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Reconstructing defects following radical parotidectomy using superficial circumflex Iliac perforator flaps

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Abstract

Background The restoration of tissue defects following radical parotidectomy poses significant challenges due to the complex anatomy and functional requirements of the region. The superficial circumflex iliac perforator (SCIP) flap presents several advantages, including its adjustable volume, the potential for chimerism with bone, and the ability to conceal scarring. This study was conducted to assess the effectiveness and safety of SCIP flaps in reconstructing defects after radical parotidectomy.

Methods This retrospective study included patients who underwent reconstruction of defects after radical parotidectomy using SCIP flaps between June 2023 and June 2024. Facial nerve reanimation was achieved through the use of cervical sensory nerve grafts. Detailed records were maintained on patient demographics, flap dimensions, pedicle length, duration of surgery, complications at the donor or recipient sites, and the survival status of the flaps.

Results The study included 10 patients (4 males, 6 females) with a median age of 45.5 years. Four had T3 tumors and six had T4 tumors. Facial nerve reanimation was performed in 9 patients. Flap sizes ranged from 4 cm×8 cm to 6 cm×10 cm, and pedicle lengths from 4 cm to 9 cm. Duration of operation ranged from 210 to 450 min. Six patients underwent postoperative radiotherapy. All flaps survived without radiation-related recipient complications or donor site complications.

Conclusion The use of SCIP flaps has been demonstrated to be a viable and safe option for the reconstruction of defects resulting from radical parotidectomy when combined with nerve grafting techniques.

Keywords Perforator flap, Rehabilitation, Parotid neoplasms, Microsurgical free flaps, Iliac artery

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Introduction

Defects caused by radical resection of parotid malignancies remain a challenge to clinicians in rehabilitation [1]. As tissue volume loss after parotidectomy can lead to facial contour asymmetry, lack of skin coverage, and potential deleterious effects of adjuvant therapy [2], one of the main purposes of parotid defect reconstruction is to repair tissue volume loss [3].

Free-flap transfers, including anterolateral thigh (ALT) and radial forearm (RF) flaps, are preferred options for repairing defects caused by radical parotidectomy [3]. Free flaps can provide sufficient and adjustable amounts of tissue volume with freedom of orientation and degree [4]. In contrast to free muscle flaps, consistent contour can be maintained over the long term through restoration with free composite tissue flaps to tolerate the effects of adjuvant radiotherapy and avoid tissue regression [1].

However, as mainstay choices, both ALT and RF flaps are still unsatisfactory in some clinical situations. In regards to defect concavity, RF flaps are sometimes insufficient to restore the parotid contour even when folded [3], and although volume can be adjusted with ALT flaps, the reliability of the trimmed flaps or perforators is still unclear, and untrimmed ALT flaps is usually too thick for certain cases with no doubt [5]. In addition, for certain patients, the ALT or RF scar is relatively apparent, which affects patient quality of life [6]. Furthermore, if the parotid malignancy invades adjacent bone, such as the mandible [1], RF flaps can provide only limited hard tissue, and ALT flaps are incapable of providing hard tissue.

Superficial circumflex iliac perforator (SCIP) flaps, originating from groin flaps [7], possess several benefits, including optimal texture, adjustable volume, enduring stability, potential for chimerism with bone, two-team operation, hidden scarring, and reduced donor site complications [6, 8]. The relatively larger scale of flap size, thinner thickness combined with folding, and chimeric bone tissue, make SCIP fit more types of defects while compared with ALT and RF. These attributes make SCIP flaps a viable option for reconstructing radical parotidectomy defects. SCIP flaps have been employed to address defects in various head and neck regions, such as the oral floor, tongue, and maxilla, due to their distinctive advantages [5, 6]. Although concerns have arisen regarding short pedicles and small vessel calibers, these limitations have been effectively addressed through pedicle elongation and supermicrosurgical techniques [5].

Considering all the attractive advantages of SCIP flaps, in this study, we attempted to use SCIP flaps in the treatment of radical parotidectomy defects and to evaluate their effectiveness and safety.

Patients and methods

Patients

This study was approved by the Ethics Committee of Peking University School and Hospital of Stomatology (IRB number: PKUSSIRB-202167124), and in compliance with the Helsinki Declaration. The study cohort comprised patients who had undergone radical parotidectomy and subsequent reconstruction utilizing SCIP flaps at the Peking University School of Stomatology. Informed consent was obtained and well documented. Patients with a prior history of radiation therapy in the head and neck region were excluded from the study. Comprehensive data collection was conducted, capturing patient demographics (age, sex), pathological results, and TNM staging (the American Joint Committee on Cancer Staging Manual, eighth edition [9]).

