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Advanced Head and Neck Reconstruction; A Seven-Year Experience in Iran

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Abstract

Background: One of the most challenging methods is a free flap reconstruction in the third world: wanting in more endeavors. There is an intense requirement in the realm of training and experience in addressing head and neck defect issues. This study is aimed at expressing our experience with the free flap as a useful reconstruction method.

Methods: Some patients were included as candidates in a retrospective study for free flap reconstruction, referring to diverse hospitals in different places in Tehran, Iran, from 2013 to 2020. Patients' demographic data, tumor profile, as well as flap results, were under assessment. Means (±Standard Deviation=SD), and median (with an interquartile range =IQR=Q1-Q3) for continuous variables; frequencies, as well as proportions for categorical variables, were reported. The variables' comparison among both groups – death or survival –was conducted employing either X2 tests or Fisher's accurate test for proportions; also, unpaired t-tests for means.

Results: 330 individuals of patients undergoing 7 years of free-flap operation were under evaluation. The age ranged from 7 to 96 years, with an average of 51.91 ± 17.87 (Mean ± SD). The tongue (118, 37.6%) was the tumor's most typical origin; radial forearm flap (133, 40.3%), the most employed flap accompanied by anterolateral thigh flap (110, 33.3%). The success rate of free flaps surgery was 94 %, and merely 20 individuals of (6%) patients experienced flap necrosis; 21 individuals of patients (6.4%) died in the hospital after the surgical operation.

Conclusion: In spite of the several limitations in our country as there are in other developing countries, the surgery of free flap reconstruction in head and neck defects has experienced an evolution in the last few years. In order to achieve better outcomes, we are supposed to mitigate the related issues to underlying diseases, patients suffering from, and the delay in the realm of detecting flap vascular complications in our setting.

Keywords: Free Flap, Head And Neck Reconstruction, Head And Neck Cancer, Reconstruction Surgery, Cancer Surgery

Conflicts of Interest: *None declared*
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Introduction

The free-flap transfer is an incredible, versatile method, making an evolution in the realm of cancer surgery. Putting such a method into use has made it feasible to utilize tumor ablation operation as an option for the treatment of head and neck cancer at the advanced levels. Still, previous operations were excluded due to the requirement for

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↑What is "already known" in this topic:
Reconstruction of the large head and neck defect is a challenging issue. In a developing country, free flap techniques, as the best modality treatment for these defects, are encountered with major problems, including lack of facilities and a cohesive team.

→What this article adds:
For the first time in Iran, a team consisting of the head and neck surgeons have been created, which has overcome the existing problems and has presented its methods and experiences. The results with a high success rate are inconsistent with other advanced centers.

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aggressive resection, as well as the loss of appropriate reconstruction tissues (1-3).

In 1971 Antia and Buch proposed the Superficial Inferior Epigastric procedure aimed at facial defects: an unprecedented step. Making use of this method was useful in covering up the defect followed by the Amloblastoma tumor resection (4).

Since the late twentieth century, there has been a development in both the introduction and the employment of various types of free flap. These flaps' utilization was based on the size, as well as the type of tissue required, so as to repair the body's defects. In the last few decades, this method has become more familiar in terms of head and neck reconstruction following tumor ablation, as well as facial defects because of congenital or traumatic causes.

The satisfying outcomes of these reconstruction methods, in comparison with that of the previously available ones such as local flap, as well as the regional flap, have resulted in their extensive acceptance and usage among micro-vascular and plastic surgeons.

Taking an unprecedented step, a team including specialists of head and neck cancer surgeons was created so as to employ the free flap method in our institute, despite lacking insufficient development. This study is aimed at expressing our experience with the free flap as a useful reconstruction method.

Methods

This is a retrospective cohort study regarding the patients referred to different hospitals in Tehran, Iran, from 2013 to 2020, including Rasoul-e Akram, Firozgar, Erfan hospitals. Putting the Current Procedural Terminology (CPT) code into use, patients undergoing free flap surgery of head and neck cancer were included. An informed consent process was taken from each participant.

This study was conducted following the approval of Institutional Review Board: IR.IUMS.REC.1401.032, Iran University of Medical Sciences. Ethically, all the patients' data were considered confidential. Written consent was obtained from the patients for inclusion in the study.

