

# Reconstruction spectrum of head and neck defects using a radial forearm free flap

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## Summary

**Introduction:** The radial forearm free flap (RFFF) is one of the cornerstone of reconstructive microvascular surgery in the head and the neck. It is a fasciocutaneous flap, which is mainly used for free flap reconstructions not only in the head and neck region – for its pliability, long vascular pedicle, predictability and possibility for two teams working synchronously. **Material and methods:** In our group analysis, we decided to include and evaluate the data of all patients who were treated at our department between March 2018 to April 2024 with diagnoses that resulted in a soft tissue defect in the head and neck area, which was closed using a microvascular radial forearm flap. **Results:** In total, in our group of 75 patients in a 6-year period, we used the RFFF for tongue reconstruction, reconstruction of the defects of the floor of the mouth, defects after orbital exenteration, defects in the retromolar area, oropharynx, and midsize cheek defects, temporal, frontal or parotidomasseteric defects. We also use the RFFF as a workhorse to reconstruct midsize defects of the infraorbital region, the lip, the area of the alveolar process of the lower or upper jaws, and the palate. **Discussion and conclusion:** From the perspective of overall complications in our group, we performed 75 radial forearm free flaps reconstructions in head and neck region with no flap loss. The RFFF is very reliable free flap, with a very low risk of complications. It should be emphasized that thanks to sufficient venous drainage, supported by including of the cephalic vein into the flap during its harvesting, and by performing at least two venous anastomoses, we did not lose a single radial free flap in our group of patients.

## Key words

radial forearm free flap – soft tissue head and neck defects – microvascular free flap – reconstruction

Hocková B, Slávik R, Poruban D et al. Reconstruction spectrum of head and neck defects using a radial forearm free flap. *Acta Chir Plast* 2024; 66(4): 154–159.

## Introduction

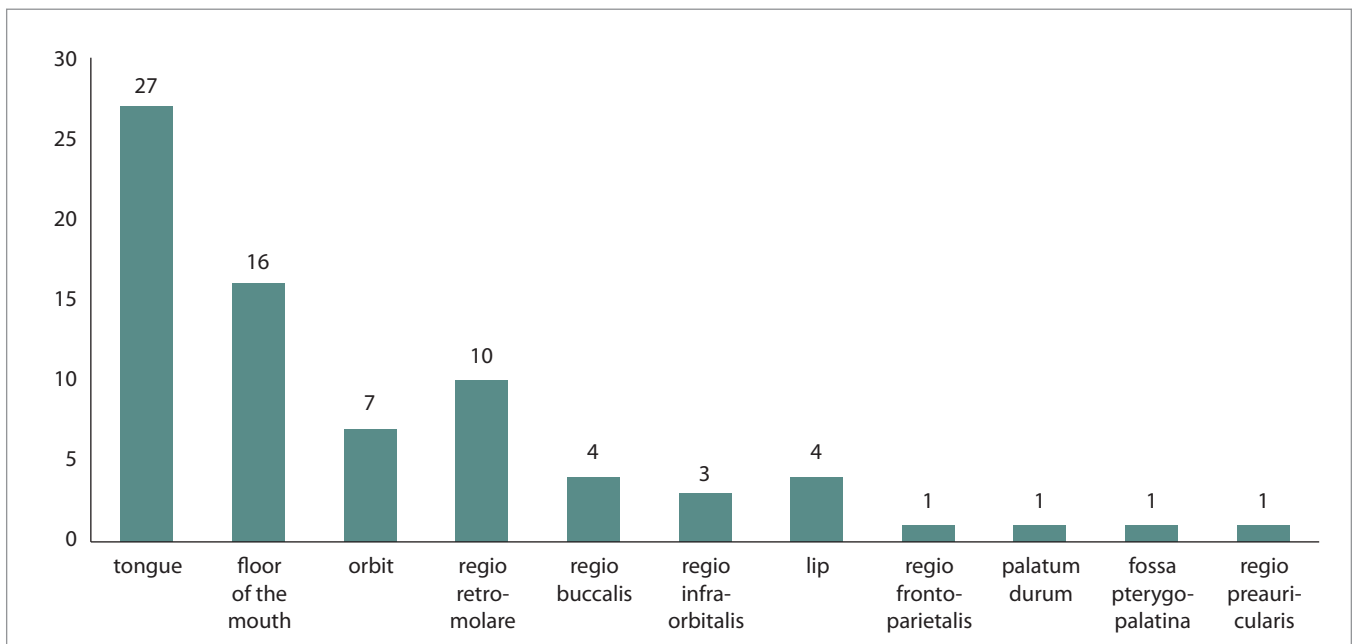
Soft tissue defects in the orofacial area arise as a result of injuries, inflammatory conditions, congenital defects, trauma, but in most cases as a result of the ablative phase of surgical treatment in a group of oncologic patients. In the treatment process, there is an effort to close the defect and reconstruct it according to the type of originally lost tissues, which is complicated in the head and neck area by the complexity of the anatomical structures and functional units of the organs. Around 1970, Mathes and Nahai [1] presented not only the concept of muscular and musculocutaneous flaps, but also included in their publication the “reconstructive ladder”, which was an algorithm for choosing a reconstruction option, based on

