Quality of Life Related to Oral Function in Edentulous Head and Neck Cancer Patients Posttreatment

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Purpose: Surgical treatment of malignancies in the oral cavity and subsequent radiotherapy often result in an oral condition unfavorable for prosthodontic rehabilitation. This study assessed the quality of life related to oral function in edentulous head and neck cancer patients following oncology treatment of malignancies in the lower region of the oral cavity. ***Materials and Methods:*** Patients treated between 1990 and 2000 with surgery and radiotherapy for a squamous cell carcinoma in the oral cavity who were edentulous in the mandible and had been treated with a conventional, non-implant-retained denture received an invitation for a clinical check-up (clinical assessment, questionnaires regarding oral function and quality of life). ***Results:*** Sixty-seven of the 84 patients who fulfilled the inclusion criteria were willing to participate in the study. The mean irradiation dosage that these patients had received in the oral region was 61.8 ± 5.4 Gy. Half of the patients (n = 33) were not very satisfied with their prostheses; they wore their mandibular prostheses at most a few hours per day. It was concluded from the clinical assessment that two thirds of the patients (n = 44) could benefit from an implant-retained mandibular denture. Analyses of the questionnaires revealed no significant associations between functional assessments, quality of life, and parameters such as size of the primary tumor, location of the primary tumor, and different treatment regimes. Despite cancer treatment, the patients reported a rather good general quality of life. ***Conclusions:*** Sequelae resulting from radiotherapy probably dominate oral function and quality of life after oncology treatment. In two thirds of the patients, improvement of oral function and related quality of life would be expected with the use of an implant-retained mandibular denture. *Int J Prosthodont 2007;20:469–477.*

Surgical treatment of malignancies involving the oral cavity often results in an altered anatomic situation, which may cause a severe disturbance in oral function. Adjuvant radiotherapy further deteriorates the oral condition, such as through reduced salivary secretion and its related sequelae of impairment of speech, chewing (mastication), and swallowing.[1–8] As a consequence, the ability to obtain proper stability and retention of a mandibular prosthesis may be seriously at risk.[1,9–11] In addition, particularly after radiotherapy, the load-bearing capacity of both the native and reconstructed tissues is compromised.[7,9,12,13] Moreover, ill-function of the mandibular prosthesis may further increase the above-mentioned problems.[13]

Until recently, neither reconstructive surgery nor conventional prosthodontic techniques were capable to successfully address denture-related problems.[14,15] A proper choice of reconstruction techniques in combination with implant-supported or -retained prostheses can likely improve the oral rehabilitation of these patients.[6,8,9,11,16-25] Therefore, the use of implants is advocated with increasing frequency for prosthetic support in patients who are treated for malignancies in the lower region of the oral cavity.[10,12,19,25,26]

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However, it is questionable whether head and neck oncology patients fully appreciate the benefits of oral rehabilitation aimed to improve oral function as an important aspect of their quality of life (QoL) in general. As stated by a recent consensus report on oral and facial rehabilitation, "Quality of life in oral and facial rehabilitation is largely unresearched. There is an apparent need to develop and employ specific instruments for the assessment of quality of life in oral and facial rehabilitation."[27] The need for additional instruments to obtain more detailed outcome measurements has raised the issue of measuring the QoL of cancer patients by assessing not only their functional status, but also their physical, social, and emotional well-being through self-administered questionnaires.[28,29] During recent years, a variety of instruments to assess QoL have been developed and applied in cancer patients, particularly in patients with head and neck cancer.[30–37] It is now accepted that QoL is a multidimensional concept, and this is reflected in the breadth of QoL questionnaires. There are 4 main categories of questionnaires that must be considered in patients with oral cancer: global, general cancer, head and neck specific, and performance. Global or generic questionnaires (eg, Hospital Anxiety Depression scale, General Health Questionnaire, Short Form 36) tend to deal with physical, psychologic, and social functioning and can be applied to any disease group or normal population. General cancer questionnaires (eg, EORTC QLQ-C30) apply to any malignant disease and focus on symptoms and the side effects of treatment. Head and neck specific questionnaires (eg, EORTC H&N35, UW-QOL) are intended to measure complications, side effects, and functional problems of particular importance in head and neck cancer. Performance questionnaires (eg, EORTC H&N35, OHIP, GARS-D) are specific to an assessment of oral function.[28]

In this paper, an assessment was made of the QoL related to oral function in edentulous head and neck cancer patients following oncology treatment of malignancies in the lower region of the oral cavity with a combination of surgery and radiotherapy. All patients had been treated with non-implant-retained conventional dentures.

Materials and Methods

Patient records were reviewed of all patients who presented because of a malignancy of the head and neck between January 1990 and December 2000 to the departments of Oral and Maxillofacial Surgery and Ear, Nose, and Throat disease at the University Hospital Groningen and the Department of Oral and Maxillofacial Surgery at the Medical Centre Leeuwarden, The Netherlands. The following data were obtained from the records: tumor diagnosis and TNM classification, location of the tumor, specific treatment of the tumor, and irradiation dosage.

