SCIP flap in head and neck reconstruction after oncologic ablative surgery: a systematic review

SCIP FLAP IN HEAD AND NECK RECONSTRUCTION AFTER ONCOLOGIC ABLATIVE SURGERY: A SYSTEMATIC REVIEW

ABSTRACT

Background: In the surgical treatment of head and neck locally advanced malignancies, microvascular free flaps represent the most valuable solution to reconstruct the tissue defect after resection of the primary neoplasm. In particular, microvascular free flaps allow to restore the functional and aesthetical features of the head and neck compartments. The superficial circumflex iliac perforator (SCIP) flap represents, as an evolution of the groin flap, a valid alternative to the radial fasciocutaneous free (RFFF) flap or the anterolateral thigh (ALT) flap.

Methods: This systematic review adhered to the recommendations of the PRISMA (Preferred Reporting Items of Systematic Reviews and Meta-analysis) 2009 guidelines. A computerized MEDLINE search was performed using the PubMed service of the U.S. National Library of Medicine (www.pubmed.org) and Scopus database (www.scopus.com). Two authors screened the articles, then selected and extracted data on malignancies characteristics, reconstructive techniques, outcomes, and complications.

Results: A total of 25 articles were selected and reviewed among the 39 identified through the search string. Six out of the selected 25 articles were case reports, while the remaining 19 articles were retrospective case series. The whole study population was represented by 174 oncologic patients undergoing ablation of a head and neck tumor and reconstruction with a SCIP flap. The site of reconstruction was the oral cavity in 125 (71.0%) patients, being the

tongue the most common subsite in 73 (41.5%) patients, the pharynx in 10 (5.7%) cases, the larynx in 3 (1.7%) and head and neck skin in 36 (20.4%) patients.

Only two cases of total flap loss were reported. Partial flap loss or shrinkage requiring minor surgical revisions was observed in 11 patients (6,32%). Primary closure of the donor site was achieved in the whole study population, according to the available data.

Conclusions: In head and neck postoncological reconstruction, despite the caliber and the length of the pedicle, SCIP flap offers a pliable and thin skin paddle, allowing single-stage resurfacing, medium to large skin paddle, possibility of composite-fashion harvest and a well-concealed donor site.

INTRODUCTION

In case of locally advanced head and neck malignancies, surgical resection of the primary neoplasm and neck dissection represent in many cases the gold standard of treatment. The resulting tissue defect should be reconstructed to restore the usual oral and pharyngeal sealing from neck compartments and to provide functional and aesthetical satisfactory results.

At present, microvascular flaps represent the most valuable solution to reconstruct the defect. To maintain tissue mobility and function, pliability and thinness are explicitly required in certain head and neck subsites such as tongue or floor of the mouth.

In absence of important bony resection, the fasciocutaneous radial forearm free flap (RFFF) represents a workhorse flap despite the significant morbidity of the donor site [1].

Among the alternatives to minimize RFFF donor site morbidity, anterolateral thigh (ALT) flap represents a valid solution with less donor site morbidity. Other advantages of this flap are the

possibility of a large skin island, the chimeric options by including muscle, skin, fascia on different nourishing branches and relatively good pliability, despite its thickness in patients with higher BMI [2] or unaesthetic scar in women in particular. In addition, in some cases, the ALT flap could require secondary debulking procedures, in particular in high functional demand subsites such as the tip of the tongue or the soft palate.[3]

Medial sural artery perforator flap (MSAP) represents another viable alternative to the RFFF, and, despite the inconsistency of the perforant vessel, it is taking hold in head and neck reconstruction due to its moderate donor site morbidity, the hairless skin, its long pedicle and its good pliability [4]. In particular, especially in women, donor site morbidity could increase due to the skin graft required when the donor site defect is bigger than 5 cm [5].

The groin flap, based on the superficial circumflex iliac artery (SCIA), has been used for head and neck reconstruction since the early 1970s [6]. The groin flap provides a large cutaneous island from a concealed donor site with moderate harvesting morbidity, mainly consisting in prolonged drainage output and lymphocele. The donor-site morbidity together with the shortness of its pedicle and the inconsistency of inguinal anatomy limited its use.