the principle that the simpler the solution, the better the result. Since that period, the reconstruction ladder has undergone criticism aimed at choosing the simplest possible reconstruction option, without taking into account the importance of form and function. In 1994, Gottlieb [2] reported that the simplest option was not always the best approach, with reconstructive surgery looking for creative parallels rather than simple options.

The radial forearm free flap (RFFF) or the “Chinese flap” is one of the cornerstone of reconstructive surgery. The RFFF has been used for several decades to reconstruct skin and soft tissue defects in head and neck surgery [3]. It was first used by Guofan Yang in China in 1978 [4], as a fasciocutaneous free

flap from the forearm with a pedicle radial artery and venae radiales. Soutar and McGregor pioneered its use for the reconstruction of intraoral defects, and subsequently the flap became one of the preferred types in reconstructive surgery [5]. The RFFF is a fasciocutaneous flap, which is mainly used for reconstruction in the head and neck for pliability, a long vascular pedicle and two teams working synchronously. Its anatomical variations are not very frequent, which ensures a relatively constant anatomy that we can rely on during raising flap.

The aim of this manuscript is to report a retrospective analysis of a group of 75 patients treated at our department whose soft tissue defect in the head and neck area was reconstructed with the use of RFFF. We present the possibilities



**Graph 1.** Number of radial forearm free flaps used in different head and neck anatomic areas in 6 years, a single department.

of using the RFFF in different anatomical areas of the head and neck.

### Materials and methods

In our group retrospective analysis, we decided to include and evaluate the data of all patients who were treated at our department between March 2018 to April 2024 and with the diagnoses that resulted in a soft tissue defect in the head and neck area, which was closed using a radial forearm free flap. The usual way of raising forearm free flap at our department is to proceed together with the forearm fascia. Flaps are usually harvested to include the fascia, because the deep fascial plane in the extremities has abundant blood flow, which is important for flap perfusion [6].

Since the RFFF in reconstructive surgery is considered one of the most basic options for the reconstruction of soft tissue defects from the group of free flaps, the harvest of this flap at our department is carried out and thus trained in dissection and the possibilities of working with a vascular pedicle in most cases by young residents. Out of the total number of 75 flaps, up to 59 were harvested

by a resident. Standard steps within the preoperative preparation of patients before raising radial free flap include Allen's test. In case of a negative Allen's test, we would consider using a lateral arm free flap. Of course, the flap is taken from the patient's non-dominant hand.

We monitored and evaluated complications in two groups, in the first group from the point of view of the overall health of the patients, and in the second group complications from the point of view of RFFF raising. We evaluated the donor site morbidity in the post-operative follow-up based on the patient's subjective assessment, namely hypoesthesia in the given location, limitation of hand mobility, or weakening of function. The overall follow-up of patients after reconstructive procedures is closely related in most cases to the oncological disease, based on regular clinical checks to rule out locoregional recurrence in combination with imaging examinations.

### Results and complications

The group of patients consists of 42 men (56%) and 33 women (44%); the oldest

patient was 86 years old at the time of the surgery, and the youngest patient with a diagnosis of carcinoma of the floor of the oral cavity was 35 years old at the time of surgery.

