Osseous and osteocutaneous free flaps in head and neck reconstructive surgery - Results of the IPOLFG ENT department

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ABSTRACT

Objectives: Evaluate the surgical success and complications of bone and osteocutaneous free flaps.

Study design: Retrospective.

Material e Methods: Analysis of all bone and osteocutaneous free flaps performed at the Otorhinolaryngology department of IPOLFG, between 2015 and 2020.

Results: Sixteen patients were evaluated, with a mean age of 50.3±17.4 years and 62.5% male. Nine free flaps from the fibula and seven from the scapula were performed, viable in 93.8% of the cases. The functional result was successful in 81.2% of cases. Record of two major early complications, one hemorrhagic and one requiring total flap resection. The most common late complications were infection and extrusion of the osteosynthesis material. The diagnosis of malignant neoplasm and osteonecrosis prior to reconstructive surgery were associated with complications.

Conclusions: Bone and osteocutaneous free flaps have high surgical and functional success rates, with a good long-term viability in head and neck reconstructive surgery.

Keywords: Free Tissue Flaps; Fibula; Scapula; Complications

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INTRODUCTION

Osseous and osteocutaneous free flap procedures entail complex techniques with good functional results in head and neck reconstructive surgery. The surgical treatment of malignant tumors in particular involves extensive and mutilating resections that lead to the loss of functional tasks such as swallowing.[1] The use of osseous and osteocutaneous free flaps allows reconstruction after maxillary or mandibular resection, thus improving the quality of life of patients and reducing surgical morbidity.[2] The free flaps that are most commonly applied in head and neck surgery are fibula , scapula , and radial forearm free flaps, all with good functional results.[1,3]

Complications described in the literature include total or partial flap necrosis, infections, hemorrhage, osteosynthesis plate extrusion, fistulae, and osteonecrosis.[4,5]

This study aimed to determine the success, complications, and factors associated with surgery using osseous and osteocutaneous free flaps.

MATERIAL AND METHODS

This retrospective study analyzed all medical records of patients who had been treated with osseous or osteocutaneous free flaps for maxillary or mandibular reconstruction between 2015 and June 2020 at the Otorhinolaryngology department of Instituto Português de Oncologia de Lisboa Francisco Gentil.

The evaluation included demographic data, including sex and age, comorbidities such as hypertension, smoking, and alcohol consumption; pre- and postoperative chemotherapy and/or radiotherapy; site of resection, (maxillary or mandibular), surgical outcomes determined by the viability of the flap, and complications.

Postoperative complications were defined as early or late if they occurred within six weeks of surgery, or thereafter and classified as major if emergency surgical revision was required. Necrosis of the flap was classified as total necrosis if complete extraction of the flap was necessary, and partial if the flap remained implanted and only the necrosed tissue was debrided.

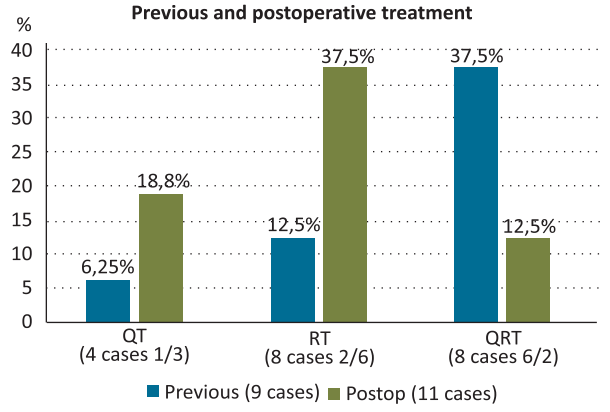
The functional result was determined in terms of oral feeding ability and nasal permeability.

Data were statistically analyzed using IBM SPSS Statistics 23 (IBM Corp, Armonk, NY, USA). Categorical and continuous variables were assessed using the Fisher exact test and Mann-Whitney test, respectively. Statistical significance was set at $p<0.05$.
We also reviewed of the most recent literature on the topic.

