Prosthetic Rehabilitation, Implant Survival and Quality of Life 2 to 5 Years after Resection of Oral Tumors

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ABSTRACT

Background: After oral tumor resection, structural and functional rehabilitation by means of dental prostheses is complex, and positive treatment outcome is not always predictable.

Purpose: The objective of the study was to report on oral rehabilitation and quality of life 2–5 years after resection of malignant oral tumors.

Materials and Methods: Data of 46 patients (57 ± 7 years) who underwent oral tumor surgery were available. More than 50% of tumors were classified T3 or T4. Open oro-nasal defects resulted in 12 patients and full mandibulary block resections in 23 patients. Comprehensive planning, implant placement, and prosthetic rehabilitation followed an interdisciplinary protocol. Analysis comprised tumor location, type of prostheses, implant survival, and quality of life.

Results: Because of advanced tumor status, resections resulted in marked alteration of the oral anatomy requiring complex treatment procedures. Prosthetic rehabilitation comprised fixed and removable prostheses, with 104 implants placed in 28 patients (60%). Early implant loss was high (13%) and cumulative survival rate of loaded implants was <90% after 5 years. Prosthetic plans had to be modified because of side effects of tumor therapy, complications with implants and tumor recurrence. The majority of patients rated quality of life favorable, but some experienced impaired swallowing, dry mouth, limited mouth opening, appearance, and soreness.

Conclusions: Some local effects of tumor therapy could not be significantly improved by prosthetic rehabilitation leading to functional and emotional disability. Many patients had passed away or felt too ill to fill the questionnaires. This case series confirms the complex anatomic alterations after tumor resection and the need for individual treatment approaches especially regarding prosthesis design. In spite of disease-related local and general restrictions, most patients gave a positive assessment of quality of life.

KEY WORDS: dental implants, oral cancer, prosthetic rehabilitation, quality of life, survival rate

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INTRODUCTION

In the last years, the majority of oral tumors detected in Switzerland were found in patients aged between 50 and 60 years.¹ The gender ratio (male : female) was approximately 7:3. Smoking habits and regular consumption of alcohol are often associated with development of oral tumors² and increases the risk by 6- to 15-fold.^{3,4} After smoking cessation, the increased risk for tumor development diminishes and may disappear within 5 to 10 years.^{3,5}

The goal of tumor resection is to remove the pathologic tissue, and equally to also maintain a maximum of

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function.⁶ Nevertheless, sequelae of loco-regional tumor resection are multiple: destruction of normal anatomy, large areas of scar tissue and grafts from skin, loss of teeth, side effects of radiotherapy comprising fast caries development. Impaired systemic health is aggravated by radio- and chemotherapy and subsequently tends to deteriorate.

The structural and functional rehabilitation after oral tumor resection requires some kind of prosthetic reconstruction in many patients. The local oral conditions after tumor therapy as well as general health, social, psychological, and economic aspects determine the final treatment outcome of prosthetic rehabilitation.⁷

At the time when oral tumors are diagnosed, several patients present with advanced neglect of oral homecare, and this increases the need for tooth removal. Thus, many patients remain with a reduced dentition or without any teeth after tumor therapy. The prosthetic treatment becomes complex and requires an individual prosthesis design that has to respect the specific anatomical conditions.

Implant-supported prostheses for partially and completely edentulous patients in routine situations have become a reliable treatment modality. In oral cancer patients however, the risk of implant failures increases with radiation of the bone^{8,9} and is enhanced if grafted bone is present.¹⁰ One study shows that in the late 80-ties early 90-ties implant placement was rare in tumor patients.¹¹ In spite of a higher implant failure rate, this treatment gradually became a well-accepted option in the therapeutic spectrum of oral tumor rehabilitation. This is particularly true for the mandible^{12,13} and it appears that edentulous patients could profit from implants.¹⁴

Another treatment goal of prosthetic rehabilitation with and without implants should be enhancement of quality of life by means of functional, esthetic, and social rehabilitation.¹⁵ Long-term data collection of oral tumor patients proves to be difficult because their life expectancy is often reduced. One study found that 50% of patients with oral tumors passed away within an average time of 2.3 years after completion of the treatment, that is, before they reached 5 years of survival.¹⁶

The aim of the present case series was to report on treatment outcome of patients 2 to 5 years after resection of malignant oral tumors with focus on prosthetic aspects, implant survival, and quality of life.

