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Long-term health-related quality of life after mandibular resection and reconstruction

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Abstract

Purpose To compare short- and long-term quality of life (QOL) scores in patients undergoing mandibular resection and reconstruction.

Materials and methods All the patients who underwent resection and reconstruction of the mandible between 2000 and 2015 at a large tertiary center were retrospectively reviewed. Their QOL was measured by the University of Washington QOL questionnaire. Between 12 and 189 months (median 83.5 months) had elapsed since the end of treatment. The QOL of the short-term (< 5 years) and long-term (> 5 years) follow-up groups was compared and analyzed.

Results Fifty-eight patients completed the questionnaire. The scores for physical function, emotional function, activity, recreation, and taste domains were significantly higher for the long-term follow-up group. The activity and pain domains posed a significant problem for significantly more patients in the short-term follow-up group.

Conclusion Comparison of the short- and long-term QOL scores of patients undergoing mandibular resection and reconstruction revealed that the scores for the latter were significantly higher in several domains. This finding might be indicative of a cumulative effect of time on patients' QOL, even many years post-treatment.

Keywords Mandibulectomy · Quality of life (QOL) · Long term · Follow-up

Introduction

Long-term quality of life (QOL) can be influenced by various factors, ranging from the patient's social background to the disease being treated and treatment modalities [1]. Post-surgical functionality of patients undergoing micro-vascular reconstruction may vary substantially between individuals and will often conform over time [2]. Subjective QOL outcomes can be quantified by several methods such as personal questionnaires [3]. QOL of head and neck (H&N) patients is a field of growing interest, as evidenced by an increasing number of publications that use a wide variety of assessment strategies [4, 5]. Most of these reports, however, are the result of short-term follow-up periods that represent the initial 1–2 years post-treatment [6–8]. Moreover, these publications are based on general H&N populations, and do not focus on specific anatomical sites or organs, with only a handful of long-term publications on QOL following mandibular resection and reconstruction [9, 10]. A major finding of QOL studies with relatively long-term follow-up periods is that scores usually decline immediately post-treatment (~ 3 months), but, as the side effects of various treatments subside, the improvement phase commences and displays a gradual enhancement of QOL over the 1st year [11, 12]. QOL scores plateau at a specific "new normal" roughly 1 year post-surgery, without any major changes thereafter

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[13]. Although this steady state is a good overall score on the average [14], not all domains necessarily stabilize and QOL may even continue to improve [15].

The aim of this study was to compare the short- and long-term QOL of patients who have undergone mandibular resection and reconstruction.

Methodology

The Tel-Aviv Sourasky Medical Center research and ethics committee board approved this study (TLV-0254-16). The study cohort was composed of all 182 patients who underwent a mandibular resection and reconstruction between January 1, 2000 and December 31, 2015 at our institution. The inclusion criteria were the diagnosis of an oral cavity neoplasm involving the mandible and requiring a mandibulectomy. Exclusion criteria were: (1) recurrent disease, (2) a second primary of the H&N, (3) mandibulectomy due to non-neoplastic reasons (e.g., trauma cases, osteomyelitis, etc.), (4) incomplete information in the medical records, and (5) failure to complete the questionnaire.

The patients' medical charts were reviewed retrospectively for demographics, clinical data, surgical interventions, operative time, and length of stay in the intensive care unit and hospital. Additionally, both immediate complications (i.e., those occurring during the hospital stay) and delayed complications were recorded. An informed consent was obtained from all the patients before they filled out the QOL questionnaire (below). Each patient's QOL was measured once during the study period and this was done at least 1 year post-treatment (range 12–189 months, median 83.5). Patients were divided into short- (< 5 years) and long-term (> 5 years) follow-up groups, according to previous studies in this field [16]. A subgroup analysis to test the impact of radiation treatment on QOL was also performed.