Surgical procedure

Before the operation, the donor site was assessed by clinical examination, computed tomography angiography (CTA), and/or Doppler ultrasound. The surgery was conducted under general anesthesia, with two teams working concurrently to resect the tumor and harvest the flap. The tumor was resected as usual, and if necessary, a neck lymph node dissection was carried out, while efforts were made to preserve the facial nerve. Details regarding the spatial relationship between the facial nerve and the tumor, as well as the status of the facial nerve preservation, were documented.

The process of harvesting the flap was described in our previous report [5]. Here, we simply summarize the process (Fig. 1). After locating the femoral artery and iliac crest, the flap was designed utilizing the pedicle elongation technique. The flap was then raised by identifying the perforator on the supra-scarpa fascial plane and extending it towards the femoral artery. The superficial vein was located and dissected within the adipose tissue layer based on the CT angiography results. Excess skin was trimmed from the flap to allow for a longer, more mobile pedicle. The flap folding was performed after tailoring under the protection of perforator, and de-epidermis according to the design of folding [10]. For arterial anastomosis, a branch of the external carotid artery, such as the superior thyroid artery, was utilized. Venous anastomosis was performed using branches of the internal jugular vein accessed via a neck incision. If the facial nerve could not be preserved, facial nerve reanimation was conducted. Given the presence of a neck incision, nerve cable grafts, including those from the greater auricular nerve or other cervical sensory nerves, were employed for restoration. Postoperatively, adjuvant radiotherapy and/or chemotherapy were administered as required. Data on flap dimensions, duration of surgery, facial nerve preservation status, pedicle length, and