All patients treated with a combination of surgery and radiotherapy for a squamous cell carcinoma in the lower region of the oral cavity (squamous cell carcinoma of tongue, floor of the mouth, mandibular gingiva, buccal mucosa, or oropharynx) who were edentulous in the mandible and alive with no signs of recurrence of disease at the time of the survey received a mailed letter of introduction, with information about the study and an invitation for a clinical check-up at the hospital. All patients were screened by a maxillofacial surgeon and experienced prosthodontist. During this visit, a thorough, standardized anamnesis was taken, a clinical assessment was made, and the patients were asked to fill out a number of questionnaires. The anamneses focused on oral function (speech, swallowing, chewing), patients' comfort with wearing the denture, any wishes of the patients to improve oral function and denture comfort. The clinical assessment included a thorough assessment of dental status, oral condition, and prosthetic rehabilitation. Attention was paid to the depth of the buccal vestibule, level of muscular activity, neutral zone, deviation of the mandible, mobility of the tongue in relation to oral function, sensibility of the lip and chin as experienced by the patient, and wetness of the oral mucosa. Prosthetic problems related to lack of stability and retention of the mandibular denture were evaluated in rest and during function. After the clinical assessments, patients were requested to complete questionnaires regarding oral function and QoL as well as questionnaires regarding denture satisfaction and the impact of denture-related problems on social activities:

- QoL was assessed using the core questionnaire (EORTC QLQ-C30) and the head and neck module (EORTC H&N35) of the European Organization for Research and Treatment of Cancer (EORTC).[30,32] All scores ranged from 0 to 100. With regard to the functional scales of the EORTC QLQ-C30, higher scores meant higher quality of life and better results. In the symptom scales and single-item scales of the EORTC QLQ-C30, higher levels represent greater degrees of problems caused by the symptom, so that the best result in these scales was a score of 0. In the head and neck module, higher scores represent greater degrees of problems and good results show low scores.
- The psychologic, physical, and social impact of oral disorders was assessed using the Oral Health Impact Profile (OHIP) questionnaire comprising 6 multi-item scales.[38,39] Responses on each item ranged from "very often" (score 4) to "never" (score 0). Adding the scores results in a total score per scale; a high score

means a high impact on the aspect concerned. In addition, the OHIP-14 (14 items, range 0 to 56), a short form of the original OHIP-49 measuring the overall impact of dental problems, was used.[40]

- General QoL was assessed with the Linear Analogue Self Assessment method (LASA, 1-item version).[41] The patients were asked to indicate their general QoL on a bar with a length of 10 cm, with the left extreme position indicating "the worst possible situation" (score 0) and the right extreme position indicating "the best possible situation" (score 10).
- Denture satisfaction was assessed using a validated questionnaire consisting of 8 separate items focusing on the function of maxillary and mandibular dentures and specific features such as esthetics, retention, and functional comfort.[42] Each item was presented with a 5-point rating scale, on which the patient indicated the extent to which he or she was (dis)satisfied. A high score indicated greater dissatisfaction.
- Overall denture satisfaction was expressed on a 10-point rating scale (0 to10), from completely dissatisfied (score 0) to completely satisfied (score 10).
- Subjective chewing ability was assessed using a 9-item questionnaire on which the patient could rate on a 3-point scale his or her ability to chew different kinds of food.[43]
- The impact of denture problems on social activities, such as going out and contacting and visiting people, was assessed with the Groningen Activity Restriction Scale Dentistry (GARS-D).[44] GARS-D is an 11-item scale yielding a score ranging from 0 to 22. The higher the score, the greater the impact on social activities.

The data were evaluated using SPSS 11.5 software for Windows (SPSS). Because the data were not normally distributed, a nonparametric Mann-Whitney *U* test was used when comparing subgroups. Differences between subgroups were stated as significant if $P < .05$.

Results

Patients

In total, 84 patients fulfilled the inclusion criteria and were invited for a clinical check-up at the hospital. Seventeen of these patients did not want to participate in the study (nonresponse rate: 20.2%), predominantly because of poor general health (n = 7) and travel distance (n = 5). Thus, 67 patients (37 men and 30 women; mean age: 63.5 ± 10.1 years; range: 39 to 87 years) participated in the study (Table 1). The mean cumulative dose of irradiation to the oral region was 61.8 ± 5.4 Gy (range: 50 to 70 Gy). The mean follow-up between end of radiotherapy and the clinical check-up was 4.5 ± 2.9 years (range: 1 to 10 years). Staging of the squamous cell carcinomas (all primary tumors) was done according to the TNM classification (Table 2). The tumors were predominantly staged as larger tumors (T2 to T4). The tumors were located in the tongue (n = 20), floor of mouth (n = 19), mandibular gingiva (n = 19), and oropharynx (n = 9). Twenty-four of the 67 patients had undergone a mandibular continuity resection. In 11 of these 24 patients, the mandibular continuity resection was reconstructed with a composite free vascularized flap (n = 10) or reconstruction plate (n = 1). Furthermore, mandibular rim resection was performed in 10 patients, and 8 patients had undergone a mandibulotomy (mandibular swing procedure). Defects of the soft tissues were mainly managed by primary closure (n = 27) or with free flaps (n = 21).