Questionnaire

QOL assessment was performed using the fourth version (v4) of the University of Washington Quality of Life (UW-QOL) questionnaire. The UW-QOL is a self-administered scale that provides a broad measure of QOL for patients with H&N cancer with suitable practicality, validity, reliability, and responsiveness [17]. The questionnaire consists of items on 12 disease-specific fields: pain, appearance, activity, recreation, swallowing, chewing, speech, shoulder, taste, saliva, mood, and anxiety, as well as three general QOL questions. There are 3–5 possible choices from which to choose the responses to each of the 12 questions to enable the patients to best describe their functional state during the previous week. Scoring is scaled from 0 (worst result) to 100 (best possible result). Patients were also asked to choose up to 3 of the 12 disease-specific domains that were most important to them throughout the past 7 days. Further analysis of the questionnaires enabled the identification of significant domains according to an algorithm that combined the responses for the individual domains and the important problems [18]. We also calculated two subscale scores, physical function and social–emotional function, both of which are averages of six domain scores. The domains used to calculate the physical function subscale score are chewing, swallowing, speech, appearance, taste, and saliva production [18]. The social–emotional function subscale score included the domains of anxiety, mood, pain, activity, recreation, and shoulder function [18]. The UW-QOL v4 questionnaire has a validated Hebrew version [19].

Statistical analysis

The QOL scores of the patients in the different groups were evaluated and compared with the Statistical Package for the Social Sciences (version 23.0; SPSS, Inc. IBM). The associations between variables and the UW-QOL scores were tested using the Kruskal–Wallis test, Mann–Whitney test or Spearman correlation as needed. The significance level was set at $p < 0.05$.

Results

A total of 182 patients who underwent a mandibular resection and reconstruction during the study period were identified, and 103 of them were alive and eligible for QOL assessment. The 58 patients who agreed to participate in this study included 32 men (55.2%) and 26 women (44.8%) with a mean age 56 SD ± 16 years. The median follow-up was 83.5 months (range 12–189). The cutoff point between short- and long-term follow-up was 5 years: accordingly, 17 patients were assigned to the former and 41 were assigned to the latter. 40 patients (69%) underwent a segmental mandibulectomy and 33 patients (57%) underwent reconstruction with an osseous free flap. Other important clinical data, such as pathology, disease staging, complications and adjuvant treatment, are listed in Table 1.

The scores of activity, recreation, and taste were significantly higher in the long-term follow-up group compared to the short-term follow-up group ($p = 0.001$, $p = 0.004$, and $p = 0.028$,respectively;Table 2). Chewing and taste received the lowest scores in the short-term follow-up group (50.0 and 49.38, respectively). Chewing also received the lowest score in the long-term follow-up group (64.63). A subgroup analysis of patients with malignant disease revealed similar results, with the scores for activity and recreation being significantly higher in the long-term follow-up group (Table 2).

Table 1 Patient demographic and clinical data

	≤ 5 years ($N = 17$)	> 5 years ($N = 41$)	p value
Age, years (mean)	62.56 (10.66 std)	56.53 (16.13 std)	0.032
Gender			
Male	10 (58.8%)	22 (53.7%)	
Female	7 (41.2%)	19 (46.3%)	0.72
Pathology			
Oral cavity squamous cell carcinoma	14 (82.4%)	27 (65.9%)	0.19
Ameloblastoma	1 (5.9%)	9 (22.0%)	0.13
Other	2 (11.7%)	5 (12.1%)	> 0.99
T			
1	1 (5.9%)	2 (4.9%)	0.87
2	2 (11.8%)	12 (29.3%)	0.16
3	1 (5.9%)	9 (22.0%)	0.14
4	13 (76.5%)	18 (43.9%)	0.02
N			
N0	10 (58.8%)	35 (85.4%)	0.03
N1	2 (11.8%)	2 (4.9%)	0.35
N2	4 (23.5%)	4 (9.8%)	0.17
N3	1 (5.9%)	0 (0.0%)	0.12
Stage			
Stage 1	0 (0.00%)	3 (7.3%)	0.25
Stage 2	1 (5.9%)	9 (22.0%)	0.14
Stage 3	3 (17.6%)	8 (19.5%)	0.87
Stage 4	13 (76.5%)	21 (51.2%)	0.08
Resection type			
Marginal	7 (41.2%)	11 (26.8%)	
Segmental	10 (58.8%)	30 (73.2%)	0.27
Resection segment			
Lateral	16 (94.1%)	34 (82.9%)	
Symphysis	1 (5.9%)	7 (17.1%)	0.258
Length	5.67 (2.13std)	5.66 (2.06std)	0.98
Reconstruction type			
Soft tissue	9 (52.9%)	16 (39.0%)	
Osseous	8 (47.1%)	25 (61.0%)	0.33
Reconstruction type—segmental			
Free bone graft	0	1 (3.33%)	0.55
Soft tissue free flap	2 (20%)	4 (13.33%)	0.62
Osseous free flap	8 (80%)	23 (76.66%)	0.84
Local/regional flap	0	2 (6.66%)	0.42
Early complications	4 (23.5%)	3 (7.3%)	0.084
Late complications	6 (35.3%)	9 (23.1%)	0.342
Adjuvant therapy			
Radiotherapy	10 (58.8%)	16 (39.0%)	0.168
Chemotherapy	3 (17.6%)	10 (24.4%)	0.575
Gastrostomy	2 (11.8%)	1 (2.4%)	0.144
Tracheostomy	0 (0.0%)	2 (4.9%)	0.354