In total, in a group of 75 patients, we used the RFFF for tongue reconstruction after resection in 27 patients (36%). The second largest group included 16 patients (9%) with the reconstruction of defects after resection of the floor of the oral cavity. In 7 patients (9%), we reconstructed the defect after orbital exenteration, in 10 patients (13%) we used it to reconstruct the regio retromolare, often in combination with the soft palate or lateral wall of the oropharynx. For the closure of the cheek defect, we used the radial flap in 4 patients (5%), and in 4 patients (5%) in the group of lip reconstruction. The smallest group of 3 patients (4%) underwent the reconstructions of the regio infraorbitalis. The smallest groups with one patient each underwent the reconstruction of regio frontotemporoparietalis after resection of malignant melanoma, the reconstruction of fossa pterygopalatina, palatum durum and the reconstruction of



**Fig. 1.** Preoperative photography - malignant melanoma of the scalp with metastases in the temporo-parotid area.



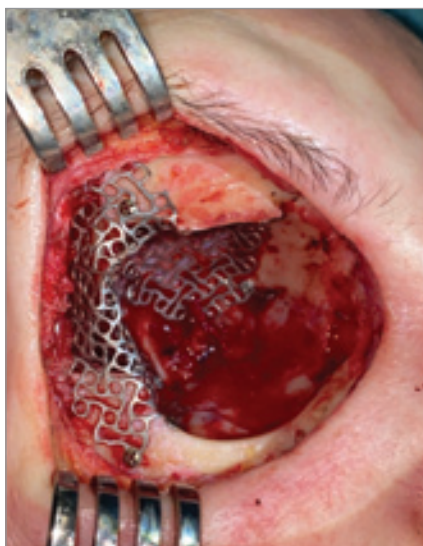
**Fig. 2.** Reconstruction of a fronto-parieto-temporal defect with the radial forearm free flap.



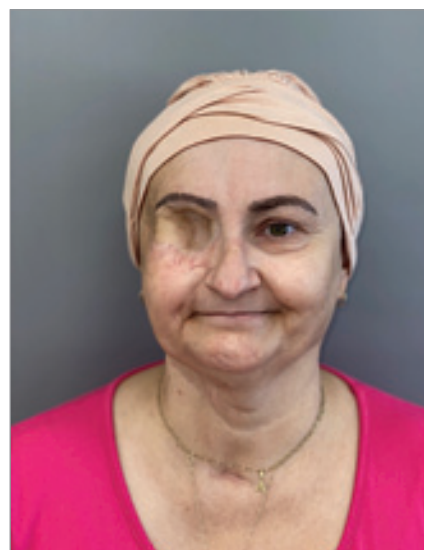
**Fig. 3.** Squamous cell carcinoma – floor of the mouth left.



**Fig. 4.** Reconstruction of the floor of the mouth with the radial forearm free flap.



**Fig. 5.** Reconstruction of the roof and lateral wall of the orbit with a titanium mesh after orbital exenteration and resection of the roof for adenoid cystic of the lacrimal gland.



**Fig. 6.** Reconstruction of the orbit with the radial forearm free flap after exenteration and resection of the roof.



**Fig. 7.** Recurrence of basal cell carcinoma – regio infraorbitalis.

a defect in the parotideomasseteric region after parotidectomy (1%). We summarized all the data from localisation of the RFFF in Graph 1: the number of radial forearm free flaps used in different head and neck anatomic areas in 6 years at a single department. In enclosed photographic documentation, we present 6 patients with reconstructed soft tissue

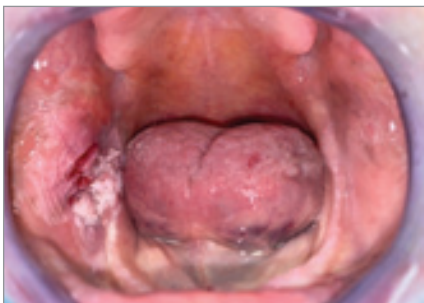
defect in orofacial region from our department (Fig. 1–12).

If we look closely to the literature, we can find modifications of raising radial forearm free flap. Lip reconstruction using the RFFF with two islands is described by Sun et al., who focused on lip reconstruction in a group of patients [7]. Maintaining the oral seal ranks among the main advantages of the use of two islands, avoiding microstomia and related complications. At our department, the “double island” method was used in the case of secondary reconstruction of the region facies ventralis maxillae – a penetrating cheek defect combined with the lateral part of nose, when we combined the double island of the RFFF





**Fig. 8.** Reconstruction of the regio infraorbitalis with the radial forearm free flap.



**Fig. 11.** Verrucous squamous cell carcinoma of the right retromolar and buccal region.



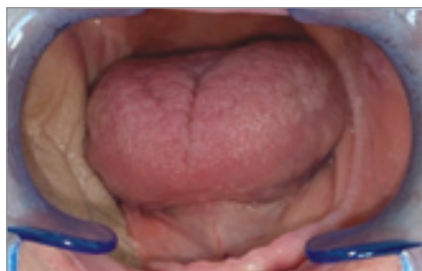
**Fig. 13.** Defect of the anterior wall of maxilla and a partial defect of the inferior and medial orbital wall on the right 2 years after ablative surgery due to squamous cell carcinoma.



