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Versatility of Radial Forearm Free Flap for Intraoral Reconstruction

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SUMMARY

Introduction The radial forearm free flap has an important role in reconstruction of the oncologic defects in the region of head and neck.

Objective The aim was to present and evaluate clinical experience and results in the radial forearm free transfer for intraoral reconstructions after resections due to malignancies.

Methods This article illustrates the versatility and reliability of forearm single donor site in 21 patients with a variety of intraoral oncologic defects who underwent immediate (19 patients, 90.5%) or delayed (2 patients, 9.5%) reconstruction using free flaps from the radial forearm. Fascio-cutaneous flaps were used in patients with floor of the mouth (6 cases), buccal mucosa (5 cases), lip (1 case) and a retromolar triangle (2 cases) defects, or after hemiglossectomy (7 cases). In addition, the palmaris longus tendon was included with the flap in 2 patients that required oral sphincter reconstruction.

Results An overall success rate was 90.5%. Flap failures were detected in two (9.5%) patients, in one patient due to late ischemic necrosis, which appeared one week after the surgery, and in another patient due to venous congestion, which could not be salvaged after immediate re-exploration. Two patients required re-exploration due to vein thrombosis. The donor site healed uneventfully in all patients, except one, who had partial loss of skin graft.

Conclusion The radial forearm free flap is, due to multiple advantages, an acceptable method for reconstructions after resection of intraoral malignancies.

Keywords: radial forearm free flap; intraoral reconstruction; oncologic defects

INTRODUCTION

Oral cancer is a serious malignant disease, affecting the lip, buccal mucosa, tongue, or floor of the mouth with tendency to metastasize to the cervical lymph nodes.

Microsurgical free tissue transfer has been an option for head and neck reconstructions after oncologic resections since 1980s [1-6]. The free flaps with rich vascularity provide a high degree of versatility and reliability. The radial forearm free flap was originally described for reconstruction of head and neck defects by Young et al. [1] in 1981. Soutar and McGregor [2] pioneered its use for intraoral reconstructions, and since than this flap become one of the preferred flaps in this field of reconstruction surgery. The palmaris longus tendon and the part of the radius could be included into the flap, giving the opportunity to reconstruct composite tissue defects. The lateral antebrachial cutaneous nerve could be raised within the flap, facilitating sensory innervation to the recipient reconstructed tissue [4, 5, 6].

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OBJECTIVE

In this article we present versatility and reliability of the free radial forearm flap in reconstruction of various intraoral head and neck defects after cancer ablative surgery.

METHODS

From 2003 to 2010, a total of 21 patients underwent intraoral reconstruction after radical surgery for oral cancer. The medical records of 21 patients were reviewed for age, gender, and location of primary tumor (Table 1).

Nineteen patients underwent immediate reconstruction after tumor ablation, and two patients had secondary reconstruction. Fasciocutaneous flaps were used in patients with floor of the mouth defect, hemiglossectomy, buccal mucosa, lip and a retromolar triangle defects. The fasciocutaneous flaps with its vascular pedicle having the radial artery, concomitant veins and the cephalic vein were raised in 19 patients, and in 2 patients the palmaris longus tendon was additionally included. The composite flaps with the palmaris longus tendon were used for oral sphincter reconstruction. The important preoperative assessment (Allen test) was done to ensure that circulation of the hand will not be impaired after division of the radial artery. We performed flap dissection after exsanquination of the forearm, using elastic bandage and raising the tourniquet to approximately 250 mm Hg.

After inserting the flap at the recipient site, vascular anastomoses were performed in end-to-end and end-to-side fashion. The recipient arterial vessels were facial artery and superior thyroid artery, and recipient veins were: v. jug-

Table 1. The summary of patients

Characteristics		Value
Gender (n)	Male	20
	Female	1
Age (years)	Mean	53
	Range	37–68
Diagnosis (n)	Squamous cell carcinoma	20
	Verrucous carcinoma	1
Tumor location (n)	Floor of the mouth	6
	Tongue (hemiglossectomy)	7
	Buccal mucosa	5
	Lip	1
	Retromolar triangle	2
Radiotherapy (n)	Preoperative	15
	Postoperative	2

n – number of patients

ularis externa, v. thyroidea superior and v. facialis. Donor site defects were reconstructed with a partial thickness skin graft using local flaps.