The collected data was about the patients' personal and medical information: age, gender, cancer origin site, pathology, as well as the type of flap. Furthermore, a clinical recordings review, including flap complication, donor site complication, as well as survival rate, was carried out. The data analyzed made use of SPSS software.

Diagnostic examination of Metastasis was carried out before surgical operation (preoperatively) in head and neck defects due to malignant tumor etiology.

All of the operations were done by the same senior surgeon, along with the related teams. Two groups of teams were included in all of the procedures' stages: the first for tumor extirpation, as well as neck dissection, if necessary; the second for flap harvest and reconstruction method. The senior surgeon had taken responsibility for the microvascular anastomosis by employing a magnifying microscope.

In most cases, the facial trunk, along with the external maxillary artery, was selected as a recipient artery and the facial vein or retromandibular vein was selected as a recipient's vein. Regarding a depleted neck case, the external carotid artery, as well as the internal jugular trunk, would be the other alternatives.

Arterial anastomosis preceded its venous counterpart in order to make sure of the venous return and the perfusion (Figs. 1 and 2). Handle Doppler sonography was put into use in order to conduct an assessment of the anastomosis pulse with regard to stretch.

Vessel spasm is controlled by making use of Papaverine (Tehran, Iran) irrigation (5). After the completion of the anastomosis, the vascular pedicle was evaluated in terms of redundancy, tension, or kinking, all of which predisposed it to venous thrombosis, as well as flap failure (5-7).

Skin paddle color, turgor, as well as capillary refill was kept under surveillance after the operation: every hour on the first day; every 6 hours on the second and third day. The examination process was carried out once daily on the subsequent days of admission.

The flap temperature recording was done employing the infrared thermometer in which over 2 degrees of difference with the tissues surrounding is unusual (8-10).

In the case of pedicle complication, a Doppler ultra-

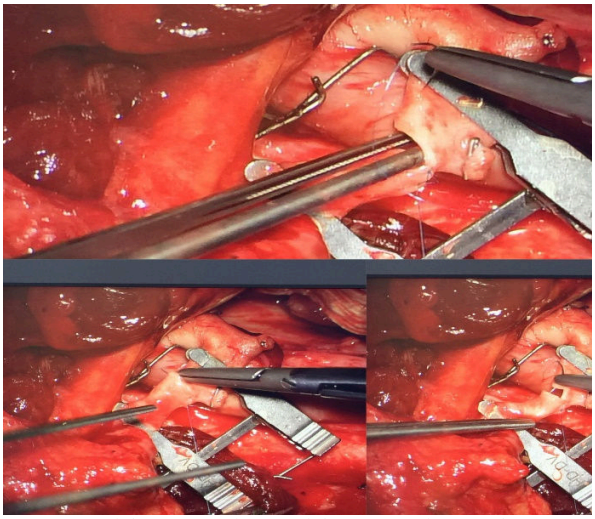

Fig. 1. Arterial anastomosis. Arterial anastomosis Precedes venous anastomosis.

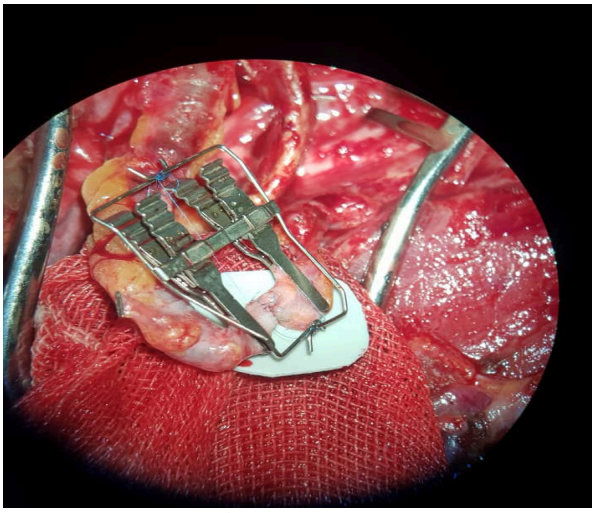

Fig. 2. Venous anastomosis

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sound assessment was executed; if either arterial or venous complication was accepted, a salvage operation would be launched.

