Comparison of Anterolateral Thigh and Radial Forearm Free Flaps in Head and Neck Reconstruction

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Abstract. *Background: The radial forearm flap (RFF) and the anterolateral thigh flap (ALT) are commonly used for the reconstruction of head and neck soft-tissue defects. The aim of the study was to investigate and compare the surgical outcomes, complications and systemic condition of the patient after reconstruction of extensive head and neck defects with ALT or RFF following cancer extirpation. Patients and Methods: Between August 2011 and November 2013, a total of 36 patients affected by head and neck cancer (31 males and five females; mean age=64.7 years, range=40-86 years) underwent microsurgical reconstruction with 29 RFF and 10 ALT procedures. The surgical outcomes and complications among these two groups were retrospectively analyzed. Results: The success rate was 97% for the RFF group and 90% for the ALT group, with one total flap loss in each group. Donor-site complications occurred in 6% of the RFF group and in 7% of the ALT group. Seven RFF-treated patients (24%) and two treated with ALT (20%) experienced systemic complications. Statistical analysis confirmed no significant difference between the two groups regarding the variables investigated ($p>0.05$). Conclusion: In our experience, ALT and RFF demonstrated analogous practicability and reliability for the reconstruction of head and neck soft-tissue defects, with similar local and systemic complications and donor-site morbidity rates.*

Several sites for procurement of free flaps have been proposed for the reconstruction of soft-tissue defects after head and neck cancer extirpation. However, these defects

have most commonly been reconstructed using radial forearm (RFF) and anterolateral thigh (ALT) flaps (1-4).

Since its introduction, the RFF has become particularly popular and accepted worldwide for the reconstruction of tongue and intraoral defects (5-8). The advantages offered by RFF include a thin texture, which facilitates folding, and an easy harvesting procedure; however, the dissection of the RFF implies the sacrifice of a major blood vessel to the hand, and the wound at the donor site often requires to be closed with a skin graft (4).

The clinical indications for using the ALT in soft-tissue head and neck reconstruction have recently increased (9). This flap indeed allows the transfer of different tissues with large amounts of skin and subcutaneous fat tissue of adjustable thickness, with a vascular pedicle of suitable length and relatively large-diameter vessels, and low donor-site morbidity (9).

Several studies analyzed and compared the two flap sources (4, 8-11). However, to our knowledge, a systematic analysis considering all the variables related to the reconstruction has not been performed. This study investigated and compared the outcomes in terms of free-flap survival and complications in the reconstructed area, morbidity of the donor site, and systemic conditions of the patient after reconstruction of head and neck defects with ALT or RFF.

Patients and Methods

Between August 2011 and November 2013, 36 patients affected by early (stage I-II) or advanced (stage III-IV) head and neck cancer were treated at the Department of Plastic, Reconstructive, Aesthetic and Hand Surgery, University Hospital Basel. Patients underwent composite resection, with excision of the primary tumor, including ipsilateral or bilateral neck dissection and microvascular flap reconstruction. Thirty-nine free-flap procedures (ALT or RFF) were performed to reconstruct the surgical defects. Patients were divided into two groups according to microsurgical reconstruction: ALT group ($n=10$) and RFF group ($n=29$).

Analysis of the following demographic and clinical variables was conducted for each group: patient sex and age, underlying disease according to the American Society of Anesthesiologists score (ASA) (12), pathological diagnosis, recipient site, previous radiation therapy.

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The microsurgical success rate, considered as flap survival, was analyzed and compared between the two groups. Complications were classified into donor-site, free-flap, and systemic complications according to Classen and Ward (13, 14). Analysis of donor-site complications included seroma, hematoma, infection, dehiscence, congestion, and skin graft loss, while systemic complications included postoperative comorbidities, pulmonary edema, postoperative hypertension and sepsis. Free-flap complications were divided into major, if needing surgical re-exploration, or minor, if not. The number of patients who developed donor-site, free-flap and systemic complications were recorded and compared between the groups.