Postoperatively, close monitoring of the flaps in the first 72 hours after surgery was performed by hourly assessment and pinprick testing when color, capillary refill, bleeding, and appearance of the flap suggested a vascular problem. The frequency of flap monitoring was reduced to every 4 h after the first 72 hours until the patients' discharge from the hospital. If the change in appearance, color and capillary refill suggested vascular compromise, patients were taken back to the operating room for re-exploration of the anastomoses.

Table 2. The characteristics of flap harvest

Characteristics		Value
Vascular pedicle (cm)	Mean	8.5
	Range	7–13
FRFF size (cm^2)	Mean	30
	Range	25–42

FRFF – free radial forearm flap

RESULTS

Twenty-one patients underwent intraoral tumor ablation and reconstruction using fasciocutaneous radial free flap transfer (Table 2). Eighteen patients were males and 3 were females, with an average age of 53 (range 37–68). Twenty patients were heavy smokers for years. Fasciocutaneous flaps were used in patients with floor of the mouth (6 cases), hemiglossectomy (7 cases), buccal mucosa (5 cases), lip (1 case) and a retromolar triangle (2 cases) defects (Figures 1, 2 and 3). Preoperative radiation therapy was given to 15 of 21 patients and postoperative radiation therapy to

Figure 1. Full thickness defect of the cheek and lip corner (a), reconstructed with free radial flap (b), and patient appearance 4 months postoperatively (c, d)

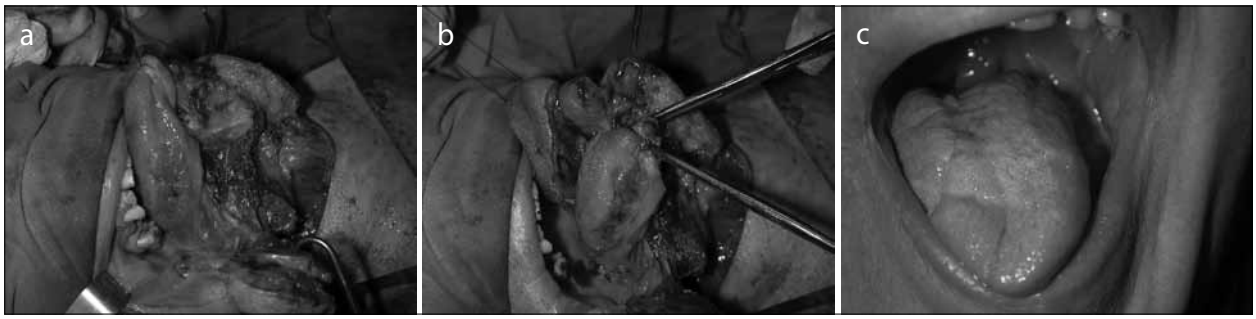

Figure 2. Squamous cell carcinoma of one side of the tongue (a), defect after radical tumor excision with modified radical neck dissection (b), and free radial flap reconstruction (c)

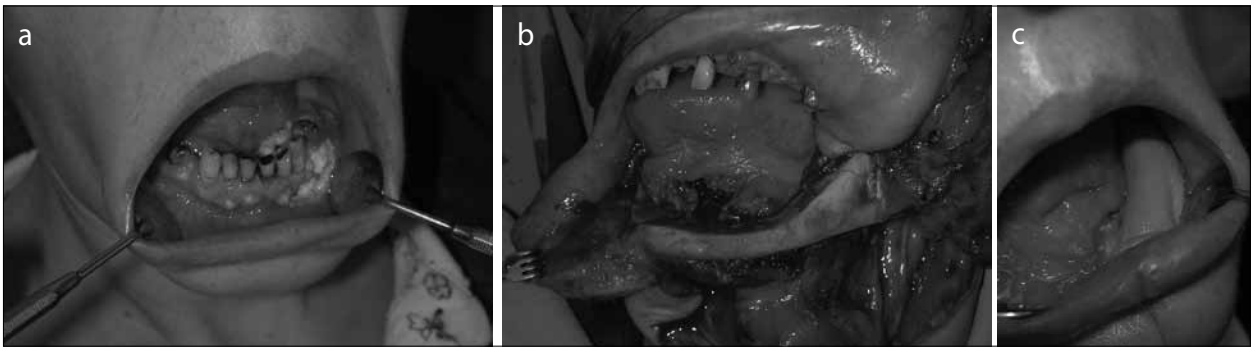

Figure 3. Squamous cell carcinoma of the alveolar ridge (a), radial excision with neck dissection (b), and free radial flap reconstruction (c)

Figure 4. Late ischemic necrosis of the radial free flap

2 patients. Donor site defects were reconstructed in 18 patients with a partial thickness skin graft, and in 3 patients using local flaps. The median hospital stay was 16 days.

