Functional rehabilitation in advanced intraoral cancer

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Introduction: Modern treatment of advanced intraoral cancer involves multidisciplinary teams with use of complicated reconstructive techniques to provide improved survival with optimal rehabilitation. Mastication is an important part of this process, and it can be severely impaired by tumor ablation. Whether flap reconstruction is a determinant factor in dental rehabilitation is still in debate.

Patients and methods: Thirty-five patients with advanced intraoral cancer were reviewed to determine dental rehabilitation of different reconstructive techniques. The patients were treated with a multidisciplinary team approach. The patients' demographics, primary treatment, reconstructive surgery, dental rehabilitation, and functional outcome were recorded and analyzed.

Results: Nine patients had Stadium III disease, and 26 patients had stadium IV. Thirty-two patients (91.42%) received postoperative radiotherapy. Masticatory and dental functional rehabilitation of patients was very poor. Only 15 patients (42.86%) could eat a normal diet, whereas 18 patients (51.42%) could manage only soft diets, and 2 patients (5.72%) could only be fed with a liquid diet. Denture rehabilitation was even more frustrating and had a direct impact on masticatory rehabilitation. Only 10 patients (28.57%) could use dentures postoperatively and 40% of patients (14 patients) could not use any denture at all. Above all reconstructive techniques, the free radial forearm flap provides the best functional outcome.

Conclusions: Reconstruction of advanced intraoral cancer results in poor denture rehabilitation, especially when bulky flaps are used. If massive resections are necessary, the free radial forearm flap reconstruction provides the best functional outcome.

Key Words: Reconstruction, Function, Intraoral, Prosthesis, Outcome, Rehabilitation

Introduction

The majority of head and neck cancer patients present with locally and regionally advanced disease. The oral cavity is the most common site of malignancies in the head and neck. It is bordered by the lip vermillion, the junction of the hard/soft palate, anterior tonsillar pillar, and the circumvallate papillae. Standard therapy usually combines surgery and radiation therapy, chemotherapy being reserved for recurrent or metastatic disease. Stage I and stage II diseases respond to single-modality treatment. Stage III and stage IV diseases generally require multiple-modality treatment, including extensive surgery followed by radiation.

Even though Edgerton^[1] introduced the concept of immediate reconstruction after resection of head and neck cancer in 1951, reconstruction after extirpation of head and neck cancer

continues to be a surgical challenge. Major reconstruction requires coordination between the ablative and reconstructive surgeons. A preoperative assessment of the anticipated defect includes size, mucosal lining, bone, and soft tissue coverage. The patient's overall condition and performance status must be considered before planning a potentially long and complicated reconstruction. Procedures that produce a large surgical defect produce more severe functional problems. When the reconstructive technique includes flaps that are adynamic and bulky, they are associated with poor functional outcome^[2]. Although the surgical approach to head and neck patients must focus on function and esthetic detail, there are few reports in literature that assess and compare the functional outcome of head and neck cancer patients who have undergone a major resection and reconstruction. The present study was designed to document the functional outcome in terms of denture rehabilitation of patients undergoing major resection and reconstruction of stage III and IV floor of the mouth cancer.

Patients and methods

Thirty-five consecutive patients affected by advanced (stage III and IV) floor of the mouth cancer were retrospectively reviewed. Approval from the ethics community of the AZG to perform a retrospective review was obtained. Only patients who underwent extensive surgical resection and flap reconstruction were studied. Patients were initially reviewed by a multidisciplinary oncology head and neck team. Dental rehabilitation services assessed all patients preoperatively as part of the standard protocol. After definitive diagnosis and systemic dissemination investigation, a combined team of head and neck surgeons and plastic surgeons

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Table 1**Treatment protocol for cancer of the floor of the mouth.**

T1N0
Local resection or interstitial radiotherapy
If tumor adherent to the ducts of submandibular gland, supra-omohyoid neck dissection
Postoperative radiotherapy if indicated by pathology findings
T2N0
Local resection or interstitial radiotherapy
Elective supra-omohyoid neck dissection or radiotherapy
Postoperative radiotherapy if indicated by pathology findings
T3N0
Local resection with resection of all anatomic sites involved
Elective supra-omohyoid neck dissection or radiotherapy (bilateral in midline cancers) with en-block resection with primary tumor
Postoperative locoregional radiotherapy
T4N0
Same treatment as T3 + modified radical neck dissection (modified radical)
T1-4N1
Local resection
Modified radical neck dissection (modified radical)
Postoperative locoregional radiotherapy (with exception of T1/T2 with 1 positive node of < 3 cm without extracapsular growth in first level)
T1-4N2-3
Local treatment as for T1-4N0
Modified radical neck dissection (modified radical)
Postoperative locoregional radiotherapy

operated upon patients. **Table 1** depicts the protocol for floor of the mouth cancer treatment.