TABLE 1 Tumor Location and Sequelae of Resection			
	Number		
Tumor location			
Mandible	21		
Maxilla	14		
Mouth floor	9		
Tongue	6		
Other oral structures involved (pharynx,	15		
lips, tonsilla, cheeks)			
Sequelae of resection			
Mandibulary block resection	23		
Antro-nasal access (with large open defect)	12 (5)		

MATERIALS AND METHODS

Patients and Tumor Diagnosis

Forty-six patients with malignant oral tumors had been referred by maxillofacial surgeons to the prosthodontic department for reconstructive therapy, in the timeperiod from 2004 to 2007. They consented that their data collection may be used for the present study. This patient cohort consisted of 31 men and 15 women with an average age of 57 ± 7 years. While 54% of them confirmed regular smoking and/or alcohol consumption, the remaining patients didn't give any related information about their habits. Seventy-eight percent of the oral tumors were squamous cell carcinoma, 9% adenocarcinoma, and the remaining 13% comprised a variety of rare tumors including oral metastasis of other tumors.

The tumor location of all 46 patients is represented in Table 1. Because of the advanced status of the tumor development, the classification of the tumors was from T2 to T4, with >50% classified as T3 or T4. The tumor localization comprised different oral structures; for example, infiltration of both jaws or tongue and moth floor were both involved, or the jaw and soft tissue of the pharynx were both infiltrated. Thus, the number of tumor location exceeded the number of patients.

Tumor Surgery

When the patients were first seen by the prosthodontist, various therapeutic measures related to the tumor had already been performed. This included teeth extractions, tumor resection, and reconstructive surgery with grafts, and radio- and chemotherapy. In all 46 patients, a surgical intervention for tumor resection was performed.



Figure 1 *A*, Palatal view of a maxilla after tumor resection showing an oro-nasal access. *B*, Panoramic radiography of a reconstructed mandible (fibula free flap, implants with ball attachments) after block resection of the tumor.

Eight out of them had exclusively resection in the soft tissues. Originally, in nine patients, chemo- and radiotherapy was prescribed without the intention of resection. Because of side effects (osteoradionecrosis) and tumor recurrence, surgery became necessary.

Additionally, 29 patients received combined bone and soft tissue grafts that were mostly obtained from the fibula.^{17,18} Twenty patients underwent radiotherapy either prior or after tumor resection with a dose varying between 56 and 81 Gy. Chemotherapy was initiated for nine patients and 13 patients received both radio- and chemotherapy. Twenty-three patients had a full block resection of the mandible and 12 remained with an open oral–nasal defect (Figure 1, A and B). Two patients underwent enucleation of one eye each and one patient had nose resection.

Prosthetic Treatment Protocol and Implant Placement

For the provisional and final reconstructive prosthetic therapy, an interdisciplinary treatment approach was aimed comprising the following steps:

- Patient examination by prosthodontist and surgeon for preparation of provisional prostheses and splints for fluoridation if radiotherapy was prescribed
- Delivery of provisional prostheses by prosthodontist and maintenance of hygiene
- Patient reevaluation and examination by prosthodontist and surgeon for planning of the final prostheses and if possible, of implant placement
- Tooth set-up and fabrication of surgical splints for implant placement, if possible
- Implant placement
- Step-by-step prosthetic reconstructive treatment with various types of prostheses

The therapeutic steps were accompanied by physiotherapy and training with the speech therapist. If necessary, this protocol was individually modified according to specific situations of the patients and related to their general health conditions. Implants were planned for various prosthetic indications. Altogether, 104 implants, 80 in the mandible and 24 in the maxilla, were placed in 28 patients, including three zygoma implants.

Regular maintenance was offered and provided by the prosthodontist for continuous adaptation of the prostheses and hygiene procedures. The surgeons performed a regular tumor monitoring with inspection of the surgical site and radiographs for early detection of tumor recurrence. However, 19 patients not living in the vicinity of the hospital preferred to visit doctors in the private practice of their home city and were irregularly seen.

Data Collection and Questionnaires for Measurements of Quality of Life

This survey was part of a quality control assessment of the prosthodontic consultation and the data were collected strictly anonymously. Therefore no permission from the ethics committee was required. One blinded investigator collected the following data from the patients' charts and from the patient's last clinical examination.