All of the statistical analyses were executed with the Statistical Package for Social Sciences version 20.0 (SPSS Inc., Chicago, IL, USA). Means (±Standard Deviation=SD), and median (with an interquartile range =IQR=Q1-Q3) for continuous variables; frequencies, as well as proportions for categorical variables, were reported. The variables' comparison among both groups – death or survival –was conducted employing either X2 tests or Fisher's accurate test for proportions; also, unpaired t-tests for means. A value of $P<0.05$ was assumed to be statistically considerable.

Results

The present study was carried out on 330 patients who underwent free flaps surgery in Firoozgar and Erfan and Rasool Akram hospitals from 2012 to 2019. The mean age of the patients was 51.91 ± 17.87 years. The median age of patients was 53 years (IQR 38–65 years). The patients' age ranged from 7 to 96 years. One hundred and thirteen patients (34.2%) were female and 217 patients (65.7%) were male. In 314 patients with tumor etiologies, the three most common locations of the tumor origin were tongue (118, 37.6%), mandible (33, 10.5%) and buccal mucosa (27, 8.6%) in this study (Tables 1 and 2). Examination of tumor pathology revealed that squamous cell carcinoma (SCC) in 218 patients (77.6%) and Adenoid cystic carcinoma (ACC) in 27 patients (9.6%) were the most common types of tumor pathology.

Table 3 shows the frequency of the pathology of each tumor in the patients. It should be noted that in 49 patients (14.8%), only reconstructive surgeries (33 patients) or rehabilitation procedures for facial nerve paresis, gracillis free flap (7 patients) were done for them in our center, because ablation tumor surgery was carried out in other centers previously or the defects resulted from congenital facial hypoplasia (8 patients), or traumatic etiology (1 patient).

There were three types of flaps that were used the most in the patients: Radial foramen, Anterolateral thigh, and fibula in 133 patients (40.3%), 110 patients (33.3%) and 44 patients (13.3%), respectively. Table 4 shows the frequency of different types of flaps used in the patients. The success rate of free flaps surgery was 94 and only 20 (6%) had necrosis. Regarding early complications (within 72 hours of surgery); 2 patients (0.6 %) developed a venous hematoma, one of which was successfully operated and the other could not undergo salvage surgery due to respiratory arrest, loss of consciousness and patient instability.one patient (0.3%) affected by carotid artery hemorrhage, rescue surgery was performed successfully. 12 patients (3.6 %) had tumor recurrence in one year follow up. Out of those 12 patients, 9 patients underwent reoperation and 3 patients were considered inoperable. The mean age in the patients with recurrent and non-recurrent events was 57.00 ± 12.99 and 51.75 ± 18.00 years, respectively.

Table 1. Etiology of free flap reconstruction

Etiology	Frequency	Percent
Tumor	314	95.2
Facial nerve rehabilitation	7	2.1
Congenital deformity	8	2.4
Trauma	1	0.3
Total	330	100.0

Table 2. Frequency distribution of tumor origin

Tumor origin site	Frequency	Percent
Tongue	118	37.6
Mandible	33	10.6
Buccal mucosa	27	8.6
Maxilla	25	8.0
Parotid/ parapharynx	23	7.3
Larynx/ pharynx /esophagus	20	6.4
Palate	18	5.7
Skull base	14	4.5
Orbit	7	2.2
Lip	5	1.6
Nose	4	1.3
Retro molar trigon	3	0.9
Skin	3	0.9
Floor of mouth	3	0.9
Nasopharynx	2	0.6
Others	9	2.9
Total	314	100.0

Table 3. Frequency distribution of tumor pathology

Tumor pathology	Frequency	Percent
Squamous cell carcinoma	218	69.4
Adenoid cystic carcinoma	27	8.6
Basal cell carcinoma	6	1.9
Mucoepidermoid carcinoma	6	1.9
Sarcoma	5	1.6
Undifferentiated carcinoma	3	0.9
Mixed tumor	2	0.6
Meningioma	2	0.6
Pleomorphic adenoma	2	0.6
Vascular malformation	2	0.6
Mucormycosis	2	0.6
Adenocarcinoma	1	0.3
Melanoma	1	0.3
Primitive neuroectodermal tumor	1	0.3
Papillary thyroid carcinoma	1	0.3
Ameloblastoma	1	0.3
Fibromatosis	1	0.3
Unknown pathology*	33	10.5
Total	314	100.0