RESULTS

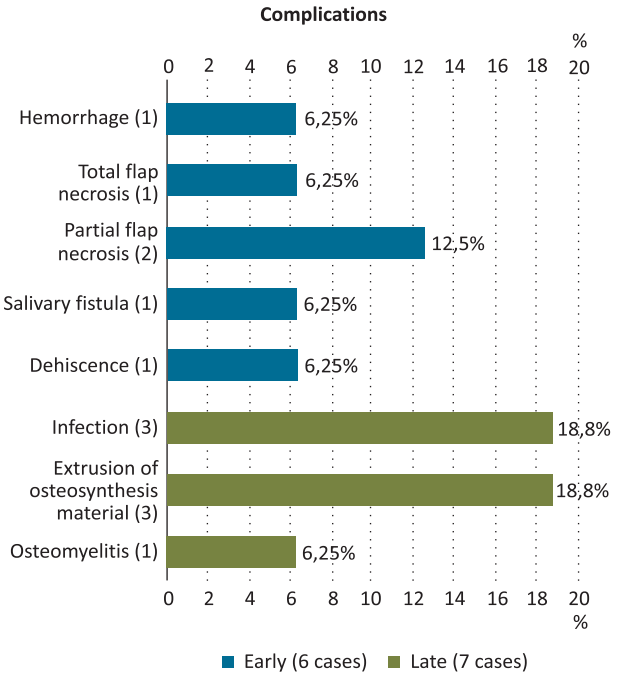
The study included 16 patients (men, 62.5%; women, 37.5%) with a mean age of 50.3 ± 17.4 years. Nine fibula and seven scapula free flaps were used for mandibular and maxillary reconstruction, respectively. Malignant tumors accounted for 75% of all lesions, and most were squamous cell carcinoma of the oral cavity. The remainder cases were benign tumors, including ameloblastoma, fibrous dysplasia, and ossifying fibroma.
The medical history revealed that 50% of the patients smoked, 31.3% consumed alcohol, and 37.5% had high blood pressure (HBP). Two (12.5%) patients had osteonecrosis before surgery, of which one was a complication of a previous radiotherapy. A significant proportion of patients received chemotherapy (CT), radiotherapy (RT), or chemoradiotherapy (CRT) before and after surgery (Graph 1).

GRAPH 1
Previous and postoperative chemotherapy (CT), radiotherapy (RT), or chemoradiotherapy (CRT)



The mean follow-up was 26.3 ± 19.1 months. The flaps were classified as viable in 15 (93.8%) patients and the functional outcome was successful in 13 (81.2%) patients.
Overall, complications developed in 56.3% of patients, of which 37.5% and 43.8% were early and late, respectively. Two major complications comprised hemorrhage and the requirement for complete flap resection. Other early complications included partial flap necrosis in two (12.5%) patients, and salivary fistula and dehiscence in 1 (6.25%) patient each. Late complications were infection and extrusion of the osteosynthesis material in three (18.8%) patients each and osteomyelitis in one (6.25%) (Graph 2).