- Dropout of patients for known and unknown reasons
- Type of prosthesis delivered in the resected jaw
- Treatment and type of prosthesis in the opposing jaw
- Number of implants placed and implant failures
- Answers from questionnaires

In 2009, that is, 2 to 5 years after treatment, all patients available received an answering form and were told, that they were free to complete it or not. This form was combined from questionnaires developed by the European Organisation of Research and Treatment of Cancer (EORTC) to investigate quality of life in cancer patients.^{19,20} The answering form included 1) the EORTC QLQ-C30 with 30 items and 2) 18 questions from the EORTC QLQ H&N. This latter head and neck module consists of a total 65 questions. The single item-questions 31 to 48, which were used in the present study, reflect local oral problems. The range of the answers is from 1 to 4 (not at all, a little bit, quite a bit, very much). The EORTC QLQ-C 30 is structured in three subgroups, which are:

- Quality of life and general well-being, consisting of two items with a range from 1 (very bad) to 7 (very good). A high average score means good quality of life.
- Functional scale consisting of 15 items with a range from 1 (very bad) to 4 (very good). A high average score means good functional capacity.
- Symptoms consisting of 13 items with a range from 1(not at all) to 4 (very much). Here, a low average score means little negative impact from symptoms.

This questionnaire investigates quality of life within a broader context, including social functional and emotional aspects.

Statistical Analysis

For patients' demographics, number and type of delivered prostheses and the EORTC QLQ H&N descriptive statistics were used. A life table analysis was used for measuring implant survival. Mean values for the EORTCQLQ-30 were calculated according to the QLQ scoring manual²⁰ with SAS/STAT 8.2 (SAS Institute Inc., Cary, NC, USA).

RESULTS

Patients and Dropouts

Eleven out of 46 patients died soon after completion of the treatment. Two patients died during the phase with the provisional prostheses. Six patients were in serious general health conditions. After a short observation time they were not regularly seen and eventually stopped to attend the recall visits.

TABLE 2A Tumor Resection and Type of Prosthesis in the Maxilla (N = 11)

	Number
Type of maxillary prosthesis	
Implant overdenture with obturator	4
CD, RPD with obturator	3
Bar overdenture on implants	3
No final treatment	1
Opposing jaw (mandible)	
Prosthesis: not necessary	7
RPD	2
CD	1
Fixed prosthesis	1

RPD = removable partial denture; CD = complete denture.

Prosthetic Rehabilitation

The duration of the entire prosthodontic treatment was 2 to 3 months for three patients, >2 years for four patients, and 8 to 16 months for 39 patients. Reasons for delay and prolonged treatment time were complications after tumor surgery and radiotherapy, comprising osteomyelitis, disturbed soft tissue healing, sequestration of grafts, caries, early loss of implants as well as recurrence of tumors. Five patients with an edentulous maxilla had a large open oro-nasal defect and received an obturator prosthesis, three out of them supported by implants. In seven patients, an attempt was made to reduce the nasal access by means of soft tissue grafting. Thus, their obturators were small. Two patients with unclear prognosis remained with simple provisional dentures and two patients passed away before the final treatment was accomplished. Table 2A and B gives an overview on the type of prosthetic reconstruction in the resected and opposing jaw from 37 patients, while Table 2C represents 9 patients who underwent resection in both jaws. The majority of prostheses were removable. The patients had a reduced number of teeth or were completely edentulous and a sufficient number of implants could not be placed for fixed prostheses.

Life Table Analysis of Loaded Implants

During the healing phase, eight implants failed and had to be removed. Four of them had not osseointegrated, one developed a fistula and large infection, and three were located in bone that developed osteoradionecrosis (Table 3). One patient with four implants died before reentry surgery. Two osseointegrated implants were not

TABLE 2B Tumor Resection and Type of Prosthesis in the Mandible (n = 26)

	Number
Type of mandibulary prosthesis	
Bar overdenture on implants	11
Overdenture with root copings	3
RPD	1
Provisional denture	1
CD	1
Fixed prosthesis on implants	6
No prosthesis/natural teeth	2
No final treatment	1
Opposing jaw	
CD	6
Telescopes/RPD	5
Provisional denture	2
Overdenture with root copings	1
Fixed prosthesis	1
No prosthesis/natural teeth	8
No final treatment	3

RPD = removable partial denture; CD = complete denture.

loaded and remained as what are so-called "sleeping" implants because of unfavorable inter jaw relations and reduced mouth opening. All except two implants were lost in bone with radiotherapy and/or bone grafts. Table 4 shows the life table analysis, which includes 90 loaded implants in 26 patients.

TABLE 2C Tumor Resection and Type of Prosthesis in Both Jaws (n = 9)

	Number
Maxilla	
CD	1
CD with obturator	3
Bar overdenture on implants with obturator	1
Ball overdenture on implants with obturator	1
RPD	2
No final treatment	1
Mandible	
CD	2
Bar overdenture on implants	2
RPD	3
Fixed prosthesis on implants	1
No prosthesis/natural teeth	1

RPD = removable partial denture; CD = complete denture.