Ablative surgery included inclusion of all diseased tissue with a 2 cm margin of normal noncancerous tissue. Radicality was assessed intraoperatively by frozen sections. Following completion of the ablative surgery, reconstruction was performed by a separate team. Tissue requirements were assessed and flap elevation was performed followed by inset with water-seal closure. Donor site and anatomic configuration requirements were assessed preoperatively by a combined team of oral maxillofacial surgeons, prosthetists, and plastic surgeons (**Fig. 1**). All patients were admitted postoperatively to the surgical intensive care unit.

Multidisciplinary assessment of Intraoral Cancer Patient

Determination of tissue requirements by a team of:

- Head and Neck surgeons
- Special dental rehabilitation unit
- Plastic Surgeon

Determination of resection, reconstructive technique, and denture rehabilitation

Figure 1. Preoperative assessment of head and neck patients by a multidisciplinary team provides a comprehensive approach to the patients and saves the patients multiple visits to different departments in the cancer center. After a general discussion, the treatment modality and reconstruction is tailored to the individual patient.

Enteral feeding was started with nasogastric tube feeding. In general, tracheostomy was not indicated unless posterior floor of the mouth resection with invasion of the tongue base was contemplated. All patients received perioperative antibiotics, which were continued for a week. Microvascular reconstructions were performed with end-to-end microanastomosis with the superior thyroid, facial, or lingual arteries and end to side with the internal jugular vein. Treatment of the neck included elective supra-omohyoid neck dissection and therapeutic modified radical neck dissection depending on the stadium (**Table 1**). Radical neck dissection was reserved to massive node involvement of the sternocleidomastoid muscle, the jugular vein, and the accessory nerve. Radiotherapy followed comprehensive surgical resection and reconstruction of advanced floor of the mouth cancer based on stage of the disease. In general, postoperative radiotherapy was indicated in T3 and T4 tumors, tumors with narrow margins of resection, perineural invasion, and angioinvasion. Indication for regional postoperative radiotherapy on the neck included > 1 node involvement, extracapsular growth, and positive nodes in second and third node stations. Patients who presented with positive disease in the neck with indication for postoperative radiotherapy had the site of the primary tumor irradiated to decrease the risk of recurrence. Postoperative radiotherapy was started within 6 weeks of surgery with total doses of 46 Gy in the elective nonoperated neck, 60 Gy in patients with indication for postoperative radiotherapy, and 64 to 70 Gy in patients with microscopic or macroscopic remaining tumor. All therapies were administered in fractions of 2 Gy 5 days per week.

After completion of full treatment (surgery +/- radiotherapy), patients received denture rehabilitation by means of dental prosthesis. Impressions were taken by the prosthetic department and prostheses were tailored to fit the patient's local requirements.

Following completion of full treatment and intervention of dental rehabilitation services, all patients were assessed individually to determine the functional outcome of major resection and reconstruction of advanced floor of the mouth cancer. The following criteria were used to assess the functional outcome of dental rehabilitation:

- Denture retention,
- Use of denture prosthesis,
- Diet,
- Satisfaction.

Statistical analysis was performed with unpaired *t* test for continuous data, χ^2 test for noncontinuous data, and Mann-Whitney test for nonparametric data. All data are presented as mean and SE of mean. Significance was accepted at $P < 0.05$.

Results

Thirty-five consecutive patients affected by advanced cancer of the floor of the mouth were studied. Patient demographics are summarized in **Table 2**. Nine patients had stadium III disease, whereas the remaining 26 patients had stadium IV disease.

Table 2**Patient demographics.**

Age (y)	57.7 ± 1.7
Sex (male/female) (n)	25/10

Table 3
Patient distribution according to TNM classification.

TNM Classification	No. Patients
T2N1	3
T2N2	2
T3N0	6
T3N1	2
T3N2	2
T4N0	8
T4N1	5
T4N2	7

Disease extension according to TNM classification is depicted in Table 3. All patients had extensive surgical resection of the primary tumor and reconstruction of the defect with regional or free flaps.