GRAPH 2
Early and Late Complications



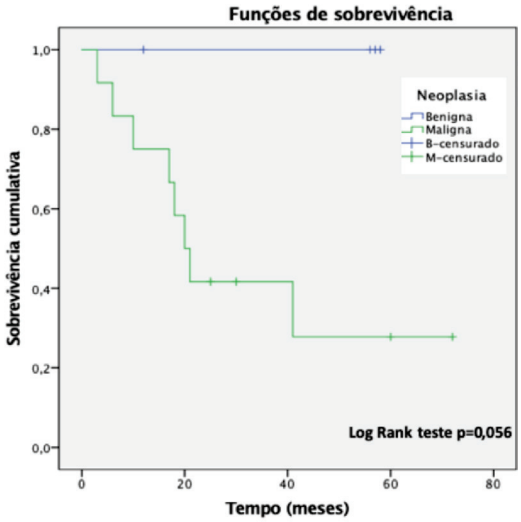
A malignant tumor relapsed after free flap reconstruction in eight patients. A statistically significant association was identified between a previous diagnosis of malignant tumor and the occurrence of complications ($\chi^2[1] = 6.86$; $p = 0.019$). The occurrence of complications was not significantly associated with osteonecrosis ($\chi^2[1] = 16$; $p = 0.475$). However, major complications and osteonecrosis were significantly correlated ($\chi^2(1) = 16$; $p = 0.008$). The occurrence of complications was significantly associated with tumor relapse ($\chi^2[1] = 6.35$; $p=0.041$) but not with age, previous or postoperative RT, previous or postoperative CT, and comorbidities such as HBP, smoking, and alcoholism (Table 1).
Categorical and continuous variables were analyzed using the Fisher exact and Mann-Whitney tests, respectively. Statistical significance was set at $p < 0.05$. An association was found between osteonecrosis and major complications $p = 0.008$.
Early and late complications were separately assessed and exhibited no statistically significant association with any of the analyzed factors. Furthermore, the type of flap (fibula or scapula) was also not associated with a higher rate of complications.
All of eight deaths were associated with tumor relapse and not with surgical complications.
The mean overall survival was 31.6 ± 22.3 months and the mean survival of the group with malignant tumors was 29.6± 21.1 months (Graph 3).

TABLE 1
Statistical analysis of the association between multivariable factors and the occurrence of complications
Categorical and continuous variables were analyzed using the Fisher exact and Mann-Whitney tests, respectively. Statistical significance was set at $p < 0.05$. An association was found between osteonecrosis and major complications $p = 0.008$.

Factors (n total)	Complications (n=9 sick people)	*p*-value
Sex Male (10) Female (6)	 7 2	0,302⁺
Age (mean 50,3±17,4)	mean 57,22±7,78	0,078*
Malignant tumor (12)	9	0,019⁺
Osteonecrosis (2)	2 (2 *major*)	0,475⁺ 0,008⁺
Relapse (8)	7	0,041⁺
Previous RT (2)	2	0,475⁺
Previous CT (1)	1	1,00⁺
Previous CRT (6)	4	0,633⁺
Postop RT (6)	3	1,00⁺
Postop CT (3)	3	1,00⁺
Postop CRT (2)	1	1,00⁺
Type of flap Fibula (9) Scapula (7)	 6 3	0,615⁺
Smoking (8)	5	1,00⁺
Alcoholism (5)	3	1,00⁺
HBP (6)	2	0,302⁺

⁺ Fischer exact test * Mann-Whitney test

GRAPH 3
Kaplan-Meier survival curve
Blue and green lines – benign and malignant tumors, respectively (Log rank test p = 0.056).



DISCUSSION

Free flaps have become the gold standard for reconstructing complex defects in head and neck surgery, as they permit single-stage tumor resection and reconstruction.[2]

Microvascular reconstruction of osseous defects has been successful and with low associated morbidity. The surgical success rate of the present osseous and osteocutaneous free flaps was 93.8%, similar to the previously reported rates (90%-98%).[1,4,6]

The factors that predict complications and flap necrosis remain controversial. Contamination of the surgical wound by oral or nasal flora, the complexity of the defect, a long surgical duration, tissue frailty , and comorbidities of the patients determine the occurrence of complications.[2,7] Here, 56.3% of our patients had complications, with 37.5% being early. This was similar to the proportion described in the literature. Two of our patients developed major complications and one exhibited total flap necrosis, indicating an overall satisfactory outcome.

