required length of pedicle could be predicted between the recipient neck vessel and the defect, which is the sum of pedicle length in harvested flap and additional length gain in de-epithelialized area.

After identifying the dominant perforators and isolating them, the position of the skin paddle can be adjusted. The custom-designed skin paddle is located on the distal part of the flap whereas the de-epithelialization area is located on the proximal part of the flap. The results of the insetting can be seen after application of the fasciocutaneous free flap on the defect area.

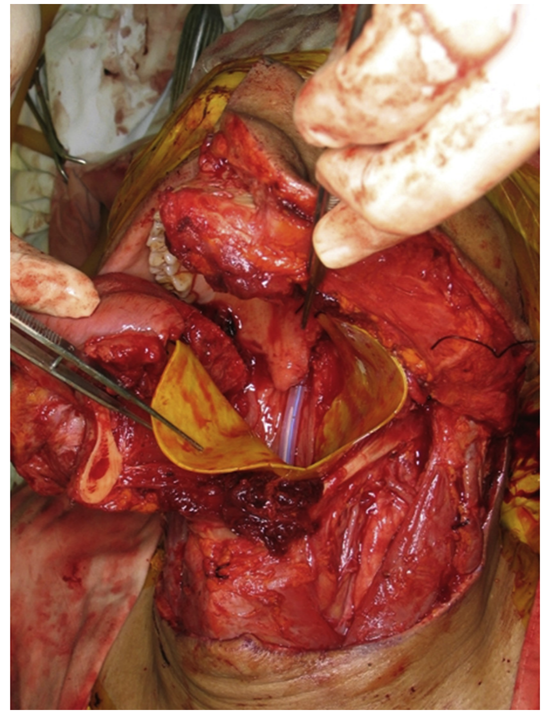

Fig. 1. Using a rubber sheet, oropharyngeal defects were simulated into an imagined status to estimate the actual defect.

De-epithelialization of the proximal part was done next, including thickness control of the distal part of flaps. The flap is tailored for volume and thickness for each patient. The extent of the tunnel should be considered during thickness control of the flap so that the flap is not too bulky.

The actual insetting of the flap is done on the skin part, and the de-epithelialized part is situated based on the pedicle length according to the skin and soft tissue defects. Microanastomosis is followed by insetting of the flap and watertight repair is then performed.

2.3. Volumetric analysis

We measured the volume of the flap and the tumor postoperatively. Patients underwent a contrast-enhanced computed tomography (CT) scan at 2 weeks postoperatively. Volumetric analysis was performed by a blind reviewer using the data obtained from PACS (Picture Archiving and Communication System) software. The flap appears as a fatty layer on the axial images, which helps to delineate the flap boundaries (Fig. 3). In addition, the presence of surgical clips helps to identify the location and the extent of the flap (Higgins et al., 2012). Contouring of the flap was performed on the axial slices of CT scans and the flap volume was calculated by summation of the areas in each section (Fig. 3). The volume of the resection specimen was obtained from a pathology report. The volume of the flap and tumor was compared using a Wilcoxon signed-rank test.

Flap characteristics and complications were reviewed in terms of flap size, area, pedicle length gain, flap loss, fistula formation, partial flap necrosis, bleeding, and surgical site infection. Flap size and area were measured using rulers following the design. Length