QOL quality of life

A subgroup analysis on the effect of post-operative radiation revealed that scores for activity and recreation were significantly higher in the long-term follow-up group (Table 2).

None of the scores for the questions in the global questions section reached a level of significance, although HR-QOL showed a trend towards significance ($p = 0.057$)

Table 2 University of Washington quality of life specific domain scores by time of follow-up

	All patients			Only malignant pathology			Only radiation treated		
	≤ 5 years	> 5 years		≤ 5 years	> 5 years		≤ 5 years	> 5years	
	Mean (sd)	Mean (sd)	pv	Mean (sd)	Mean (sd)	pv	Mean (sd)	Mean (sd)	pv
Pain	70.58 (34.50)	80.49 (22.01)	0.515	68.75 (34.76)	78.33 (24.33)	0.501	65.00 (37.64)	82.81 (17.60)	0.312
Appearance	59.37 (23.93)	68.90 (27.26)	0.219	58.33 (24.40)	65.83 (27.45)	0.393	60.00 (17.48)	70.31 (26.17)	0.257
Activity	51.47 (31.79)	81.70 (25.01)	0.001	50.00 (31.62)	83.33 (24.86)	0.001	52.50 (29.93)	85.94 (20.35)	0.005
Recreation	58.82 (31.79)	82.92 (21.96)	0.004	57.81 (32.56)	81.67 (23.61)	0.010	55.00 (36.89)	85.94 (18.19)	0.021
Swallowing	62.94 (48.44)	78.78 (35.22)	0.429	60.63 (49.05)	76.33 (36.90)	0.472	57.00 (49.90)	80.00 (33.86)	0.313
Chewing	50.00 (39.52)	64.63 (35.78)	0.185	46.88 (38.60)	58.33 (34.95)	0.318	45.00 (28.38)	59.38 (32.76)	0.248
Speech	69.41 (34.72)	84.63 (23.35)	0.096	67.50 (34.93)	81.00 (25.51)	0.191	71.00 (33.48)	88.75 (15.00)	0.154
Shoulder	77.64 (32.50)	85.61 (28.11)	0.313	76.25 (33.04)	85.00 (28.50)	0.325	76.00 (33.07)	91.25 (23.91)	0.131
Taste	49.38 (37.50)	73.17 (35.73)	0.028	50.67 (38.45)	66.67 (37.81)	0.181	51.11 (35.16)	68.75 (34.23)	0.223
Saliva	54.70 (44.45)	71.53 (35.50)	0.166	51.88 (44.30)	65.33 (36.46)	0.303	43.00 (44.98)	58.13 (40.20)	0.366
Mood	64.70 (35.42)	76.82 (25.24)	0.273	62.50 (35.36)	73.33 (26.21)	0.367	65.00 (33.75)	75.00 (24.15)	0.509
Anxiety	61.33 (40.50)	76.34 (30.96)	0.234	58.57 (40.55)	69.67 (33.16)	0.410	66.25 (40.69)	66.25 (31.38)	0.896
Health-related QOL compared to month before having cancer	23.43 (34.72)	27.56 (22.06)	0.211	23.33 (35.94)	25.83 (21.26)	0.257	22.22 (34.11)	29.69 (20.85)	0.199
Health-related QOL during the past 7 days	38.75 (29.63)	57.07 (28.12)	0.057	37.33 (30.11)	55.33 (28.13)	0.068	42.22 (32.32)	58.75 (27.78)	0.193
Overall QOL during the past 7 days	53.76 (28.01)	61.50 (25.37)	0.364	53.33 (28.95)	60.67 (26.51)	0.401	51.11 (26.67)	66.25 (27.05)	0.183
Physical average function	57.00 (26.43)	73.57 (21.87)	0.031	55.31 (26.32)	68.92 (21.84)	0.106	54.08 (25.89)	70.89 (21.29)	0.126
Social average function	63.88 (25.11)	80.65 (18.79)	0.015	62.15 (24.86)	78.56 (19.61)	0.023	62.77 (23.68)	81.20 (15.73)	0.035