The superficial circumflex iliac artery perforator flap (SCIP) represents the evolution of the groin flap. Its perforator perfusion and the use of specific harvesting technique guided by inguinal vascular pattern studies [7], [8], allowed to overcome the main limitations of the groin flap. The main advantages of the SCIP flap are a pliable and thin skin paddle of medium to large dimensions allowing single stage resurfacing, expedient harvest, possibility of composite fashion harvest with lymphatics, muscle, or bone, and a well-concealed and hidden donor site. However, possible disadvantages include a short pedicle and small vessel caliber, particularly

in the medial or superficial branch, and inconsistent anatomy, mainly in the lateral or deep branch [9].

The choice of the most suitable flap in each single case depends on many variables such as size and depth of the defect, involvement of neurovascular adjacent structures, availability of donor site and surgeon's expertise.

The aim of this systematic review is to evaluate the use of SCIP flap in head and neck postoncological reconstruction, in relation to multiple factors, such as the anatomical site to be reconstructed, its dimensions, the functional and aesthetical outcomes obtained. We will critically discuss whether the SCIP flap could be considered as first choice in specific head and neck reconstructions.

METHODS

Eligibility criteria

This systematic review adhered to the recommendations of the PRISMA (Preferred Reporting Items of Systematic Reviews and Meta-analysis) 2009 guidelines, to guarantee a scientific strategy of research to limit bias by a systematic assembly, critical appraisal and synthesis of all the relevant studies published on the chosen topic [10]. With the research question being focused on the application of SCIP flap in head and neck oncologic reconstructive surgery, data from studies on patients that underwent reconstruction with this flap were pooled for review process. Two authors (A.R. and A.A.) evaluated the methodological quality of studies identified using the Joanna Briggs Institute (JBI) Critical Appraisal Checklist for Case Reports

and the National Institutes of Health (NIH) quality assessment tool for observational case series [11]. In the first checklist above, eight major components were evaluated, scoring the items as 0 (not reported) or 1 (reported): for the purposes of this review a value of 5 or more was considered to represent a good quality case report. In the latter checklist for case series, instead, nine major items were considered and a minimum of 6 items well described according to the authors (A.R. and A.A.) assessed the rating quality of the study as good or fair.

Information sources and search

In July 2022, a computerized MEDLINE search was performed using the PubMed service of the U.S. National Library of Medicine (www.pubmed.org) and Scopus database (www.scopus.com), running the following search string: "((scip flap) OR (superficial circumflex iliac perforator flap)) AND (reconstruction) AND ((head and neck) OR (nose) OR (paranasal sinus) OR (rhinopharynx) OR (oral cavity) OR (floor of the mouth) OR (tongue) OR (mandibular) OR (jaw) OR (oropharynx) OR (palate) OR (hypopharynx) OR (larynx) OR (tracheal) OR (face))". The initial search returned a total of 39 results. After electronically removing duplicates, titles and abstracts obtained were screened independently by two of the authors (A.R. and A.A.), who subsequently met and discussed disagreement on citation inclusion. The inclusion criteria for citations were set a priori to encompass as many articles as possible without compromising the validity of the results. Articles mentioning patients surgically treated for head and neck cancer, who underwent reconstruction by a SCIP flap, after resection of a malignant tumor (either in a primary setting or in salvage surgery) were included.

Exclusion criteria were articles written in languages other than English and with research subject clearly unrelated to head and neck oncology and/or the SCIP flap.

Afterwards, the selected full-texts articles underwent a second screening by the same two authors. Full-texts articles were considered regardless of their study design, in order not to miss any relevant data, and were included if: (1) reporting cases of reconstruction of head and neck defects by SCIP flap; (2) stating the defect type and localization; (3) defining the type and size of the SCIP flap employed for the reconstruction (e.g., simple fasciocutaneous or chimeric flap with iliac bone); (4) listing postoperative early and late complications; (5) specifying the need of revision surgery and (6) reporting the functional outcomes of the reconstruction.

After manual search on the references from the pooled full texts, the final number of articles included in the present review was identified (**Figure 1**), and the main information was extracted and summarized in a database.

The results were expressed as mean (standard deviation - SD) for continuous variables with normal distribution. The heterogeneity among studies, mainly attributable to a lack of randomization, limited our ability to perform any statistical analysis of the pooled data in a formal meta-analysis.