Table 1 Characteristics of the Included Patients

Age (y)	63.5 ± 10.1 (39–87)
Sex	
Male	37 (55%)
Female	30 (45%)
Mandibular resection	
No resection	25 (37%)
Mandibulotomy	8 (12%)
Rim	10 (15%)
Segment	24 (36%)
Mandibular reconstruction	
No reconstruction	13 (54%)
Reconstruction plate	1 (4%)
Free flap	10 (42%)
Soft tissues	
Primary closure	27 (40%)
Skin graft	5 (8%)
Pedicled flap	14 (21%)
Free flap	21 (31%)

Table 2 Staging of the Squamous Cell Carcinomas According to TNM

	N0	N1	N2a	N2b	N2c	Total
T1	3	–	–	2	–	5
T2	11	5	1	4	1	22
T3	3	7	1	2	–	13
T4	17	5	2	3	–	27
Total	34	17	4	11	1	67

Clinical Assessments

All patients were edentulous in the mandible, and all but 2 were edentulous in the maxilla as well. The patients were edentulous in the mandible for an average of 25.0 ± 16.4 years (range: 1 to 56 years), and most were wearing their second mandibular denture (range: 1 to 10; median: 2), which on average was 5.4 ± 7.3

Table 3 No. of Patients Wearing Their Prostheses

	Maxilla (n = 65)	Mandible (n = 67)
Day and night	20	4
Only during day	25	30
Few hours per day	5	4
Never	15	29

Table 4 Factors Influencing (Dys)function of the Mandibular Prosthesis

	Yes	No
Surgically compromised buccal vestibule	58	9
Disturbed sensibility lip/chin	31	36
Mandibular deviation (due to surgery)	16	51
Xerostomia	48	19
Compromised neutral zone	57	10

years old. Eleven patients had become edentulous as part of the oncology treatment. Almost half of the patients wore their mandibular prosthesis never (n = 29) or at most a few hours per day for cosmetic reasons (n = 4) (Table 3). Insufficient retention of the mandibular prosthesis was noted in 55% of the patients and diminished stability in 23% of the patients. Related to the prior tumor surgery, high scores were observed on negative prosthetic factors, such as compromised neutral zone and surgically compromised buccal vestibule (Table 4). Patients reported their complaints to be located in the mandible (86%), maxilla (3%), or a combination of both (11%). The complaints were reported to be caused by surgery (8%), radiotherapy (8%), the prosthesis (7%), or a combination of these factors (76%). According to 89% of the patients, the complaints developed after tumor treatment (particularly after radiotherapy), while 11% reported the complaints as existent before oncologic therapy, especially resulting from ill-functioning of their mandibular dentures.

From the clinical assessments, it was concluded that in 44 of the 67 patients (66%) a beneficial effect could be expected from making an implant-retained mandibular denture and little or no improvement could be expected from making a new set of conventional dentures. In the other 23 patients, oral function (speech, chewing, swallowing) was severely impaired as a result of surgery and/or radiotherapy, and thus no improvement of oral function could be expected from any treatment directed only to create more stability of the mandibular denture. Impaired tongue function was particularly important in that judgment. Of the 44 patients who could possibly benefit from making an implant-retained mandibular denture, 22 patients wore their denture for at least a few hours per day. The other 22 patients did not wear a conventional prosthesis because of lack of retention related to an unfavorable anatomic condition.

Functional Assessments and QoL

Data regarding the functional assessments and QoL were analyzed with regard to size of the primary tumor, location of the primary tumor, and different treatment regimes (Tables 5 and 6). No significant differences between the subgroups were found. Whether the surgical treatment of the malignancy included a continuity resection or no bone resection at all did not make any difference in the way the patients experienced functioning after oncology treatment. Moreover, despite being treated for cancer, the patients reported a rather good general QoL on the EORTC QoL function scale and Linear Analogue Self Assessment (LASA) scale. The mean overall denture satisfaction score was 5.5. Half of the patients (n = 33) rated their prosthesis as dissatisfying. The group of patients who wore their mandibular prosthesis on a regular basis were compared to the patients who did not wear their prosthesis or used it only for cosmetic reasons. In this comparison, many significant differences were observed, especially on the questions regarding the social impact of oral disorders (OHIP), denture satisfaction, and chewing ability. Patients who wore their mandibular prosthesis on a regular basis showed better results on these items (Tables 7 and 8). When comparing patients who could benefit from implant-retained mandibular dentures and those who could not, patients who could benefit from implant-retained dentures showed significantly worse results for denture satisfaction, chewing, functional limitation, physical pain, and physical disability (Tables 7 and 8).