The development of complications at the recipient site increased the hospital stay by 8 days. The recipient site complications were the following: 1 total flap necrosis due to late ischemic necrosis that appeared on the 10th day after surgery and 1 partial flap necrosis due to venous congestion. The total flap necrosis was detected in a 57-year-old male patient that had a long tobacco consumption history (Figure 4). The re-exploration of the anastomoses was required in 3 cases due to venous congestion, and in 1 case the flap was successfully salvaged.

Systemic complication that occurred was perforating duodenal ulcer in 1 patient. The overall flap survival rate was 90.5%.

There was 1 donor site complication: a partial skin graft loss, which was successfully resolved with skin grafting.

DISCUSSION

Microvascular surgery is highly successful and relatively safe method for reconstruction of extensive intraoral defects. Ideal reconstruction is considered to be an achievement of balance between function, coverage of vital structures and cosmetics.

The radial forearm free flap has a positive effect on restoring function and appearance to patients with soft tissue intraoral defects after tumor ablation surgery. Radial free flap has pliable skin paddle, which is relatively hairless, with little bulkiness and drapes over the complex shapes within the oral cavity [4-8]. When extensive resections are performed intraorally, especially after tongue resections, this flap offers less resistance to movements compared to other reconstructive options. More bulky flaps for tongue reconstruction would limit its movements and inhibit the muscular hypertrophy of the remaining tongue musculature. For example, the rectus abdominis musculocutaneous flap is too bulky and may result in abdominal hernia [7].

Radial free flap provides consistent, vascular pedicles, with adequate length in diameter. The relatively long vascular pedicle allows performance of the microvascular anastomosis away from the defect, which is important because of the possibility of avoiding the preoperatively irradiated vessels [5-8].

The color match was acceptable because the flap is hidden inside the oral cavity. The sensibility can be achieved by including the lateral antebrachial nerve into the flap [7, 8, 9].

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The method of reconstruction of partial mandibular defects with composite osteocutaneous radial free flap has been criticized by some authors due to inadequate volume of harvested bone and inability to reconstruct significant mandibular defects. The reconstructed bone graft raised from radius is too weak to withstand normal masticatory stresses. Also, care must be taken to prevent the radius from the risk of fracture. The recommended length of radius is 10 to 12 cm and the thickness up to 40% of circumference of the radius [4]. Immobilisation of the radial forearm after flap harvesting is recommended, and the flap is raised either with the bone segment or without it. For raising bone segment within the flap, 6 to 8 weeks of immobilization is necessary. Fasciocutaneous flap without bone segment requires immobilization for a week [4].

More often in the reconstruction of composite tissue defects we performed free DCIA and fibula flap, depending on the site and size of the tissue defect.

Over the past few decades, the success rates for microsurgical reconstructions have greatly improved, but flap compromises and failures still occur [9-12]. The most common complication and reason for flap failure is thrombosis. When flap compromise occurs, it is usually because of a problem within the venous portion of the pedicle [11-15]. The venous system is a low-flow system that is more prone to stasis. In addition, the vein can be easily compressed or kinked with hematoma, poor pedicle orientation, or neck motion. The arterial flow is rapid, with thicker arterial wall and therefore problems with anastomoses will become evident at a much earlier stage than those in the venous system. As Yu et al. [13] pointed out, postoperative arterial thrombosis is often associated with intraoperative arterial thrombosis due to technical difficulties, such as artery size mismatch, calcified vessels, and technical mistakes. Adequate pedicle length and geometry are essential to prevent venous thrombosis. Bui et al. [12] reviewed 1193 consecutive free flaps to study free flap re-exploration. They found that 21 patients (1.8%) were sent back to the operating room for evacuation of a hematoma. The radial forearm was the most common flap that developed a hematoma (43%). A majority (86%) of the re-explorations for hematomas were related to the head and neck [12]. In the study of Bui et al. [12], 5 patients (2.8%) developed signs of hematoma in the upper neck postoperatively that necessitated surgical exploration; venous thromboses caused by hematoma compression were found in 2 of these 5 patients.