ETHICAL STATEMENT

This research was conducted in full accordance with the World Medical Association Declaration of Helsinki (2002). Due to the nature of this study, the Institutional Review Board of the University Hospital of Bologna, Italy (Comitato Etico dell'Area Vasta Emilia Centro) does not perform a formal ethical assessment. There was no funding source for this study.

RESULTS

A total of 25 studies was included in this systematic review, as showed by the PRISMA flow diagram (**Figure 1**) [3], [12]–[35]. Six out of the selected 25 articles were case reports [13], [19],

[20], [23], [28], [30], while the remaining 19 articles were retrospective case series [3], [12], [14]–[18], [21], [22], [24]–[27], [29], [31]–[35]. None of the studies were either randomized controlled trial or prospective case-series.

According to the Joanna Briggs Institute (JBI) Critical Appraisal Checklist for Case Reports, all six case reports included in this review presented good quality rating.

However, implementing the National Institutes of Health (NIH) quality assessment tool for observational case series, three studies included pointed out fair quality rating, while the remaining seventeen case series presented good quality rating.

The whole study population was represented by 174 oncologic patients (97 males, 77 females) undergoing ablation of a head and neck tumor and reconstruction with a SCIP flap, over the last 25 years (2004-2022). The mean reported age of patients was 61.7 (± 11.9) years.

The main tumor's histologic diagnosis was squamous cell carcinoma (SCC) in 151 (86.8%) patients. Ten (5.7%) patients were diagnosed with other cutaneous malignancies (e.g., basal cell carcinoma, skin melanoma, sebaceous carcinoma, and dermatofibrosarcoma), four (2.3%) patients with salivary gland malignancies, six (3.4%) patients with primary bone malignancies (osteosarcoma or fibrous malignant histiocytoma), two (1.1%) patients with meningioma and in the remaining patient (0.6%) no diagnosis was specified.

The anatomical defect was located in the oral cavity in 125 (71.0%) patients, being the tongue the most common subsite in 73 (41.5%) patients, while the buccal mucosa in 20 (11.4%) patients, the floor of the mouth in 13 (7.3%) cases, the gingiva or retromolar trigone in 12 (6.8%). The pharynx was involved in 10 (5.7%) cases while the larynx in just 3 (1.7%) out of the total of cases. Eventually, the head and neck skin was involved in 36 (20.4%) patients.

Data regarding preoperative treatment, such as neoadjuvant chemotherapy or concurrent chemoradiation therapy were reported only in 3 articles, for a combined total of 4 (2.3%)

patients. Similarly, the adjuvant chemoradiation or radiation therapy was mentioned in 5 articles only, achieving a total of 9 (5.1%) patients who received post-operative adjuvant treatment [3, p. 201], [18], [20], [23], [31].

The SCIP was mostly harvested as a fasciocutaneous flap in 164 (94.2%) patients, as osteocutaneous flap with iliac bone in 7 (4.0%) patients, as a sensate flap with nervous anastomosis in 2 (1.1%) and as a myocutaneous flap with sartorius muscle in 1 (0.6%) patient. The mean SCIP flap area was 54.1 (± 37.0 SD; range 12.9 – 126.1) cm^2. The flap's thickness was mentioned only in 8 articles [3], [24], [26], [27], [29], [30], [33], [35], being on average 1.36 (± 0.6 SD; range 0.5 – 1.8) cm. The mean length of the superficial circumflex iliac pedicle was reported in 14 articles [3], [14], [17], [21], [22], [24], [26], [28]–[30], [32]–[35], being 8.13 (± 1.6; range 4.6 – 10.2) cm. Based on the available data, the mean SCIP flap's artery and vein caliber was 0.8 (± 0.2; range 0.5 – 1.2) mm and 1.3 (± 0.3; range 1.1 - 1.8) mm, respectively. In nine of the pooled articles for a total of 51 patients [3], [13], [15], [21], [22], [24], [26], [30], [32], the authors specified the superficial or the deep perforator branch of the SCIA chosen for the anastomosis: in 37 patients the superficial branch was preferred for the arterial anastomosis, in 6 patients the deep branch was chosen, while in the remaining 8 patients the surgeons decided to use both the deep and the superficial branches for the anastomosis.