Chi-square analysis with Fisher's exact test was performed to assess the relationship between surgical technique, outcomes and complications. Statistical analyses were performed for all tests using GraphPad Prism version 5.00 for Windows (GraphPad Software, San Diego, CA, USA). Statistical significance was determined by a value of $p \leq 0.05$. Written consent was obtained from all patients, and the guidelines of the Declaration of Helsinki were followed.

Results

Thirty-six consecutive patients (31 males, five females; mean age=64.7 years, range=40-86 years) underwent microvascular flap reconstruction following head and neck tumor ablation. A total of 29 RFF and 10 ALT procedures were performed to reconstruct the defects. Two patients underwent a second free-flap transfer due to recurrence. One patient underwent a second free-flap procedure following flap loss. Squamous cell carcinoma was the most frequent histological diagnosis, while the oral cavity was the most frequent site of reconstruction in both groups. The patients' demographic and clinical data are listed in Table I.

The microsurgical success rate was 97% for the RFF group and 90% for the ALT group. Re-exploration, classified as major flap complication, was needed in three cases treated with RFF and in three cases treated with ALT, with one total flap loss in each group.

Minor flap complications (Table II) were observed in 23 cases of the RFF group and in nine cases of the ALT, and included dehiscence, infection, hematoma, congestion, seroma, and partial flap loss, all generally more frequent in the RFF group.

Donor-site complications occurred in 10 cases of RFF and in four cases of ALT (Table III). Dehiscence was the most frequent donor-site complication (five cases in the RFF group and two in the ALT group).

Systemic complications were experienced by seven patient of the RFF group and three of the ALT patients, and consisted of respiratory failure in two, aspiration pneumonia in three, and cardiopulmonary failure in two patients of the RFF group; hypoxemia in two and edema in one patient of the ALT group. Perioperative mortality was observed in two cases, one in each group, due to hypoxemia and respiratory failure complicated by encephalitis.

There was no statistical significant difference between the two groups regarding donor-site complications, major flap

complications, minor flap complications or systemic complications (Table IV). However, there was a trend towards a higher flap re-exploration rate in the ALT group compared to the RFF group ($p=0.162$, relative risk=0.35, 95% confidence interval=0.1-1.4).

Discussion

The RFF and ALT are two types of free-flaps that are frequently used for complex reconstruction after tumor ablation in the head and neck region (15-24). Microsurgical outcomes, donor-site and systemic complications should be the main factors influencing the selection between RFF and ALT. In order to determine the advantages and disadvantages of each flap type, we performed a retrospective study on 36 patients with large defects in the head and neck area who underwent reconstruction with either RFF or ALT after cancer extirpation. However, the main limits of this analysis were the low number of patients included and the unequal distribution of patients between the two groups.

Previous investigations supposed a correlation between the microsurgical outcomes and the practicability of flap harvesting and preparation (4). While RFF harvesting is relatively easy to perform, ALT dissection is more difficult, due primarily to the anatomy of the perforator originating from the descending branch of the lateral circumflex femoral artery (4). Our study found no significant difference in terms of microsurgical outcomes expressed as flap survival rates between RFF and ALT, showing that the anatomic variability of ALT perforators did not influence survival rates and demonstrating that the two flaps present analogous reliability, in line with the results achieved by Liu *et al.* (4).

Surgical re-exploration rates for compromised flaps, considered as major flap complications according to Classen and Ward's classification (13), present large variability in the literature, with reports of between 3% and 20% (25-30). Our data indicated a re-exploration rate of 10% for RFF and of 30% for ALT flaps, without statistical significant difference between the groups ($p=0.16$). However, there was a trend towards a higher re-exploration rate in the ALT group, which we supposed to be correlated with the high number of patient that received pre-operative radiation therapy in the small sample analyzed (Table I). In fact, although the majority of studies confirm that radiation therapy does not influence flap survival, many authors reported a reduced clinical success rate in head and neck surgery in the case of prior radiation therapy (31-33).

Systemic medical complications developed in 24% of the RFF group and in 20% of the ALT group, without any difference statistically significant, between the two groups ($p=0.83$). This high rate of complications is in line with the literature and is mainly due to the medical comorbidities of

Table I. Patient demographic and clinical data.