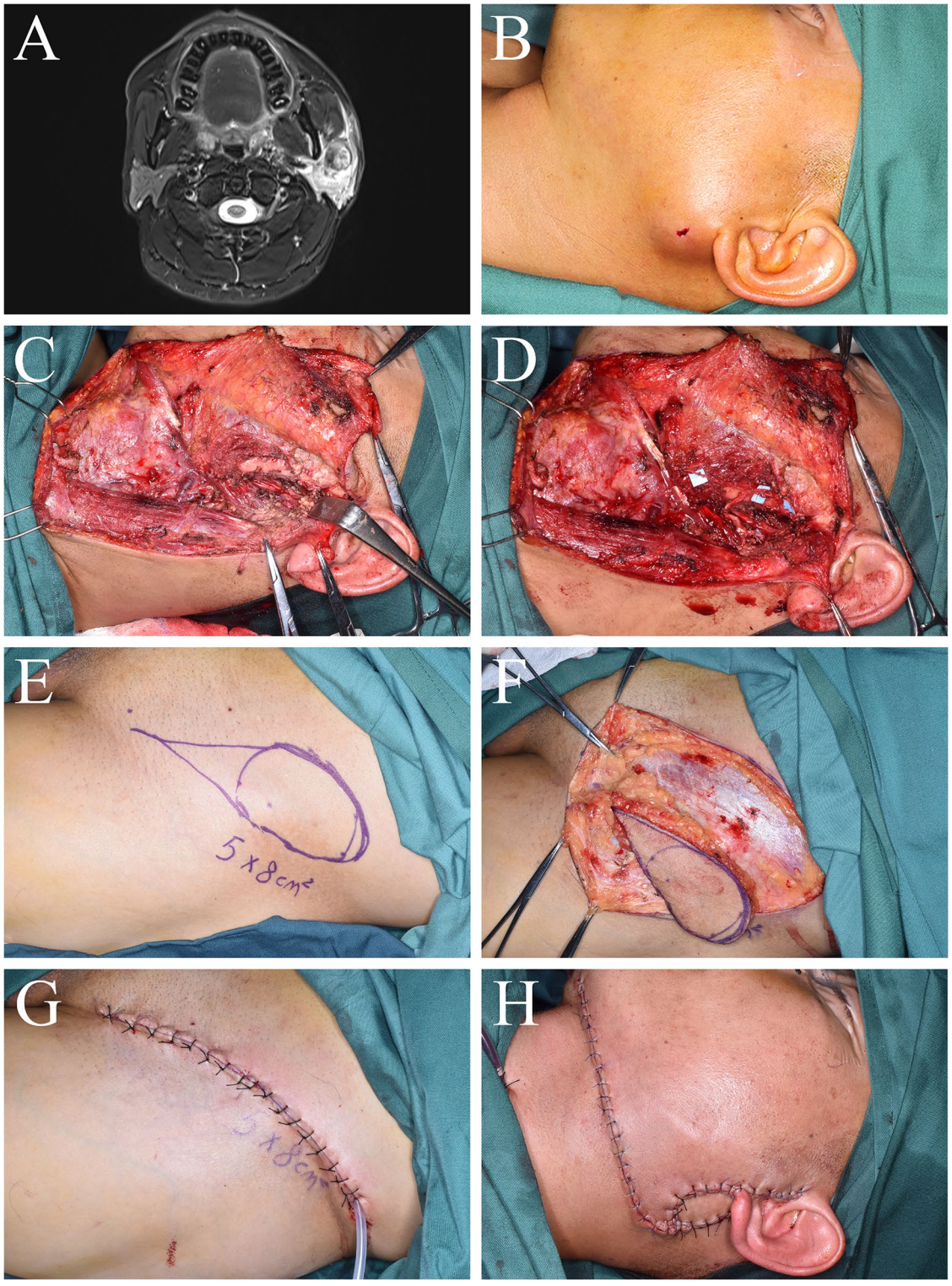

Fig. 1 The surgical procedure of Patient No. 10, in which a SCIP flap was used to restore the radical parotidectomy defects. (**A**) T2-weighted MRI imaging. (**B**) Preoperative recipient site. (**C**) Recipient site after tumor resection. (**D**) Facial nerve reanimation. (**E**) SCIP flap design. (**F**) Harvesting of SCIP flap. (**G**) Closure of donor site show well incision concealment. (**H**) Closure of recipient site show well volume and color compatibility

Table 1 Information on the flaps

No.	Sex	Age	T stage	Flap size	Pedicel length	Recipient artery	Recipient vein	Adjuvant therapy
1	Male	43	4	5 cm×7 cm	5 cm	Occipital	Internal jugular	Radiotherapy and chemotherapy
2	Male	42	4	4 cm×8 cm	8 cm	Superior thyroid	Internal jugular	Radiotherapy
3	Female	71	3	6 cm×8 cm	6 cm	Superior thyroid	Branches of the internal jugular	Radiotherapy
4	Male	53	4	6 cm×8 cm	4 cm	Superior thyroid	Branches of the internal jugular	None
5	Female	46	3	7 cm×7 cm	6 cm	Superior thyroid	Branches of the internal jugular	None
6	Female	50	4	6 cm×10 cm	6 cm	Superior thyroid	Internal jugular	None
7	Female	45	3	5 cm×7 cm	8 cm	Superior thyroid	Internal jugular	Radiotherapy
8	Female	11	3	6 cm×8 cm	6 cm	Superior thyroid	Internal jugular	None
9	Female	53	4	5 cm×7 cm	6 cm	Superior thyroid	Internal jugular	Radiotherapy
10	Male	42	4	5 cm×8 cm	9 cm	Transverse Cervical	Internal jugular	Radiotherapy

choices of postoperative treatment were meticulously recorded.

Follow-up

During the follow-up period, any complications that arose were documented. These included systemic issues as well as problems specific to the surgical site, such as infections, instances of dehiscence, the formation of fistulas, and injuries related to radiation therapy, whether they occurred at the donor or recipient site.

Results

This retrospective study included 10 individuals who received SCIP flap reconstruction for radical parotidectomy defects at Peking University School of Stomatology between June 2023 and June 2024. The study cohort comprised 4 male and 6 female, with a median age of 45.5 years, spanning from 11 to 71 years. All patients were treatment-naive. Tumor stages included T3 in 4 patients and T4 in 6. The pathological diagnoses were mucoepidermoid carcinoma in 5 patients, salivary duct carcinoma in 3, epithelial-myoepithelial carcinoma in 1, and poorly differentiated carcinoma in another. Patient demographics are detailed in Table 1.

All flaps were successfully harvested. Details regarding flap dimensions, recipient vessels, and pedicle lengths can be found in Table 1. The overall surgical duration varied from 210 to 450 min, with a median time of 285 min. Six patients received postoperative external radiotherapy, while one underwent concurrent chemotherapy. Facial nerve reanimation was conducted in nine patients. All flaps survived without any systemic or surgical complications, and no radiation-related injuries were observed during follow-up.

Discussion

Radical parotidectomy is an operation that results in severe facial destruction, leading not only to the loss of tissue in the parotid region but also to the loss of adjacent structures, including the mandible, masticatory muscle, skin, and sometimes even the temporal bone [1]. Simultaneous reconstruction is urgently needed, as contour defects due to radical parotidectomy increase the possibility of radiation-related injury and cause significant asymmetry, which might further impair patients' quality of life. The preferred donor tissue options for this type of defect, such as ALT and RF flaps [3], cannot satisfy all the clinical requirements. The use of SCIP flaps, which have advantages such as an easily adjustable volume, the possibility of chimerism with bone, scar concealment, and minor donor site morbidity [6, 8], can be regarded as a potential solution for some scenarios, but their feasibility and safety need to be determined. Hence, in this study, we evaluated patients suffering from radical parotidectomy defects who underwent reconstruction via SCIP flaps as a reference for treatment selection.