Discussion and Conclusions

Surgical treatment of malignancies in the oral cavity and subsequent radiotherapy often result in an anatomic and physiologic oral condition unfavorable for prosthodontic rehabilitation. This unfavorable oral condition may have a negative effect on both denture satisfaction and QoL in general. It is remarkable that in this study hardly any significant differences were observed regarding functional outcome and QoL for the different treatment regimens and size or location of the primary tumor. This is in contrast to most studies in the literature, reporting tumor site, tumor size, type of mandibular defect, and type of reconstruction to be associated with functional outcome.[45,46] At most, the present study showed tendencies of such associations, but either these associations were not very strong

Table 5 EORTC QLQ-C30 and H&N35 Data When Comparing Different Treatment Regimes

	All n = 67	NCR n = 43	CR n = 24	RC n = 11	NC n = 13	MR n = 10	MS n = 8	NB n = 25
QLQ-C30								
Global health status/QoL	78.1 ± 19.5	77.0 ± 18.6	80.1 ± 21.3	80.8 ± 24.9	79.5 ± 19.1	75.7 ± 21.5	79.2 ± 14.1	77.7 ± 18.4
Physical function	79.1 ± 20.4	76.8 ± 20.5	83.2 ± 20.0	88.0 ± 17.4	79.5 ± 21.7	73.9 ± 21.2	85.0 ± 15.8	77.3 ± 21.0
Role function	79.7 ± 27.9	75.8 ± 28.3	87.0 ± 26.1	88.3 ± 27.3	85.9 ± 26.2	86.1 ± 21.1	75.0 ± 34.5	74.0 ± 28.9
Emotional function	84.6 ± 19.8	85.5 ± 17.6	83.0 ± 23.8	82.5 ± 30.0	83.3 ± 18.9	87.5 ± 15.3	87.5 ± 20.4	85.7 ± 17.9
Cognitive function	85.1 ± 20.0	87.3 ± 16.8	81.2 ± 24.8	81.7 ± 29.9	80.8 ± 21.4	83.3 ± 21.3	95.8 ± 7.7	88.0 ± 15.6
Social function	87.4 ± 23.6	87.7 ± 23.3	87.0 ± 24.6	95.0 ± 15.8	80.8 ± 28.7	86.1 ± 25.5	85.4 ± 35.0	90.7 ± 16.7
Fatigue	21.9 ± 24.1	23.5 ± 23.0	18.8 ± 26.0	16.7 ± 30.2	20.5 ± 23.5	25.0 ± 21.8	12.5 ± 13.8	25.3 ± 24.7
Nausea/vomiting	2.3 ± 7.7	2.8 ± 9.0	1.4 ± 4.8	0.0 ± 0.0	2.6 ± 6.3	5.6 ± 14.8	0.0 ± 0.0	2.0 ± 5.5
Pain	13.6 ± 21.8	17.5 ± 25.0	6.5 ± 12.0	1.7 ± 5.3	10.3 ± 14.5	27.8 ± 29.6	6.3 ± 17.7	14.0 ± 22.4
Dyspnoea	11.3 ± 20.6	14.3 ± 22.3	5.8 ± 16.4	3.3 ± 10.5	7.7 ± 20.0	16.7 ± 22.5	8.3 ± 23.6	13.3 ± 21.5
Insomnia	15.4 ± 26.4	14.3 ± 24.6	17.4 ± 29.9	13.3 ± 32.2	20.5 ± 29.0	8.3 ± 15.1	16.7 ± 25.2	17.3 ± 27.4
Appetite loss	12.8 ± 24.1	13.5 ± 24.5	11.6 ± 23.8	10.0 ± 31.6	12.8 ± 25.6	13.9 ± 30.0	4.2 ± 11.8	14.7 ± 23.7