In most studies included, the main recipient vessels were the superior thyroid vessels and the superficial temporal vessels, and both arterial and venous anastomosis were performed in an end-to-end fashion [3], [14], [15], [17], [20], [21], [23], [24], [26], [30], [33], [36]. Among the whole study population, only in 4 (2.3%) patients a venous graft was necessary in the making of the arterial anastomosis [25], while in other 4 (2.3%) patients a venous graft was necessary in the making of the venous anastomosis [12]. With regard to the vein anastomosis, most of the studies included [3], [14], [16], [28]–[30], [32], [33], [35] specified the use of the subcutaneous

vein or SCIV, instead of the comitant veins of the SCIA, which were explicitly preferred only in four studies [13], [17], [26], [28].

The donor site morbidity was satisfactory in the whole study population, achieving primary closure in 100% of the cases, based on available data. Regarding the flap's outcome, there were only 11 (6.2%) partial necrosis or minor complications such as fistula formation, recipient site dehiscence or osteonecrosis and 2 (3.5%) complete flap losses, computing for the need for 5 revision surgeries.

Data about functional outcome were reported in qualitative way by most of the authors. Only few authors employed validated questionnaires o scoring systems: Gur et al. assessed the functional outcomes via the University of Washington Quality of Life Scale (UW-QOL) [31], Iida et al. assessed the cutaneous sensitivity of a sensate SCIP flap through the Semmes-Weinstein Test [15], and Ma et al. evaluated the tongue mobility through the Shin three level scale [37] and speech ability through the 10-points Hirose Japanese scoring system[38]. Green et al. evaluated the 6-month post-operative swallowing function and diet with MD Anderson Dysphagia Inventory and Normalcy of Diet questionnaires and the speech function with Speech Handicap Index questionnaire [32].

It was not possible to evaluate data regarding long-term outcomes and complications, since data regarding surgical outcome achieved a mean follow-up of 20.0 (range 3.5 – 98.9) months.

DISCUSSION

Head and neck reconstruction after oncological resection represents a high challenging task for the reconstructive surgeon. In oral cavity a functional reconstruction is often required, especially for tongue or soft palate defects. Flap tissue should be highly pliable and versatile to

adapt to the local anatomy and movements while providing a durable oral and pharyngeal sealing from neck compartments [21].

A workhorse flap is defined by its reliable anatomy, easy harvesting, the possibility to be used in different sites and defects of various complexity, and ease of learning [39]. In this study, we aim to answer if the SCIP flap fits this definition in head and neck reconstruction by performing a systematic review of the literature.

Although it was initially described in 2004 [25], [36], only 3 articles out of 25 were published before 2012 [19], [25], [28].

According to our analysis, SCIP flap revealed a heterogeneous use for head and neck reconstruction. In most cases, it was used for intraoral reconstruction, mainly for tongue defect but also for pharynx and larynx defects. The functional outcome (speech, swallowing and eating) was predominantly reported as good, however rarely an objective scale was used. Likewise, the cosmetic outcomes were always described as satisfactory, especially in case of skin reconstruction. These results are probably due to the thinness and pliability of this flap, that allows dynamic movement for tongue defects and optimal resurfacing when employed for facial skin reconstruction [21].

SCIP flap can be raised in a composite fashion. This provides multiple indications, from bone defect coverage to lymphedema management. The flap could be harvested with iliac bone, sartorius muscle, nerves and even with lymph nodes [21], [39]. Some authors used it as a osteocutaneous flap for mandible reconstruction with satisfying outcome [22], [25], [40]. Its use as a sensate flap was described as well, with concrete restoration of sensitivity [15].

In literature the pedicle length is described as one of the weakest features of this flap [40]. According to our review of the literature, apart from the first SCIP flap case series in head and neck reconstruction[25], direct end-to-end or end-to-side anastomosis was always possible,

mainly involving the superior thyroid artery, which is often used in RFFF or ALT flap reconstructions as recipient vessel. This choice reflects that the SCIP's pedicle length is usually long enough even to reach the mid-lower neck vessels. Moreover, pedicle elongation techniques could be helpful in obtaining an increased length of the pedicle when necessary [41]. However, patient selection is still critical, and the availability of recipient vessels should be assessed pre-operatively, especially in salvage surgery scenario (e.g., post-surgical or post-chemoradiation recurrent tumor). Koshima et al. [36] developed the SCIP flap based on the anatomical distinction of the superficial and the deep perforator branch of the SCIA: in the blood supply of the inguinal region they play a compensatory role, rather than synergistic. The variability of the dominant perforator vessel between the superficial and the deep branch consists in one of the main concerns in the harvesting of a SCIP flap [33].