QOL quality of life, *Sd* standard deviation

(Table 2). Generally, health-related QOL compared to 1 month before cancer diagnosis received the lowest score in both groups (short-term follow-up group = 23.43, long-term follow-up group = 27.56). The physical and social average scores were both significantly higher for the long-term follow-up group compared to the short-term follow-up group ($p = 0.031$ and $p = 0.015$, respectively; Table 2). The average social–emotional function was also significantly higher for the long-term follow-up group when the patients with malignant disease ($p = 0.023$; Table 2) or patients receiving post-operative radiation ($p = 0.035$; Table 2) were analyzed separately.

Analysis of the importance domains ("Methodology") revealed chewing and taste to be the two most important domains for the short-term follow-up group (23.5% and 35.3%, respectively) (Table 3). Taste was also the most important domain for the long-term follow-up group (22.0%). Activity was the second most important domain for the short-term follow-up group (17.6%), but not an important domain to the patients in the long-term follow-up group. Surprisingly, pain persisted as an important domain in the long-term follow-up group (17.1%).

Table 3 University of Washington quality of life important domains scores by length of follow-up

	≤ 5 years	> 5 years	*p* value
Pain	4 (23.5%)	7 (17.1%)	0.715
Appearance	3 (17.6%)	7 (17.1%)	> 0.999
Activity	3 (17.6%)	0 (0.0%)	0.022
Recreation	2 (11.8%)	1 (2.4%)	0.203
Swallowing	2 (11.8%)	1 (2.4%)	0.203
Chewing	4 (23.5%)	5 (12.2%)	0.426
Speech	1 (5.9%)	0 (0.0%)	0.293
Shoulder	2 (11.8%)	0 (0.0%)	0.082
Taste	6 (35.3%)	9 (22.0%)	0.334
Saliva	1 (5.9%)	3 (7.3%)	> 0.999
Mood	2 (11.8%)	2 (4.9%)	0.573
Anxiety	2 (11.8%)	1 (2.4%)	0.203

In the significance segment of the UW-QOL questionnaire, pain and activity were the only two domains that were significant for the short-term follow-up group compared to the long-term follow-up group (pain: 35.3% and

Table 4 University of Washington quality of life significant domains scores by length of follow-up

	≤ 5 years	>5 years	*p* value
Pain	6 (35.3%)	4 (9.8%)	0.028
Appearance	4 (23.5%)	9 (22.0%)	>0.999
Activity	6 (35.3%)	2 (4.9%)	0.006
Recreation	4 (23.5%)	2 (4.9%)	0.055
Swallowing	6 (35.3%)	6 (14.6%)	0.151
Chewing	5 (29.4%)	6 (14.6%)	0.270
Speech	4 (23.5%)	3 (7.3%)	0.178
Shoulder	1 (5.9%)	0 (0.0%)	0.293
Taste	6 (35.3%)	6 (4.6%)	0.151
Saliva	5 (29.4%)	4 (9.8%)	0.106
Mood	5 (29.4%)	4 (9.8%)	0.106
Anxiety	7 (41.2%)	10 (24.4%)	0.221