Table 4. Frequency distribution of different types of flaps used in the patients

Flap type	frequency	percent
Radial forearm	133	40.3
Anterolateral thigh	110	33.3
fibula	44	13.3
Rectus abdominis	14	4.2
gracillis	7	2.1
scapula	5	1.5
Iliac crest	4	1.2
Latissmus dorsi	3	0.9
Lateral tarsal	2	0.6
Temporoparietal	1	0.3
Medial condyl	1	0.3
Prefabricated illiac	1	0.3
Anterolateral thigh/ fibula	1	0.3
Anterolateral thigh/ latissmus dorsi	1	0.3
Radial forearm/ fibula	1	0.3
Radial forearm/ anterolateral thigh	1	0.3
Rectus abdominis/ fibula	1	0.3
Total	330	100.0

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However, there was no significant difference in terms of functional outcome (p=0.089). In 4 of the patients (1.2%) reconstruction and reoperation were needed due to trismus caused by fibrous tissue (in 3 cases) and atrophy of previous muscular flap in the other patient. Only a 63-year-old woman (0.3%) had an infection that required surgery. The rest of the patients improved with conservative treatment. In this study, 21 cases (6.4%) had mortality due to sepsis in 1(0.3%), encephalopathy in 1 (0.3%), pneumonia in 1(0.3%), drug overdose in 1 (0.3%), to trachea innominate artery fistula in 1(0.3%), to aspiration in 1 (0.3%) and the rest 15 expired patients (4.5%) because of underlying heart disease.

Discussion

Free flap reconstruction is a modern method in developing countries, coming across multiple challenges because of the outcome and complications. Developed countries have achieved some desirable advancements in the realm of this method, while developing countries are lacking in sufficient developments, as well as satisfying investigation into this area of stu dy (2, 4, 11).

Previous studies have stated that flap failure can be attributed to several parameters; the patient, surgery, and anesthesiology risk factors. Consequently, perioperative anesthesiology assessment must be taken into account in patients with thrombosis risk (12).

The early diagnosed pedicle thrombosis – less than three days - salvage surgery is more likely to be successful. In the case of our study, the most challenging issue was microcirculation, alteration of which took place gradually, detectable only following the 3rd postoperative day (1, 7, 13).

In our research center, there is a lack of required equipment, as well as the technology for pedicle complications and early detection like in other developing countries (2, 14). In order to solve such an issue, the senior surgeon made sure that microanastomosis was carried out as perfectly as it gets. In case any unusual sight is seen in the milking test together with Doppler assessment or any suspicions about the pedicle perfusion, re-anastomosis was implemented; moreover, we have established two surgical teams simultaneously operating so as to reduce the time of surgery, as well as to increase precision.

The findings based on the previous studies have indicated that the more surgeries are carried out, the more rate of success will be admissible, being consistent with our case: our success rate has been enhanced from 90% in the first two years - not previously published - to 94.3 % in its subsequent years(1, 14). As our surgical success rate improved, our approach shifted completely from the regional flap to the free flap procedure in complex defects.

In order to reduce the complications achieving more desirable outcomes, some research studies suggested conservative planning and limited flap-type trial (1); on the contrary, we have put different flap types and their variations into use to enhance our skills. The relatively higher mortality rate and complications in the participants referred to Firoozgar, and Rasool Akram educational hospital (21 expired cases in 197 patients) rather than Erfan private hospital (0 mortality out of 133 patients) can be attributed to more comorbidity in the former ones, as well as the prolonged surgical time because of the fellowships' participation with less experience in practice, confirmed by other studies (12, 15). Some articles have attributed the hindrance of flap surgery in developing countries to be wanting of practiced researchers and surgeons, and also, to the people's unfamiliarity with these methods (4, 14).

The head and neck fellowship training started two years ago in our institute to increase surgical specialists and also, public awareness surrounding cancer surgery, as well as the reconstruction methods being improved through the media-related educational programs.

The radial forearm flap (Fig. 3) was the first common flap employed in this study to reconstruct the tongue together with oral cavity structures. Moreover, it was utilized in a pharyngeal structure after laryngectomy. The adipofascial modification (16, 17) was put into use in compound defects of the tongue and floor of the mouth.

The double paddle radial forearm flap variation was utilized in trismus surgical treatment after facial cancer resection with acceptable aesthetical donor site appearance acceptable aesthetical donor site appearance, consistent with the other series of cases (18).