**Fig. 9.** Epidermoid carcinoma right body of the tongue and floor of the mouth.



**Fig. 10.** Reconstruction after right-sided hemiglossectomy with the radial forearm free flap.



**Fig. 12.** The radial forearm free flap 26 months after the reconstruction of the right buccal and retromolar region.



**Fig. 15.** Both free flaps (radial forearm free flap and helical rim flap) vital and adapted 1 month post-operatively.



**Fig. 14.** Peroperative photography of reconstruction with the double island radial forearm free flap (for infraorbital region and internal nasal lining) and free helical rim flap for the left nasal alai.

together with the helical rim flap (HRF) for the reconstruction of the nasal wing (Fig. 13–15).

Another modification of RFFF is raising also palmaris longus tendon with the fasciocutaneous flap, the use of which is described in the literature in the case of lip reconstruction or replacement and reconstruction of the soft palate for adequate tissue suspension. According to Lee et al. [8], a larger volume flap with palmaris longus tendon capture for total soft palate reconstruction leads to the satisfactory reconstruction of the velopharyngeal valve and thus prevents the passage of fluids, especially into the nasopharynx and the nasal cavity. We used the tendon of palmaris longus muscle in the case of a complete defect of the lower lip in a patient after local recurrence of cancer of the lower lip (Fig. 16,17)

As for overall complications after the procedure, we divided them into two groups: complications due to general condition of the patient and complications due to raising of RFFF and reconstruction.

In the first group, we would like to mention general infection of the patient with COVID-19 virus during the hospital stay, fatal hepatorenal syndrome development during the early postoperative period due to regular preoperative alcohol consumption, and a polymorbid obese patient, who died in the postoperative period due to the development of sepsis and duodenal ulcer perforation in a short term after our surgery. In this group, two patients died during postoperative hospital stay (2.5%).

As we mentioned before, every patient underwent examination with Allen's test before raising the forearm free flap. We closed the donor site after raising the radial free flap in three different ways – primary suture, closure with full-thickness skin graft or split-thickness skin graft. From the point of postoperative function of the hand, 10 patients mentioned hypoesthesia in the area of the thumb and the index finger. None of the patients reported reduced hand strength or function postoperatively.

As for the local complications, we observed lymphorrhea in the wound after neck dissection in one patient, with the need for reoperation (1.3%). The largest part of the group of patients in whom we dealt with postoperative complications was postoperative bleeding in the wound site after neck dissection or in the area of the resected defect reconstructed with a microvascular flap. In 4 patients out of 75 (5.3%), it was necessary to carry out a revision and resuturing of the venous microanastomoses due to the signs of venostasis of the flap. In 11 patients (15%), as a result of postoperative blood thinning with low molecular weight heparin and its dose adjustment according to the antiXa value, we dealt with postoperative bleeding

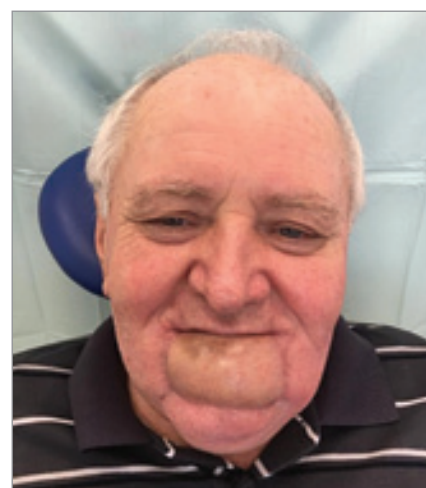


**Fig. 16. Recurrence of lower lip cancer.**

or hematoma in the wound with the need for drainage, even though only as part of the procedure under local anesthesia in most of the cases. One patient (1.3%) developed infection and disintegration of the wound after neck dissection during home care, necessitating resuture, and in one patient (1.3%) on the basis of re-evaluation of the initially negative marginal rapid section from definitive histology to positive, we indicated re-resection, radicalization at the site of the positive resection margin.