Characteristic	RFF	ALT
Gender, n		
Male	26	8
Female	3	2
Age, years		
Mean (range)	65.2 (40-86)	63.3 (40-79)
ASA score, n		
I	0	0
II	13	6
III	15	4
IV	1	0
Recipient site, n		
Oral cavity	17	6
Oropharynx	9	2
Midface	3	2
Preoperative radiation therapy, n		
Yes	3	5
Pathological diagnosis, n		
Squamous cell carcinoma	27	10
Liposarcoma	1	
Adenocarcinoma	1	

ASA: American Society of Anesthesiologists.

Table II. Minor flap complications in the patient groups treated using anterolateral thigh flap (ALT) and radial forearm flap (RFF).

Minor flap complication	RFF (n)	ALT (n)
Skin graft loss	0	0
Infection	4	2
Hematoma	3	2
Seroma	3	0
Dehiscence	9	2
Congestion	1	1
Partial flap loss	3	2
Total	23	9

n: Number of instances.

Table III. Donor-site complications in the patient groups treated using anterolateral thigh flap (ALT) and radial forearm flap (RFF).

Complication	RFF (n)	ALT (n)
Seroma	0	0
Hematoma	0	0
Infection	1	1
Dehiscence	5	2
Congestion	2	0
Skin graft loss	3	0
Total	10	4

n: Number of instances.

Table IV. Comparison by statistical analysis between the patient groups treated using anterolateral thigh flap (ALT; n=10) and radial forearm flap (RFF; n=29).

Complication	RFF, n (%)	ALT, n (%)	RR (95% CI)	p-Value
Donor site	10 (5.7)	4 (6.7)	0.86 (0.28-2.6)	0.76
Major flap	3 (10.3)	3 (30)	0.35 (0.1-1.4)	0.162
Minor flap	23 (13.2)	9 (15)	0.88 (0.44-1.78)	0.83
Systemic	7 (24.1)	2 (20)	0.88 (0.44-1.78)	0.83

RR: Relative risk, CI: confidence interval.

patients (34). Eckardt *et al.* recommended a proper and critical preoperative evaluation of the risk of post-operative complications as being essential before selection for extensive oncological and reconstructive surgery, as the majority of the patients with head and neck tumors present medical comorbidities (35, 36). In our series, the majority of patients were classified as ASA 2 or 3, with one patient classified as ASA 4, with equal distribution of pre-operative risk between the two groups (Table I).

Our study found no significant difference in terms of donor-site complications, with an overall rate of 6% for RFF group and 7% for ALT group ($p=0.76$). Many surgeons have focused on the donor sites of flaps, seeking to obtain optimal functional and an esthetic reconstruction without causing significant harm to the region of the donor flap (8). A growing body of research has recently described the advantages of the ALT donor site (10, 37-39). The study by Valentini *et al.* highlighted that the donor defect can, in most cases, be closed directly, without causing a noticeable scar, with minimal morbidity (10). Several authors have supported the idea that the RFF is most associated with donor-site morbidity and esthetic deformity (8, 10, 40, 41). In a comparative investigation, Loreti *et al.* indicated the ALT as an ideal soft-tissue flap in oral reconstruction, with functional results comparable to those of the RFF at the receiving site but with the additional advantages of minimal donor-site morbidity and a high level of patient satisfaction (9). Others have supported the belief that there is no difference. Novak *et al.* compared the two flaps regarding donor-site morbidity, finding that the majority of patients of both groups were not bothered by scar appearance, light touch, numbness or pain, and no significant difference was found regarding donor-site morbidity (11). Although our series has the limitation of having only a small number of cases, unequally distributed, we support the idea that complications at the donor site cannot indicate the selection of the best reconstructive technique between the two flaps.

Conclusion

In conclusion, our study showed that both RFF and ALT free flaps are reliable reconstructive options in head and neck after cancer extirpation. We observed that microsurgical outcomes, such as free-flap survival and complications, donor-site morbidity and systemic complications do not appear to differ significantly after ALT or RFF reconstructions. Individual patient factors and expertise of the surgeon should therefore be the determinants of the selection of the best reconstructive option (11).

Conflicts of Interest

None.

Founding

None.

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