Defects in the floor of the mouth were reconstructed with the free radial forearm flap (microvascular transplantation of fasciocutaneous tissue from the nondominant forearm) in 16 patients. The nasolabial flap (transfer of cheek skin based on a skin pedicle in a 2-staged operation) was utilized in 3 patients (1 unilateral and 2 bilateral), the pectoralis major myocutaneous flap (transfer of chest skin attached to the pectoralis muscle as a carrier of vessels) in 15 patients, and the free anterolateral thigh flap (microvascular transplantation of skin and fascia from the thigh) in 1 patient. In general, all patients were initially considered candidates for reconstruction with free tissue transfer. After review of individual patient characteristics, only 17 patients of 35 (48.57%) were reconstructed with free vascularized flaps. Reasons for conversion to reconstruction with regional flaps included small defect size in 1 patient (unilateral nasolabial flap), poor recipient vessels with severe arteriosclerosis in 8 patients (2 bilateral nasolabial flaps and 6 pectoralis major myocutaneous flap), and soft tissue requirements (obliteration of tissue defects after massive resection) reconstructed with the pectoralis major myocutaneous flap in 9 patients. All flaps survived and all patients were discharged home on postoperative day 11 ± 3.4 . Only 1 patient presented with a major postoperative complication (acute neck hematoma) that resolved with surgical drainage and hemostasis. This complication occurred in a patient reconstructed with a free radial forearm flap and poor hemostasis of the wound bed. All donor sites healed properly and only 2 patients reconstructed with free radial forearm flaps complained of a small area of sensory loss on the dorsum of the thumb in the ipsilateral

Table 4
Functional outcomes per reconstructive technique.

Type of Reconstruction	n	% Use of Denture (Always/Occasionally)	% Use of Normal Diet
Free radial forearm flap	16	56.52/31.25*	75*
Pectoralis major myocutaneous flap	15	0/33.3	6.6
Nasolabial flap	3	66.6/0**	66.6**
Free anterolateral thigh flap	1	0/0	0
Total	35	31.43/28.57	42.86

* $P < 0.05$. Free radial forearm flap versus pectoralis major myocutaneous flap and free anterolateral thigh flap.

** $P < 0.05$. Nasolabial flap versus pectoralis major myocutaneous flap and free anterolateral thigh flap.

limb. This area of sensory loss resolved at 6 months after surgery in both cases.

Thirty-two of 35 patients (91.42%) required postoperative radiotherapy. All patients could have their therapy started within 6 weeks postablation, and none of them had any wound breakdown or healing complications during or after radiotherapy.

Functional rehabilitation of patients was poor. Less than half of the patients could return to a normal diet (15 patients, 42.86%) after completion of the treatment. Eighteen patients managed to eat a soft diet (51.42%), and 2 patients (5.72%) could only be fed with a liquid diet. Denture rehabilitation was even more frustrating, with only 11 patients (31.43%) being able to use and retain their dentures. Ten patients (28.57%) could use their denture on an occasional basis, and 14 patients (40%) could not use their dentures at all. The reasons for inability to use dentures were poor retention (35%), and impossibility to fit a normal functional denture in the reconstructed site (65%). Reasons for inability to eat a normal diet included pain in 10% of patients and inability to use a functional denture in 90% of the patients.

Patients were subgrouped according to the type of reconstruction and analyzed separately. Results are shown in Table 4. Patients who had their defects reconstructed with the free radial forearm flap had a much better functional rehabilitation ($P < 0.001$) than patients reconstructed with the pectoralis major myocutaneous flap or the anterolateral thigh flap. The use of this reconstruction modality (free radial forearm flap) had a significant correlation with the use of dentures and the ability to eat a normal diet ($R^2 = 0.571$, $P < 0.001$). There were no statistical differences with the nasolabial flap, although one of the patients reconstructed with this flap required a vestibuloplasty to fit the denture. When patients reconstructed with the free radial forearm flap and the nasolabial flap were grouped together, they showed a significant improvement in functional rehabilitation (75% normal diet, 58% ability to use denture permanently, $P < 0.001$), in contrast to patients reconstructed with the pectoralis major flap or the anterolateral thigh flap, among whom only 6.25% could consume a normal diet and they could never use a denture permanently, which provides evidence that the use of these reconstructive modalities was the main cause of the poor functional outcome in this group of patients.

Discussion

Patients with cancer of the head and neck often present with advanced disease, which requires aggressive treatment with poor functional outcomes. Head and neck tumors can occur at a large number of subsites and different members of the multidisciplinary team need to collaborate to devise the best management plan for each individual patient^[3].

Quality of life issues in head and neck cancer are crucial given the nature of the disease and its treatment. Speech, mastication, swallowing, breathing, and facial appearance can be severely challenged; which makes a significant sociopsychological and functional impact. Despite the importance of quality of life issues, few clinical data are available^[4]. Denture rehabilitation is an important part of total functional restoration of cancer patients to their premorbid status. Its role in normal mastication and the ability to eat a normal diet is crucial; therefore, patient satisfaction depends to a high extent on successful denture restoration.

Despite a multidisciplinary team approach and the use of tailored reconstructive techniques, denture and masticatory functional rehabilitation was very poor in this series of patients. Less than half of the patients could return to a normal diet after completion of treatment and only around a third of patients could use and retain their prosthesis. These numbers provide the evidence that despite the ability to treat advanced intraoral cancer; the functional disability that this treatment poses in patients is still significant.