Crawly et al.'s study of 892 osseous and non-osseous free flaps did not associate flap failure with smoking, diabetes, heart disease, chronic obstructive pulmonary disease, hypertension, renal disease, or previous treatment with CT or RT. Rather, it was associated with the elapsed time between the resection of the artery of the donor region's pedicle and its anastomosis with the receiver region's blood vessels.[6] Swendseid et al.'s retrospective study of 250 patients identified early complications in 29% of patients that included wound infection, fistula, and flap dehiscence, and necrosis. Early complications were associated with smoking and previous CRT, which reinforces the importance of the effect of these factors on vascularization. The authors also describe a cluster of infections in the second year postoperatively.[4]

The present study identified a statistically significant association between the occurrence of complications and reconstructions associated with malignant tumors ($p = 0.019$) and with tumor relapse ($p=0.041$). The remaining factors, such as previous or postoperative CT and/or RT, comorbidities such as HPB, smoking, and alcoholism were not significantly associated with the occurrence of complications. Additionally, the separate evaluation of early and late complications did not reveal a higher incidence associated with the evaluated factors. However, given the small study sample, the statistical relevance is probably lower. The higher rate of complications in patients with malignant tumors and tumor relapse, may be related to worse quality and vascularization of the receiving tissues and also to the influence of multivariable factors such as CT and/or RT therapy. In a study on osseous and non-osseous free flaps, preoperative RT was associated with increased flap necrosis and infections, and suggested that surgical reconstructions proceed six weeks after the last RT session.[8]

Osteoradionecrosis is a serious complication of RT. Radiation induces endarteritis, which in turn leads to tissue hypoxia, chronic infection, and necrosis.[9] It can occur in any craniofacial bone, being more common in the mandible. Risk increases with increasing dose of RT, volume of irradiated bone, and disease extension.[10] The present study found an association between osteonecrosis and major complications such as hemorrhage and total flap necrosis, probably as a result of poor vascularization of previously irradiated receiver tissues. Frederick et al.'s study associated reconstruction with free flaps in patients with a history of osteoradionecrosis with higher rates of failure (6.3%).[2] Other studies have also indicated that osteoradionecrosis entails a higher risk of complications.[10,11]

Here, patients who developed early complications were not predisposed to late complications (22%), an association between complications is controversial.[4,7] There were no major complications, flap necrosis, or requirement for flap removal after the six-week study period, indicating that the main complications occur during the period of implantation and vascular integration of the flap.

Rates of late complications described in the literature, such as wound dehiscence, osteonecrosis, and flap rupture vary between 16% and 42%[7,12], and occurred in 43.5% of our patients. An association between late complications and adjuvant RT or CRT has been described[13]. Smoking is associated with late complications and as a predisposing factor for wound dehiscence and necrosis.[12] Although statistical significance was not attained in the present study, factors that hinder tissue vascularization, such as smoking, CT, or RT remain risk factors for both early and late complications, because they reduce tissue oxygenation and perfusion and increase frailty. Local infection is a risk factor for the development of an exposed osteosynthesis plate, potentially leading to biofilm formation.[13–15]

Patients with flaps often need revision surgery, but flap explantation is rare.[4] In the absence of perioperative flap failure, a flap explantation rate of 6% has been associated with osteonecrosis or tumor relapse. The long-term viability rate is 90%.[4] There was no record of late surgical revisions in the sample.

The limitations of the present study were as follows: a small sample size, the retrospective design, which led to loss of follow-up and a potential lower rate of complications, a six-week period to distinguish between early and late complications, with the probability of late complications occurring while patients remain under the effects of adjuvant treatment, and the heterogeneity of surgical approaches, diseases, and pre- and postoperative treatments. Other important factors that should be evaluated are surgical duration, duration of flap ischemia, flap size and thickness, and their influence on the outcomes and complications.

CONCLUSION

Osseous and osteocutaneous free flaps yielded good surgical and functional outcomes, as well as good long-term viability.

Conflict of Interest

The authors declare no conflict of interest regarding this article.

Data confidentiality

The authors declare having followed the protocols in use at their working center regarding patients' data publication.

Human and animal protection

The authors declare that the followed procedures were in accordance with the regulations established by the Ethics and Clinical Research Committee and the Helsinki declaration of the World Medical Association.

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Availability of scientific data

There are no publicly available datasets related to this study.

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