In terms of complications at the site of RFFF harvesting, we encountered the necessity of resuturing the site of skin graft removal in one patient (1.3%), as well as the necessity of resuturing the wound after raising RFFF or the exposed tendon of the palmaris longus muscle during healing after surgery (1.3%).

As it is clear from the overall listing of complications in patients groups, the overall general complications of the patients, related to their general health status or postoperative bleeding from wounds in the head and neck area, far exceeded the complications that would be related and directly connected to the raising of RFFF. From our group of patients, we did not lose a RFFF. Sufficient



**Fig. 17. Reconstruction of the lower lip with the radial forearm free flap using the palmaris longus tendon for lip suspension.**

venous drainage seems to be crucial for overall RFFF survival [9]. Including the cephalic vein into the flap during harvesting increases venous drainage and lowers the risk of venous congestion and finally flap loss [10].

## Discussion

Surgical judgment in reconstructive surgery should primarily focus on the analysis of the clinical problem and the steps that must be taken to achieve optimal reconstruction. In the subsequent procedure, it is the selection of the best possible reconstruction approach based on what structures are to be replaced, what the functional requirements are and, last but not least, what the esthetic conditions we would like to achieve. In the case of surgical treatment of soft tissue defects, there are various techniques and reconstruction options in the field of maxillofacial surgery. We logically approach wound closure options from simple options to more complex ones, keeping in mind that in some circumstances more sophisticated techniques are needed to achieve a better result [11].

Reconstructions of large head and neck defects with autologous tissue transfer and microvascular anastomo-

sis are now often referred to as the gold standard treatment for medium and large maxillofacial defects [12]. Reconstructive surgery makes it possible to provide surgical treatment even for patients with very advanced stages of the disease. Reconstruction of the defect created by resection aims at the following: sufficient coverage of the defect, volume renewal, prevention of infection, filling resected and dead spaces, restoration of function, and sufficient bone coverage, especially in anticipated adjuvant radiotherapy [13].

It should be noted that the use of a free flap and transplantation of tissue from another parts of the body to the recipient site is a unique possibility of closing defects and using the body's own tissue. An inherent advantage is also the area of the body outside the radiation area, especially in patients with previous oncological treatment. The most important point of using a free flap that cannot be overlooked is the possibility of sufficient radicality from the point of view of resection, which brings us closer to the ideal possibility of achieving free resection margins.

On the other hand, the disadvantages of extrafacial flaps include a different texture and color of the skin. Even in the case of primary reconstruction with a free extrafacial flap, resurfacing with a forehead flap or retransplantation of the flap with a skin graft from the head or neck region should follow at a second time (e.g., in nasal reconstruction) if a local or regional flap cannot be used.

In conclusion, the RFFF is considered as a workhorse free flap for the reconstructions of moderate to large simple defects thanks to a low number of complications and a low risk of flap loss.

## Conclusion

The aim of our paper was to present data to analyse and evaluate a group of 75 patients in whom we used a radial microvascular flap for the reconstruction of a soft tissue defect in the head and neck region. From the perspective of overall complications, it should be emphasized that thanks to sufficient venous drainage, which is also assisted by harvesting the cephalic vein, and by performing at least two venous anastomoses, we did not lose a single radial free flap in our group of patients. It is possible to state and confirm that, thanks to the abovementioned facts, the radial free flap is a reliable choice and in many departments it is the gold standard among microvascular flaps for the surgical reconstruction of soft tissue defects in the head and neck region.

## Roles of authors

Barbora Hocková: investigation, writing – original draft; Juraj Abelovský: formal analysis, writing – original draft; Filip Kubec, Juraj Gembeš, Martin Pawelski: data synthesis; Martina Hanzelová, Oleksandra Liebidieva: editing; Adam Stebel and Dušan Poruban: writing – review and editing; Rastislav Slávik: supervision.

## Declaration of competing interest

The authors declare no conflict of interest.

## Funding

The work of Barbora Hocková was supported by University of Palacký grant No. IGA\_LF\_2021\_008.

## Disclosure

The authors have no conflicts of interest to disclose. All procedures performed in this study involving human participants were in accordance with ethical standards of the institutional and/or national research committee and with the Helsinki declaration and its later amendments or comparable ethical standards.

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