Constipation	3.6 ± 12.0	2.4 ± 8.7	5.8 ± 16.4	0.0 ± 0.0	10.3 ± 21.0	0.0 ± 0.0	0.0 ± 0.0	4.0 ± 11.1
Diarrhea	6.2 ± 16.6	7.1 ± 18.8	4.3 ± 11.5	0.0 ± 0.0	7.7 ± 14.6	8.3 ± 28.9	4.2 ± 11.8	6.7 ± 13.6
Financial problems	11.8 ± 27.3	8.7 ± 22.2	17.4 ± 34.6	10.0 ± 31.6	23.1 ± 37.0	5.6 ± 13.0	20.8 ± 35.4	8.0 ± 19.9
H&N35								
HN Pain	15.2 ± 17.6	16.3 ± 18.1	13.0 ± 16.6	11.7 ± 17.2	14.1 ± 16.8	15.3 ± 17.0	9.4 ± 10.4	17.1 ± 20.3
HN Swallowing	25.2 ± 21.2	24.3 ± 19.4	26.9 ± 24.7	15.7 ± 19.3	34.6 ± 25.7	15.5 ± 11.0	31.3 ± 20.8	24.8 ± 20.8
HN Senses	23.3 ± 27.1	24.2 ± 26.1	21.7 ± 29.5	26.7 ± 34.4	17.9 ± 25.9	9.7 ± 16.6	41.7 ± 32.1	23.3 ± 24.1
HN Speech	17.9 ± 21.8	18.8 ± 22.0	16.4 ± 21.7	13.3 ± 20.8	18.8 ± 22.9	17.6 ± 20.9	20.8 ± 22.6	18.2 ± 22.2
HN Social eating	35.0 ± 29.4	35.5 ± 28.7	34.1 ± 31.4	31.7 ± 34.0	35.9 ± 30.5	29.9 ± 20.9	32.3 ± 32.6	36.3 ± 30.9
HN Social contact	11.1 ± 19.1	9.6 ± 17.4	13.9 ± 21.8	8.7 ± 13.7	17.9 ± 26.3	6.3 ± 13.6	8.3 ± 21.0	10.4 ± 17.6
HN Sexuality	23.4 ± 36.0	22.4 ± 35.9	25.4 ± 36.9	20.0 ± 32.2	29.5 ± 40.9	22.2 ± 38.5	18.8 ± 35.0	20.8 ± 34.8
HN Teeth	29.9 ± 36.5	29.8 ± 34.5	30.2 ± 40.7	25.0 ± 38.8	33.3 ± 43.0	25.9 ± 32.4	20.8 ± 30.5	30.6 ± 36.7
HN Opening mouth	31.8 ± 35.6	34.9 ± 34.5	26.1 ± 37.5	36.7 ± 42.9	17.9 ± 32.2	38.9 ± 37.2	37.5 ± 37.5	28.0 ± 32.9
HN Dry mouth	57.4 ± 38.9	60.3 ± 37.0	52.2 ± 42.4	46.7 ± 47.7	56.4 ± 39.4	61.1 ± 27.8	54.2 ± 43.4	58.7 ± 38.8
HN Sticky saliva	40.6 ± 37.8	39.8 ± 36.7	42.0 ± 40.5	26.7 ± 37.8	53.8 ± 39.8	42.4 ± 33.6	37.5 ± 45.2	34.7 ± 36.6
HN Coughed	19.5 ± 27.6	22.2 ± 29.1	14.5 ± 24.3	10.0 ± 16.1	17.9 ± 29.2	30.6 ± 36.1	12.5 ± 24.8	18.7 ± 25.6
HN Felt ill	6.8 ± 18.0	7.3 ± 19.0	5.8 ± 16.4	6.7 ± 21.1	5.1 ± 12.5	9.1 ± 21.6	0.0 ± 0.0	8.0 ± 19.9
HN Pain killers	33.8 ± 47.7	38.1 ± 49.2	26.1 ± 44.9	30.0 ± 48.3	23.1 ± 43.9	33.3 ± 49.2	25.0 ± 46.3	40.0 ± 50.0
HN Nutritional supplement	33.8 ± 47.7	31.0 ± 46.8	39.1 ± 49.9	40.0 ± 51.6	38.5 ± 50.6	16.7 ± 38.9	25.0 ± 46.3	36.0 ± 49.0
HN Feeding tube	10.8 ± 31.2	7.1 ± 26.1	17.4 ± 38.8	10.0 ± 31.6	23.1 ± 43.9	16.7 ± 38.9	0.0 ± 0.0	4.0 ± 20.0
HN Weight loss	18.5 ± 39.1	19.0 ± 39.7	17.4 ± 38.8	20.0 ± 42.2	15.4 ± 37.6	16.7 ± 38.9	0.0 ± 0.0	24.0 ± 43.6
HN Weight gain	20.0 ± 40.3	11.9 ± 32.8	34.8 ± 48.7	30.0 ± 48.3	38.5 ± 50.6	8.3 ± 28.9	25.0 ± 46.3	8.0 ± 27.7