Vessel's caliber was reported on average under 1 mm (slightly higher for veins). Despite that, an end-to-end anastomosis was always possible. In most cases the SCIP flap only required one venous anastomosis. According to Altiparmak et al., this could be due to SCIP flap's relatively low metabolic requirements [39].

Iida et al. and Green et al. explicitly preferred the superficial circumflex iliac vein (SCIV) rather than the comitant vein for the venous anastomosis since the former are considered to be more reliable for flap drainage and to have greater caliber than the latter[14], [32].

The pooled analysis showed that the inguinal donor site was always primary closed, with a well concealed scar and satisfying cosmetical outcome. No wound dehiscence nor lymphorrea was reported in the articles included. The possibility to raise the flap on a suprafascial plane reduces the risk of damage of the superficial lymphatics and lymph nodes located in a deeper adipose tissue, even if lymphatics and lymph nodes are often tightly adherent to the pedicle vessels. However, also in cases of lymph nodes transfer [23], [41] no signs of lymphorrea in the donor

site have been reported. The indirect linking vessels, which pass through the superficial fat, provide the perfusion of the flap. Moreover, suprafascial approach allows safe and expeditious harvest of a thin flap, even in patients with a body mass index >25 kg/m2 [42]. No functional loss or sensorial disorder were described since SCIP flap elevation does not necessitate muscle or nerve dissection.

The low donor-site morbidity is one of the main advantages of SCIP flap, especially if compared to RFFF where a skin graft is necessary in most cases relating to high donor site morbidity and poor cosmetical outcome: the choice of the SCIP flap rather than a RFFF can be also driven by a high degree of manual tasks in patient's employment besides the upper limb aestethics [27]. Regarding the possible disadvantages of the SCIP flap, in case of major tongue resection such as subtotal glossectomy or total glossectomy, it is often required a bulky flap in the reconstruction[43] which can be supplied more easily by an ALT free flap.

Moreover, according to Ma et al., the type of flap was also chosen considering the donor sites' preference expressed by the patient during the preoperative consultation [3].

In the literature only two cases of complete flap loss are described [31], [40]. Minor complication rate was low (6.2%) and it consisted of wound dehiscence and partial flap necrosis.

One of the main limitations of all studies herein included is their retrospective fashion. Both qualitative and quantitative parameters were not systematically collected and included in all studies, so it was not possible to carry out a rigorous metanalysis. Similarly an objective evaluation of the functional outcomes (e.g., swallowing, eating, speaking) was unavailable in the vast majority of the articles [3], [15], [20], [31].

The mean post-operative follow-up was quite short, being not long enough to assess the oncologic and functional long-term result of those patients reconstructed with a SCIP flap. Moreover, at present there are no data regarding the modifications of the SCIP flap to the

adjuvant (chemo-) radiation therapy, which is often needed in locally advanced oncological patient that undergo microvascular reconstruction. Further studies are needed to provide reliable findings to those unanswered questions regarding the SCIP flap in the setting of head and neck post-oncological reconstructions.

CONCLUSION

This systematic review evaluated the SCIP flap in head and neck postoncological reconstruction, providing data about the site of reconstruction, dimensional parameters, functional and aesthetical outcome of both the donor and recipient site, and its safety.

The SCIP flap offers a pliable and thin skin paddle, allowing single-stage resurfacing, medium to large skin paddle, possibility of composite-fashion harvest and a well-concealed donor site. Although it has some limitations, despite the caliber and the length of the pedicle, the SCIP flap could be considered as a viable choice for head and neck reconstructions. However, surgical expertise is needed to master the harvest and microvascular anastomosis of this flap and to be able to choose this reconstructive option over the others in the head and neck district.

Further studies with larger sample sizes and longer follow-up are required to confirm and strenghten these findings.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

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TABLE LEGENDS

Table 1. Details on the articles included in the review.

Table 2. Summary of the main results described.

FIGURE LEGENDS

Figure 1. Flow diagram of the review.