Questionnaire

The questionnaires were returned only by 52%, and forms from 18 patients were complete and properly filled out. Twelve of these 18 patients had received implants and three patients had undergone tumor resection in both jaws. Table 5 gives a summary of the EORTC QLO 30. The mean values stand satisfactory quality of life, but a few patients gave negative answers distinctly below/above the average. Figure 2 summarizes the answers of the EORTC H&N (31-48). This chart demonstrates that 60% of all patients gave a score of 1 (not at all) or 2 (a little bit) to all items. The major negative impacts on oral comfort were limitations in swallowing, dry mouth, limited mouth opening, appearance, and soreness. Figure 3 is a scatter plot depicting global quality of life (mean value EORT QLQ item 29/30) in relation to oral local problems (mean values EOTC H&N item 31-49). No clear tendency was seen.

DISCUSSION

In the present cohort of 46 patients, the early dropout after the final prosthetic treatment was high. Some of them passed away soon; some were in serious health conditions, which hindered them to attend the regular recall sessions. These are reasons why oral rehabilitation cannot always be completed and followed.²¹ Sequelae of surgical treatment for oral tumors and accompanying measures are individual, according to the type, size, and location of the tumors as well as infiltration of adjacent tissues. The incidence of problems increased with radiotherapy and the present results show that in accordance with other results, more implants were lost in irradiated bone than it is documented under standard conditions.^{10,22} The total radiation dose in the present patients was high, mostly >60 Gy. Some authors claim that up to 45 Gy no negative effects on implant survival should be expected,²³ others mentioned 50 or ≤60 Gy as a limit.^{24,25} More failures during the first 12 months were observed, but it seems that once the implants are well integrated, the survival rate becomes better.23 The previous study from the same clinical setting exhibited the same age of the patients (50-60 years) and tumor specification (>70% squamous cell carcinoma), but a better implant survival rate with a prevalence of implant-supported overdentures in the mandible.¹⁶ It appears that in the present patient group, implants were installed under

TABLE 3 Bone Characteristics Related to the Implants Placed and Lost					
	Implants inserted	Implants lost before	Implants lost after	Implants lost total	
Bone characteristics	N (%)	loading (N)	loading (N)	N (%)	
Native, no radiotherapy	16 (15.0)	2	0	2 (12.5)	
Native, radiotherapy	42 (40.0)	6	2	8 (19.0)	
Grafted, no radiotherapy	26 (25.0)	0	2	2 (7.6)	
Grafted, radiotherapy	20 (19.0)	6	0	6 (30.0)	
Total	104 (100.0)	14	4	18 (17.3)	

more unfavorable conditions and that less restricted exclusion criteria resulted in a lower survival rate.

A review study shows that the literature on specific characteristics of prostheses in oral cancer patients is not

contributing.¹² Comprehensive analyses and long-term results on prosthetic aspects are rare. Inter-jaw relation sometimes presents with a dislocation of the mandible and along with limited space and instable tissue support

TABLE 4 Life Table Analysis of 90 Loaded Implants in 26 Patients				
Time interval (year)	Implants	Failures	Survival during interval (%)	Cummulative survival rate (%)
0-1	90	0	100	100
1–2	78	2*	97.4	97.4
2–3	45	0	100	97.4
3–4	24	2^{\dagger}	91.1	88.7
4–5	9	0	100	88.7

*Two interforaminal implants with overdenture in one patient (periimplantitis).

[†]Two posterior implants in mandible supporting a fixed prosthesis (sequestration of bone).

TABLE 5 Means and SD of the EORTC QLQ-30					
Variable list	ltems no.	Mean/SD	Median	Min	Max
Global health status, QoL	29,30	72.1 ± 21.6	83.3	33.3	100
Functional scale					
Physical functioning	1-5	87.9 ± 74.7	93.3	16.7	100
Role functioning	6,7	75.9 ± 28.7	83.3	16.7	100
Emotional functioning	21-24	76.8 ± 27.9	91.6	16.7	100
Cognitive functioning	20,25	78.7 ± 25.4	83.3	33.4	100
Social functioning	26,27	75.9 ± 31.4	91.6	0	100
Symptoms					
Fatigue	10,12,18	27.7 ± 26.7	33.3	0	77.7
Nausea, vomiting	14,15	3.7 ± 9.1	0	0	33.3
Pain	9,19	22.3 ± 23.9	16.6	0	83.3
Dyspnea	8	14.8 ± 32.4	0	0	66.6
Insomnia	11	24.1 ± 31.9	0	0	100
Loss of appetite	13	16.5 ± 30.8	0	0	100
Constipation	16	3.7 ± 15.7	0	0	66.6
Diarrhea	17	9.2 ± 19.1	30	0	66.6
Economic problems	28	22.2 ± 32.3	30	0	100

SD = standard deviation; QoL = quality of life.