NCR = no continuity resection; CR = continuity resection; RC = restored continuity; NC = continuity not restored; MR = marginal mandibular resection; MS = mandibular swing; NB = no bone surgery.

Table 6 Oral Function, LASA, Denture Satisfaction, Chewing Ability, and GARS-D Data When Comparing Different Treatment Regimes

OHIP	All n = 67	NCR n = 43	CR n = 24	RC n = 11	NC n = 13	MR n = 10	MS n = 8	NB n = 25
OHIP-14	20.4 ± 11.4	20.4 ± 10.7	20.4 ± 12.7	18.4 ± 12.9	22.0 ± 12.8	22.3 ± 8.8	24.5 ± 14.7	18.4 ± 10.2
Functional limitation	15.6 ± 7.2	15.3 ± 6.9	16.0 ± 7.8	14.6 ± 7.4	17.1 ± 8.2	15.5 ± 5.5	16.2 ± 7.2	15.0 ± 7.6
Physical pain	12.1 ± 8.6	12.5 ± 8.9	11.4 ± 8.1	10.4 ± 8.8	12.2 ± 7.8	13.6 ± 5.5	13.8 ± 12.2	11.8 ± 9.2
Physical disability	18.1 ± 8.7	18.1 ± 8.0	18.1 ± 10.0	15.8 ± 10.0	20.0 ± 10.0	20.3 ± 7.8	20.7 ± 10.1	16.4 ± 7.3
Psychologic discomfort	6.2 ± 5.8	6.3 ± 5.3	6.1 ± 6.8	7.0 ± 7.7	5.5 ± 6.2	7.3 ± 6.2	7.6 ± 5.2	5.5 ± 5.0
Psychologic disability	4.0 ± 5.5	4.1 ± 5.2	3.8 ± 6.2	3.8 ± 7.2	3.8 ± 5.6	6.0 ± 6.6	4.3 ± 5.6	3.3 ± 4.5
Social disability	3.4 ± 4.6	3.6 ± 4.4	3.0 ± 5.1	3.1 ± 5.3	3.0 ± 5.1	5.3 ± 3.9	5.0 ± 7.4	2.6 ± 3.3
LASA	6.8 ± 2.5	6.7 ± 2.3	7.1 ± 2.9	6.9 ± 3.2	7.2 ± 2.7	5.9 ± 2.8	7.3 ± 1.8	6.8 ± 2.3
Denture satisfaction	23.1 ± 8.2	23.1 ± 8.2	23.3 ± 8.3	22.0 ± 7.9	24.1 ± 8.8	23.0 ± 8.1	24.0 ± 7.3	22.8 ± 8.8
Overall denture satisfaction	5.5 ± 2.4	5.7 ± 2.1	5.1 ± 2.9	5.3 ± 3.0	4.9 ± 3.0	5.7 ± 2.7	5.9 ± 1.8	5.7 ± 2.1
Chewing ability	11.7 ± 3.9	12.3 ± 3.7	11.7 ± 4.1	12.7 ± 3.4	12.2 ± 3.2	13.1 ± 3.6	10.7 ± 4.4	11.4 ± 4.1
GARS-D	7.1 ± 7.1	7.2 ± 7.1	7.0 ± 7.2	5.8 ± 7.6	7.9 ± 7.0	11.7 ± 6.6	5.0 ± 8.1	6.3 ± 6.6

NCR = no continuity resection; CR = continuity resection; RC = restored continuity; NC = continuity not restored; MR = marginal mandibular resection; MS = mandibular swing; NB = no bone surgery.