Previous reports have confirmed that postoperative monitoring provided by clinical assessment and monitoring techniques is mandatory in order to minimize flap necrosis and achieve success of the flap salvage, because it provides emergent exploration of the flap [6, 12, 14, 16, 17]. Immediate re-exploration of the anastomoses is necessary when vascular compromise is evident [5, 6, 18, 19]. In our series, three revisions of two flaps were performed during the first twelve hours postoperatively. One flap located on the floor of the mouth could not be salvaged, after attempt to re-anastomose veins. The defect was secondary salvaged with the supraclavicular fasciocutaneous pedicle flap. One flap loss was noticed on the 10th day postoperatively due to uncommon late ischemic necrosis. Tobacco exposure, increased operative time and advanced co-morbidity are factors associated with the increased risk of systemic and local complications.

In our series, squamocellular carcinoma was the most common intraoral cancer; all the patients except 1 were smokers, and 10 patients were heavy drinkers.

Donor site morbidity due to the partial loss of the skin graft over the tendons can cause tendon exposure, adhesions and delayed healing. The reports in the literature showed 2–53% of partial skin graft loss and 0–33% tendon exposure [4, 20, 21].

CONCLUSION

Free radial forearm flap with high success rate, good aesthetic and functional outcome allows reconstruction of various intraoral defects. The technique of raising the flap, closing the donor site and performing anastomoses on the recipient site, needs to be meticulous in order to achieve good cosmetic and functional outcome. Our results revealed radial free flap to be a reliable method for intraoral reconstructions.

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REFERENCES

1. Young GF, Chen PJ, Gao YZ, Liu XY, Li J, Jung SH. Forearm skin flap transplantation: a report of 56 cases. J Plast Surg. 1997; 50:162-5.
2. Soutar DS, McGregor IA. The radial forearm flap in intraoral reconstruction: the experience of 60 consecutive cases. Plast Reconstr Surg. 1986; 78:1-8.
3. Munoz-Guerra MF, Naval-Gias L, Rodriques-Campo FJ, Gonzales FJ. Vascularized free fibular flap for mandibular reconstruction: a report of 26 cases. J Oral Maxillofac Surg. 2001; 59:140-4.
4. Chen CM, Lin GT, Fu YC, Shieh TY, Huang IY, Shen YS, et al. Complications of free radia forearm flap transfers for head and neck reconstruction. Oral Surg Oral Med Pathol Oral Radiol Endod. 2005; 99:671-6.
5. Nikolić Ž, Jeremić J, Milosavljević R. Primena slobodnih mikrovaskularnih režnjeva u zbrinjavanju defekata glave i vrata. Vojnosanit Pregl. 2006; 63(8):703-12.
6. Jeremić J, Nikolić Ž, Drčić L, Petrović A, Jeremić K, Todorović V. Upotreba slobodnog radijalnog režnja u pokrivanju defekata glave i vrata. Vojnosanit Pregl. 2009; 66(4):290-4.
7. Hurvitz KA, Kobayashi M, Evans GR. Current options in head and neck reconstruction. Plast Reconstr Surg. 2006; 118:122-33.
8. Rhemrev R, Rakhorst HA, Zuidam JM, Mureau MA, Hovius SE, Hofer SO. Long-term functional outcome and satisfaction after radial forearm free flap reconstructions of intraoral malignancy resections. J Plast Reconstr Aesthet Surg. 2007; 60:5885-92.