The poor functional outcome that patients with advanced intraoral cancer exhibit depicts the fact that despite the significant advancement in the treatment and reconstruction of these patients during the last decades, we are still unable to return them to their premorbid status. In a large series of patients Finlay et al^[5] reported that in 255 consecutive patients undergoing treatment for oral cancer, 21% reported difficulty with swallowing solid foods and 46% were limited to semisolid or liquid diets, which supports the evidence that functional outcome is still very poor in advanced intraoral cancer.

Rehabilitation of oral cancer patients is particularly difficult in the case of large tissue defects and is not always accomplished completely even with primary microsurgical tissue repair; and persistence of dysphagia, reflux of liquids, and limitation to liquid food have a significant negative effect in functional outcomes^[6]. It is agreed by many that radical resection of tumors of the head and neck with immediate reconstruction by microsurgical-free tissue transfer followed by adjuvant radiation therapy provides the best possible chance for cure and functional and social rehabilitation of the patient^[7]. However, quality of life after ablative intraoral surgery is greatly affected by the functional outcome, and, in general, functional disorders play the dominant role in the impairment of post-operative quality of life. In a series of 1527 patients, Gellrich et al^[8] found that pain and functional impairment of chewing and swallowing were the most important parameters before treatment, but after surgical ablation other variables such as speech intelligibility and motility disorders become more apparent. Lack of neurosensory feedback mechanisms have been claimed responsible for diminished chewing pressure, masticatory efficiency, and inferior results despite successful reconstruction^[9], but prospective research between reinnervated and nonreinnervated flaps showed no statistical difference between groups in the speech and swallowing tests^[10].

Dental management of head and neck cancer patients has been long recognized as an important supportive role to obtain a good functional outcome^[11]. Prosthetic dentistry contributes to the long-term success of tumor treatment and facilitates rehabilitation. However, denture restoration is significantly challenged in patients with advanced intraoral cancer. The main tenet of denture rehabilitation is the maintenance of normal anatomy, allowing for a stable structural anatomic base where the prosthesis can be fitted. A thin and pliable floor of the mouth, together with a well-developed lingual and buccal sulcus and good alveolar ridge are necessary to permit wearing a functional dental prosthesis. The general principle of reconstruction with “like” tissue that rules Plastic Surgery is not feasible in surgical management of advanced intraoral cancer. There are no donor sites available that provide large amounts of vascularized oral mucosa, therefore, reconstruction of anatomy must proceed with cutaneous, fasciocutaneous, and myocutaneous flaps.

The most common reconstructive techniques used worldwide are the radial forearm flap, the pectoralis major musculocutaneous flap, and the nasolabial flap. The radial forearm flap has

become a workhorse in head and neck reconstruction. It provides a large amount of thin, pliable skin that conforms to anatomic requirements in intraoral reconstruction. It provided the best functional outcome in our series, much higher than those obtained by the pectoralis major myocutaneous flap (Table 4). The most common reason for failure in the latter was the bulkiness of the flap, which precluded wearing dental prosthesis and a good retention. Our results paralleled those found by Schliephake et al^[12], who studied a series of 135 patients with malignant tumors in the floor of the mouth and found that patients who had their defects reconstructed with myocutaneous flaps showed significantly lower Functional Living Index-cancer scores. However, in a 10-year follow-up series of 123 patients, Esser et al found that the functional results obtained for the myocutaneous island flaps and free vascularized flaps were satisfactory for both groups, and only minor differences were noted^[13], similar to that of early reports in literature^[14]. A good alternative to small and selected defects in intraoral cancer reconstruction is the nasolabial flap. In this reconstructive technique, skin from the cheek area around the nasolabial fold is transferred to the floor of the mouth in a 2-stage operation. It showed a similar functional outcome to that provided by the radial forearm, although the series in our study was too small to make any strong conclusion. Maurer and colleagues studied a series of 26 patients over a period of 10 years who had intraoral defects caused by cancer ablation reconstructed with the nasolabial flap. In 23 patients the subsequent prosthetic rehabilitation was successful and allowed a return of masticatory function^[15]. However, the 35% of the patients who had difficulties with the retention of the dental prosthesis could benefit from the use of dental implants^[16].

In summary, despite a multidisciplinary approach, treatment of advanced intraoral cancer still poses a significant morbidity and produces severe functional disabilities. Despite individually tailored preoperative planning and the choice of individual reconstructive techniques, only 42% of patients could return to a normal diet and 31% of patients were able to use and retain their dentures. Surgical treatment of advanced intraoral cancer results in poor functional outcomes and a focus on organ preservation is necessary. If massive resections are contemplated, defects should be reconstructed with the free radial forearm flap or any other tissue that matches its characteristics.

The use of dental implants for the retention of a prosthesis should be considered at the primary treatment planning.

Conflict of interest statement

The authors declare that they have no financial conflict of interest with regard to the content of this report.

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