Table 7 EORTC QLQ C-30 and H&N35 Data When Comparing Different Subgroups

	MP N = 34	NMP n = 33	II n = 44	NII n = 23
QLQ-C30				
Global health status/QoL	80.6 ± 19.3	75.0 ± 19.8	76.6 ± 19.8	80.6 ± 19.1
Physical function	85.6 ± 18.5	71.5 ± 21.6*	81.4 ± 18.4	74.2 ± 25.1
Role function	84.2 ± 24.8	73.2 ± 30.9	82.2 ± 25.2	72.9 ± 32.9
Emotional function	86.5 ± 20.3	83.3 ± 18.8	83.0 ± 22.5	88.9 ± 11.2
Cognitive function	84.7 ± 21.3	85.4 ± 18.0	85.1 ± 19.6	84.7 ± 20.2
Social function	92.3 ± 17.8	80.3 ± 29.3*	85.1 ± 27.0	89.6 ± 18.9
Fatigue	21.0 ± 25.6	23.9 ± 23.6	20.5 ± 24.0	25.9 ± 25.7
Nausea/vomiting	0.9 ± 3.8	3.5 ± 10.0	0.7 ± 3.4	4.8 ± 11.5*
Pain	12.6 ± 22.0	18.2 ± 26.5	15.2 ± 22.7	15.2 ± 27.3
Dyspnoea	8.1 ± 16.5	16.2 ± 23.7	13.0 ± 21.6	9.7 ± 18.3
Insomnia	16.2 ± 27.9	13.1 ± 23.5	19.6 ± 29.5	5.6 ± 12.7
Appetite loss	8.1 ± 18.3	17.2 ± 27.8	11.6 ± 22.5	13.9 ± 25.9
Constipation	3.6 ± 10.5	3.0 ± 12.8	3.6 ± 12.6	2.8 ± 9.4
Diarrhea	3.6 ± 10.5	8.1 ± 20.5	5.8 ± 12.8	5.6 ± 21.2
Financial problems	4.5 ± 17.9	18.8 ± 32.7*	8.9 ± 24.0	15.3 ± 31.1
H&N35				
HN Pain	16.5 ± 17.3	15.9 ± 18.1	17.0 ± 17.7	14.7 ± 17.4
HN Swallowing	23.7 ± 20.0	29.8 ± 22.7	28.8 ± 21.1	22.3 ± 21.7
HN Senses	22.1 ± 26.4	26.8 ± 28.6	25.4 ± 26.7	22.2 ± 28.9
HN Speech	12.6 ± 16.8	22.9 ± 24.5	14.7 ± 19.5	22.7 ± 24.0
HN Social eating	30.0 ± 27.7	42.7 ± 31.6	38.2 ± 29.7	31.6 ± 30.8
HN Social contact	7.7 ± 11.3	14.0 ± 24.2	11.3 ± 18.7	9.4 ± 18.7
HN Sexuality	25.0 ± 38.3	25.3 ± 35.6	28.5 ± 38.9	18.8 ± 32.3
HN Teeth	33.3 ± 33.3	32.1 ± 43.8	35.7 ± 38.5	27.3 ± 36.6
HN Opening mouth	30.6 ± 38.8	35.4 ± 34.3	37.7 ± 36.2	23.6 ± 36.1
HN Dry mouth	60.4 ± 41.5	57.6 ± 37.5	58.0 ± 40.0	61.1 ± 38.9
HN Sticky saliva	40.5 ± 40.9	42.7 ± 35.1	45.7 ± 40.0	33.3 ± 33.3
HN Coughed	16.2 ± 24.4	20.2 ± 30.0	17.4 ± 28.8	19.4 ± 23.9
HN Felt ill	6.3 ± 19.0	7.3 ± 16.4	7.4 ± 17.2	5.6 ± 18.8
HN Pain killers	29.7 ± 46.3	39.4 ± 49.6	32.6 ± 47.4	37.5 ± 49.5
HN Nutritional supplements	29.7 ± 46.3	39.4 ± 49.6	34.8 ± 48.2	33.3 ± 48.2
HN Feeding tube	2.7 ± 16.4	21.2 ± 41.5*	8.7 ± 28.5	16.7 ± 38.1
HN Weight loss	16.2 ± 37.4	21.2 ± 41.5	13.0 ± 34.1	29.2 ± 46.4
HN Weight gain	10.8 ± 31.5	30.3 ± 46.7*	23.9 ± 43.1	12.5 ± 33.8

*Significant at $P < .05$ (Mann-Whitney U test).
MP = regularly wearing mandibular prosthesis; NMP = not regularly wearing mandibular prosthesis; II = indication for implant therapy; NII = no indication for implant therapy.

Table 8 Oral Function, LASA, Denture Satisfaction, Chewing Ability, and GARS-D Data When Comparing Different Subgroups

OHIP	MP n = 34	NMP n = 33	II n = 44	NII n = 23
OHIP-14	16.0 ± 10.1	25.4 ± 11.7*	22.2 ± 12.1	17.0 ± 10.6
Functional limitation	13.2 ± 6.5	18.5 ± 7.3*	16.9 ± 7.2	13.3 ± 7.3*
Physical pain	11.0 ± 8.4	14.4 ± 9.4	14.5 ± 9.3	9.0 ± 7.4*
Physical disability	13.8 ± 7.3	22.9 ± 8.1*	19.7 ± 9.1	15.1 ± 7.8*
Psychologic discomfort	4.9 ± 5.8	7.8 ± 5.8*	7.1 ± 6.5	4.7 ± 4.5
Psychologic disability	2.7 ± 4.9	5.5 ± 6.0*	4.6 ± 6.3	3.0 ± 3.9
Social disability	2.4 ± 3.7	4.3 ± 5.2	3.6 ± 4.9	2.8 ± 3.7
LASA	7.2 ± 2.6	6.4 ± 2.5	6.8 ± 2.7	6.9 ± 2.4
Denture satisfaction	20.3 ± 7.4	27.3 ± 7.5*	25.5 ± 7.7	18.7 ± 7.4*
Overall denture satisfaction	6.3 ± 1.9	4.4 ± 2.6*	4.9 ± 2.3	6.5 ± 2.4*
Chewing ability	10.0 ± 3.9	13.7 ± 2.7*	12.6 ± 3.3	10.0 ± 4.3*
GARS-D	6.0 ± 6.9	8.2 ± 7.3	7.4 ± 7.3	6.2 ± 6.9

*Significant at $P < .05$ (Mann-Whitney U test).
MP = regularly wearing mandibular prosthesis; NMP = not regularly wearing mandibular prosthesis; II = indication for implant therapy; NII = no indication for implant therapy.

or the numbers in the various subgroups were too small to reach significance. Also, the general QoL, as scored with EORTC QLQ C-30 and LASA, was good compared to other studies.[29,47] This may explain why it was hard to find differences between different treatment regimes. It can be expected that the rather good overall QoL in this study is slightly overestimated because of the small group of nonresponders (n = 7) who were in poor general health. Moreover, the specificity of the data collected, biases and confounding factors (such as the rather high QoL scores of patients in this study), and lack of controls contribute to the possible shortcomings of this study. Despite these limitations, this study has a reasonable sample size compared to other functional outcome studies on oral cancer patients.[48,49] In addition, the mean follow-up of 4.5 years was reasonable for functional outcome assessments following cancer treatment.