The anterolateral thigh flap (Fig. 4) was a versatile and applicable flap capable of providing various tissue types on a large-scale in terms of the number of cases used this flap after radial forearm flap in this article. It was applied to the tongue, oral cavity, orbitomaxillary, parapharyngeal, scalp, and pharyngolaryngeal defects. Double paddle flap or bipedicled variations (method described in literature's) (19, 20) assisted us with reconstructing complex oral cavity defect, glossectomy loss, as well as skin neck involvement and pharyngo-cutaneous defect (21).

Fig. 3. A patient with tongue mass (squamous cell carcinoma). A) Preoperative view of a patient with tongue mass. B) Radial forearm flap. C) Postoperative view of the same case following right hemiglossectomy and reconstruction with radial forearm free flap. D) View after one month follow up.

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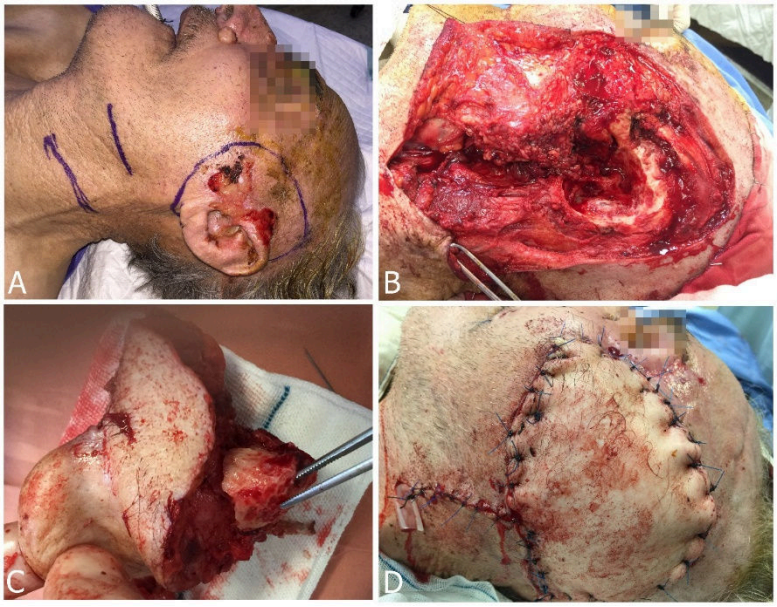

Fig. 4. A patient with recurrent tumor (basal cell carcinoma) in lateral temporal region with extension to left parotid gland. A) Preoperative view of mass. B) After completion of lateral temporal resection, total parotidectomy, resection of involved skin and left auricle. C) Specimen D) Anterolateral thigh flap inset to covering the defect.

Fig. 5. A patient with left mandibular tumor (squamous cell carcinoma). A) Preoperative view of left mandibular mass. B) Tumor involved the skin, leading to oro-cutaneous fistula. C) Tumor specimen. D) Harvesting of osteomyocutaneous fibula free flap. E) Fibula flap following osteotomy and reconstruction plate insertion. F, G) Postoperative view after 2 months follow up.

In this review, the anterolateral thigh flap with long pedicle and large tissue volume also was employed in skull base tumors to protect Dura, as well as neurovascular structures, and to fill dead spaces with a successful result. According to the other reviews, and without the requirement for a vein graft in pedicle lengthening (22-24).

The fibula flap (Fig. 5) was the first choice of ours for maxillary and mandibular reconstruction. Doppler sonography of leg vascular structure was carried out before the surgical operation in order to assess the anatomical changes in our practice.

Furthermore, other flaps were put into use less frequently; for example, gracillis flap in facial paralysis as a dynamic rehabilitation, rectus flap to correct facial atrophy, and other flap types.

Conclusion

The free flap procedure is a versatile method in head and neck cancer operations. In spite of the deficits in developing countries, there has been the capacity to make

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considerable progress. Forming a professional team in Iran and training them has helped to reduce the issues and potential difficulties. It is of significant importance to make drastic efforts to mitigate the issues caused by the patients' underlying diseases, as well as the complications accompanied by the prolonged surgical time; also, to make a more precise decision regarding the management of such patients. Moreover, it is required to apply newer and more reliable methods for postoperative flap monitoring so as to diagnose vascular anastomotic problems earlier.

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improve our facility for giving better care.

Conflict of Interests

The authors declare that they have no competing interests.

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