Figure 2 European Organisation of Research and Treatment of Cancer Quality of Life Questionnaire (H&N 31–48) mean value distribution (%).

rendering fabrication of prostheses and establishment of stable occlusion difficult. Oral conditions and the prosthetic rehabilitation varied considerably among the patients in the present study. This did not allow identifying common characteristic traits and comparing various types of prostheses with regard to function and esthetics.



QoL and local oral problems

Figure 3 Local oral problems [European Organisation of Research and Treatment of Cancer Quality of Life Questionnaire (EORTC QLQ) H&N items 31–48, minimum value 18 for no problems/maximum value 72 for many problems] in relation to quality of life (EORTC QLQ-C30 items 29 + 30; maximum value 8 for good quality of life).

The mandibular implant overdenture supported by two to four implants was the most frequent type of prosthesis in the present study. This was a benefit for many patients and facilitates oral hygiene. But because of limited space, fixed prostheses would be preferred in some cases. Much more publications on oral tumor patients deal with mandibular prostheses than maxillary, particularly with the edentulous mandible.¹² One study observed among their patient group that no type of superstructure was particularly favorable,²² but other authors claim, that in spite of a reduced survival rate, implants facilitated and improved prosthodontic treatment.²⁶ Such patients may regain satisfactory function and are able to adapt on a good level to their prosthesis.¹⁵ Implant prostheses with a connecting bar are quite stable, but fixed prostheses are suggested by some authors to avoid ulcers and adverse soft tissues reactions.26-28

Major limitations in functional rehabilitation derive from scar tissue with reduced mouth opening, reduced tongue mobility, insufficient lip closure and dry mouth,^{28–30} which has a negative impact on quality of life. Theses aspects led most often to negative ratings by the patients in the present study as well. High technical quality, accurate fabrication and good retention of the prostheses by means of implants cannot fully compensate for and do not prevent the perception of a negative treatment outcome.³¹ In some patients, it may not even be possible to fabricate prostheses because of inadequate intraoral conditions¹⁸ and not all patients may be eligible for implant placement.³²

In the present study, quality of life related to the specific conditions of tumor patients was measured only in patients who were available and willing to complete the questionnaires. Some could be reached neither by phone nor written mail and it was assumed that they had passed away or were referred to a nursing home. Other patients considered themselves not being able to answer the questions because they felt too ill and too frail. Thus, one could conclude, that the patients with better oral and general health conditions answered the questions. Nevertheless, the prosthetic rehabilitation was on the same level of complexity, that is, with obturators, resection in both jaws, and radiation therapy as in the nonanswering patients.

From the EORTC QLQ H&N, which reflects sitespecific effects, it appears that some patients adapt well to their compromised situation and express satisfactory quality of life within the given limitations. The subjective perception of disability may depend on objective limitations but equally on individual expectations and general health. Swallowing hard food, dry mouth, limited mouth opening, and soreness were the most typical complaints of the patients. Quality of life (EORTC QLQ 30) based on more general measures, with a functional and emotional domain was judged quite favorably. The results from both questionnaires were in good accordance with other reports.7,14,33 Low ratings for global quality of life came from five patients. Three out of them experienced limitations in oral function that were combined with limitations in the social and emotional domain. One patient with a recurrent tumor felt completely depressed. She had always cared for her body health, was a nonsmoker, and did not consume alcohol. One patient in bad systemic health conditions with a nose resection was satisfied with oral function but complained strongly about appearance. It seems that quality of life was not strictly related to neither the degree of oral tissue destruction or side effects of the treatment, nor the type of prosthetic reconstruction. Individual perception of a handicap,

general health conditions, and the individual course of illness determined their judgment a well.

CONCLUSIONS

The present case series confirms the complex anatomic alterations after tumor resection and the need for individual treatment approaches especially regarding prosthesis design. In spite of many common problems, oral cancer patients are an inhomogeneous segment of dental patients, and prosthetic rehabilitation is characterized by a variety of types of prostheses. Some local effects of tumor therapy could not be significantly improved by prosthetic rehabilitation leading to functional and emotional disability. Many patients had passed away or felt too ill to fill the questionnaires. In spite of disease-related local and general restrictions, most patients gave a positive assessment of quality of life. Inasmuch it is important that prosthodontists regularly care for this segment of patients. Rehabilitation requires clinical experience, prosthetic skills, and understanding the physical, emotional, and psychological dimension of the patients' problems.

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