9. Brown JS, Devine JC, Magennis P, Sillifant P, Rogers SN, Vaughan ED. Factors that influence the outcome of salvage in free tissue transfer. Br J Oral Maxillofac Surg. 2003; 41:16-20.
10. Pohlenz P, Blessmann M, Blake F, Li L,Schmelzle R, Heiland M. Outcome and complications of 540 microvascular free flaps the Hamburg experience. Clin Oral Investig. 2007; 11:89-92.
11. Chubb D, Rozen WM, Whitaker IS, Acosta R, Grinsell D, Ashton MW. The efficacy of clinical assessment in the postoperative monitoring of free flaps: a review of 1140 consecutive cases. Plast Reconstr Surg. 2010; 125:1157-66.
12. Bui DT, Cordeiro PG, Hu QY, Disa JJ, Pusic A, Mehrara BJ. Free flap reexploration: indications, treatment, and outcomes in 1193 free flaps. Plast Reconstr Surg. 2007; 119:2092-100.
13. Yu P, Chang DW, Miller MJ, Reece G, Robb GL. Analysis of 49 cases of flap compromise in 1310 free flaps for head and neck reconstruction. Head Neck. 2009; 31:45-51.
14. Devine JC, Potter LA, Magennis P, Brown JS, Vaughan ED. Flap monitoring after head and neck reconstruction: evaluating an observation protocol. J Wound Care. 2001; 10:525-9.
15. Liu Y, Jiang XZ, Huang JT, Wu Y, Wang GD, Jiang L, et al. Reliability of the superficial venous drainage of the radial forearm free flaps in oral and maxillofacial reconstruction. Microsurgery. 2008; 27:243-7.
16. Disa JJ, Cordeiro PG, Hidalgo DA. Efficacy of conventional monitoring techniques in free tissue transfer: an 11-year experience in 750 consecutive cases. Plast Reconstr Surg. 1999; 104:97-101.
17. Liu Y, Zhao YF, Huang JT, Wu Y, Jiang L, Wang GD, et al. Analysis of 13 cases of venous compromise in 178 radial forearm free flaps for intraoral reconstruction. Int J Oral Maxillofac Surg. 2012; 41(4):448-52.
18. Kesting MR, Hölzle F, Wales C, Steinstraesser L, Wagenpfeil S, Mücke T, et al. Microsurgical reconstruction of the oral cavity with free flaps from the anterolateral thigh and the radial forearm: a comparison of perioperative data from 161 cases. Ann Surg Oncol. 2011; 18(7):1988-94.
19. Lee JT, Chen PR, Cheng LF, Wang CH, Wu MS, Huang CC, et al. A comparation between proximal lateral leg flap and radial forearm flap for intraoral reconstruction. Ann Plast Surg. 2013; 71(1):43-7.
20. Timmons MJ, Missotten FE, Poole MD, Davies DM. Complications of radial forearm flap donor sites. Br J Plast Surg. 1986; 39(2):176-8.
21. Swanson E, Boyd JB, Manktelow RT. The radial forearm flap: reconstructive applications and donor-site defects in 35 consecutive patients. Plast Reconstr Surg. 1990; 85(2):258-66.

Примена радијалног подлакатног режња у покривању интраоралних дефеката

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КРАТАК САДРЖАЈ

Увод Микроваскуларни радијални подлакатни режањ има важну улогу у реконструкцији онколошких интраоралних оштећења ткива.

Циљ рада Циљ рада је био да се прикаже свеобухватност слободног фасциокутаног радијалног режња у покривању различитих интраоралних дефеката.

Методе рада Слободни радијални подлакатни фасциокутани режањ је примењен код 21 болесника ради покривања интраоралних оштећења након онколошких ресекција. Код 19 болесника примењена је примарна реконструкција, а код два секундарна. Слободни радијални режњеви употребљени су ради покривања дефекта пода усне дупље (код шест болесника), након хемиглосектомија (7), оштећења букалне мукозе (5), усне (1) и регије ретромоларног троугла (2). Тетива мишића *m. palmaris longus* укључена је у режањ код два болесника ради реконструкције оралног сфинктера.

Резултат Успешност реконструкције је била 90,5%. Компликације тоталне некрозе режња су забележене код два болесника (9,5%). Код првог је касна исхемијска некроза примећена након недељу дана од реконструкције, док је код другог дошло до венске конгестије режња, која се није могла решити непосредном ревизијом анастомозе. Код два болесника, као последица венских тромбоза, рађена је секундарна ревизија анастомоза. Давајуће регије су нормално зарасле код свих болесника осим код једног, где је дошло до делимичног губитка слободног кожног трансплантата.

Закључак Микроваскуларни радијални подлакатни режањ је из неколико разлога прихватљива метода реконструкције после ресекција због интраоралних онколошких дефеката.

Кључне речи: микроваскуларни радијални подлакатни режањ; интраорална реконструкција; онколошки дефекти

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