Radiotherapy seems to be a dominating factor influencing oral functioning and QoL. In this study, all patients had received a combination of surgery and radiotherapy. When these results are compared to a group of patients in another study who underwent surgical treatment for an oral malignancy but did not receive radiotherapy, the scores in the present study are worse on all aspects of oral functioning and QoL.[50] The patients in this other study are not fully comparable because they received dental implants as part of the oncology treatment during ablative surgery. However, the other study also included a group of patients who did receive radiotherapy as part of their cancer treatment. Again, the irradiated patients in that study performed worse in terms of oral function and QoL.[50]

Many problems in oral function are related to the sequelae of radiotherapy and diminished function of the tongue. According to the literature, irradiation has a significant negative influence on function of the tongue, while speech does not differ between irradiated and non-irradiated patients.[49] Diminished function of the tongue may in part be the result of reduced salivary flow and other irradiation effects, such as oedema and fibrosis, but may also result from reduced mobility and loss of nervous innervation caused by surgery.[51] Loss of tongue function and volume affects the patient's ability to discriminate food particle location and size. This creates inefficiencies in the manipulation and consolidation of the food bolus, resulting in impairment of the oral and pharyngeal phases of swallowing. In such situations, even an implant-retained stable prosthesis will not be of benefit to the patient.[8,46,52,53] In contrary, increasing the vertical dimension with a mandibular prosthesis may even lead to more severe complaints, because the tongue may lose its ability to have proper contact with the palate.[52] This may impair both swallowing and speech. Therefore, some patients do not wear their mandibular prosthesis during eating because they experience eating without the prosthesis less troublesome. It has been reported that these problems can be solved to some extent by lowering the palatal contour in the maxillary prosthesis.[52] Further research should include more sophisticated forms of reconstructive surgery with restoration of sensory and motor innervation in conjunction with implant therapy for improving retention and stabilization of the prosthesis.

As stated in the literature, there is certainly a need for more objective validated tests of oral function.[46] This way, the effects of surgical therapy and prosthodontic intervention could be measured instead of using questionnaires that may not be discriminative enough to elucidate specific components of oral function and the effect of oral rehabilitation on QoL. To cover all aspects of measuring QoL in head and neck cancer patients (global, general cancer, head and neck specific, and performance), the questionnaires of the European Organization for Research and Treatment of Cancer (EORTC) (core questionnaire QLQ-C30 and the head and neck module H&N35) were used in combination with the OHIP questionnaire, LASA, denture satisfaction, chewing ability, and GARS-D questionnaires. This is in line with a recent consensus report, which stated, "Health-related quality of life measurements in this respect need a specific questionnaire with appropriate sensitivity and responsiveness. This is supposed to be in addition to existing validated questionnaires tapping broader concepts, eg, head- and neck-specific questionnaires."[27]

In general, the questionnaires used performed well on oral function but showed little or no changes on QoL-related aspects. As mentioned previously, QoL, as scored with the EORTC QLQ C-30 and LASA, appeared to be good when compared to other studies.[29,47] In this study, the global health/QoL scale of the EORTC QLQ-C30 revealed a score of 78. In the literature, scores between 60 to 70 are commonly reported.[29,47] With regard to the LASA, the scores in the present study are even in the same range of healthy noncancer patients.[44]

No differences were observed when comparing different treatment regimes. A major reason that even the more specific questionnaires did not detect differences in QoL may be that the oncology treatment, particularly radiotherapy, has resulted in so much distress and morbidity (eg, worries about survival, fatigue, xerostomia, trismus, loss of taste, swallowing disorders, problems with speech) that different treatment regimes have minor to no impact on overall QoL.

It remains questionable whether the questionnaires used are as discriminative as needed when the starting point is a good general QoL. However, when comparing patients who wore their mandibular prostheses on a regular basis to those who did not wear their prostheses or used them only for cosmetic reasons, many

significant differences were observed on the more specific questionnaires regarding oral function, such as OHIP, denture satisfaction, and chewing ability. Thus, when assessing the impact of oral treatments on QoL, one must ask questions regarding QoL that focus on the oral component. The EORTC H&N35 seems to be not as specific as needed in this respect, and the OHIP, GARS-D, denture satisfaction, and chewing ability scores may be too specific for the oral component and fail to reflect an impact on more general QoL. Thus, there is still a need for more specific questionnaires to refine the impact of the oral component on QoL.[54] Another option is to use semistructured interviews to obtain more individual information regarding oral function after oncologic treatment or prosthodontic rehabilitation.[55] In combination with more objective oral function tests regarding speech, chewing, swallowing, lip competence, etc, this may offer more insight into more specific treatment-related QoL in head and neck oncology patients.

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