Tissue volume loss is one of the main types of damage caused by radical parotidectomy [2, 11]. Fat grafts, local muscle or facial rotational flaps, and vascularized free flaps are modalities clinicians most often employ for volume restoration [3]. Fat grafts are considered ideal for superficial parotidectomy because of the low incidence of complications and ease of harvesting; however, controversies exist regarding the unpredictable reabsorption rate and fat liquefaction rate, which can reach 90% and are unfavorable for large defects [11, 12]. Local flaps are also chosen in some cases because of the short operation time and adjacent incision, but the sacrifice of nearby tissue offers only a limited volume and creates another concavity, leading to poor aesthetics [13]. RF flaps are applicable for patients with relatively small defects but are not adequate for large defects even after folding [3]. ALT flaps can be harvested with versatility in terms of degree of thickness [14], but the technique of elevation might lead to a lower flap survival rate. SCIP flaps are more variable in terms of volume than ALT flaps as they can be harvested with thin thickness and a large scale; small SCIP flaps can fit small defects, and large defects can be restored with large folded SCIP flaps [6, 15]. Owing to the limited sample size, the advantage of a large-volume scale was not demonstrated in this study,

but the lack of radiation-related injury still demonstrated the good volume compatibility of SCIP flaps.

Scar concealment is desired in patients with better tumor prognoses and can improve the quality of life of survivors [16]. With the development of treatment, the survival time of patients with parotid malignancies has significantly improved [17], which has made the pursuit of quality of life possible and essential. Scaring is one of the greatest problems patients are concerned with [15]. The raising of an RF flap leaves an apparent scar on the forearm, and a second donor site is required for the skin graft [18]. The scar remaining with SCIP flap harvesting is inconspicuous and can be covered by underwear [19], thereby meeting more patients' desires for scar concealment than ALT flaps do.

Bone defects are relatively rare in parotidectomy, but if they are present, restorative options are few. RF flaps may provide both hard and soft tissue, but the volumes of both types of tissue are limited. A scapular flap can provide sufficient bone and color-matched soft tissue [1], but this flap cannot be harvested in a two-team operation. In contrast, SCIP flaps can be harvested in a chimeric form with an iliac bone supplied by the superficial circumflex iliac artery [8, 20]. Although in this study we did not have a case in which SCIP chimerism with iliac bone was needed to restore a combined defect of the parotid and mandible, we demonstrated the feasibility and safety of this chimeric modality in the rehabilitation of the maxilla in a previous report [5].

Complications at the donor site are also noteworthy. SCIP flaps were reported to have similarly low morbidity and potentially improved donor site outcomes compared with RF and ALT flaps [6]. This might be attributed to the minimal sacrifice of tissue and function after modification of the groin flap and the lack of need for muscle and nerve dissection during harvesting [21]. As in the previous study, no complications were reported in our cohort, which showed good safety outcomes at the donor site.

However, SCIP flaps still have disadvantages in terms of restoring radical parotidectomy defects. Like ALT flaps, SCIP flaps have a paler color than the face, which is often chronically sun-damaged and becomes darker or reddened, making SCIP flaps not match the face in this patient population. In addition, the regular process of SCIP flap harvesting does not yield motor nerve grafts as does ALT flap harvesting [22], which means that an extra nerve graft donor site is needed. And in this study, the donor nerve was the cervical sensory nerve.

The primary limitations of this research stemmed from the minimal sample size, its retrospective methodology, and the absence of a control group along with a quantifiable assessment of functionality and aesthetics, especially for facial nerve. These issues are expected to be rectified in forthcoming investigations.

The use of SCIP flaps was demonstrated to be a viable and safe option for the reconstruction of defects resulting from radical parotidectomy when combined with nerve grafting techniques in this study, but additional work in future investigations is needed.

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None.

Author contributions
WW collected and analyzed the data and drafted the manuscript. ZJ, ZYW and SY collected and analyzed the data and critically revised the manuscript. LXM and LSM conceptualized and designed the study, performed the statistical analysis, participated in the data collection, and critically revised the manuscript. All the authors have read and approved the final manuscript.

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

Declarations

Ethical approval
This study was approved by the Ethics Committee of Peking University School and Hospital of Stomatology (IRB number: PKUSSIRB-202167124), and in compliance with the Helsinki Declaration.

Consent for publication
Informed consent for publication was obtained from the included patients and well documented.

Competing interests
The authors declare no competing interests.

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