Table 5 University of Washington quality of life perfect scores by length of follow-up

	≤ 5 years	>5 years	*p* value
Pain	8 (47.1%)	18 (43.9%)	>0.999
Appearance	1 (6.3%)	13 (31.7%)	0.083
Activity	3 (17.6%)	23 (56.1%)	0.009
Recreation	3 (17.6%)	22 (53.7%)	0.019
Swallowing	10 (58.8%)	26 (63.4%)	0.773
Chewing	5 (29.4%)	18 (43.9%)	0.384
Speech	7 (41.2%)	25 (61.0%)	0.247
Shoulder	11 (64.7%)	32 (78.0%)	0.334
Taste	4 (25.0%)	23 (56.1%)	0.043
Saliva	7 (41.2%)	21 (53.8%)	0.562
Mood	6 (35.3%)	17 (41.5%)	0.772
Anxiety	7 (46.7%)	23 (56.1%)	0.560

9.8%, respectively, $p=0.028$; activity: 35.3% and 4.9%, respectively, $p=0.006$) (Table 4).

The fields of activity, recreation, and taste received the highest scores of 56.1%, 53.7%, and 56.1% for the patients in the long-term follow-up group (Table 5) compared to scores of 17.6%, 17.6%and 25.0% for the short-term follow-up group (Table 5). These differences were statistically significant (activity: $p=0.009$, recreation: $p=0.019$, and taste: $p=0.043$).

Discussion

Ample data exists on the short-term QOL of patients who undergo resection and reconstruction of the mandible, but almost none on their long-term QOL. In a literature review on QOL among long-term survivors of cancers in various sites (including H&N), the authors defined "long-term" as more than 5 years [16]. That definition is generally accepted although not consensual, and long-term follow-up in most publications ranges from 5 to 10 years [20].

In one of the few papers that focused on long-term QOL in the H&N population, Mehanna et al. [21] found that overall QOL at 10 years post-treatment decreased significantly compared to years 1 and 2, and hypothesized that those results were mostly due to psychological and social effects, such as the loss of post-treatment euphoria and the loss of interest on the part of the family and the medical staff after the end of follow-up (usually 5 years post-treatment). These results were not reflected among the patients in the current study who had more than 10 years of follow-up compared to patients with fewer than 10 years of follow-up. Our subgroup analysis of overall QOL and specific domains, such as activity and recreation, demonstrated improvement in scores rather than decline. We hypothesize that these results may be due to a selection bias, since most of the patients who completed the questionnaire were in active follow-up.

The domains of activity and recreation were significantly better in the long-term follow-up group compared to the short-term follow-up group. Notably, there is some overlap between these two domains in the HR-QOL. For example, there is reference to outdoors activity in both domains. When analyzing the score distribution among the patients (see Online Appendix), we found a significant shift in the variability, common response and the mean scores between groups (short vs. long-term follow-up). The responses of the short-term follow-up group were scattered across all possible choices, whereas they were mostly in the three better possibilities for all three domains in the long-term follow-up group. The other significant group differences were the higher percentages of 'best score' (patients scoring a perfect 100) in the long-term follow-up group and the shift towards a better mean score compared to the short-term follow-up group. Taste was the third domain with better scores in the long-term follow-up group. Although these results are not derived from comparisons of responses in questionnaires filled in by the same patient, they raise the issue of ongoing changes in QOL. As previously mentioned, the QOL scores tend to plateau after 1 year. Significantly higher QOL scores in the long-term follow-up group might indicate that improvement in QOL does not cease after the first few years. Indeed, there was a trend for the scores of the entire questionnaire towards higher average scores in the long-term follow-up group compared to those of the short-term follow-up group. Despite the same limitation of not repeating the questionnaire among the same patients, an analysis of the linear change over the years showed an obvious trend in improved scores as a function of time (see Fig. 1).

A proposed algorithm calculated from the UW-QOL domains defines a 'significant problem' with regard to the

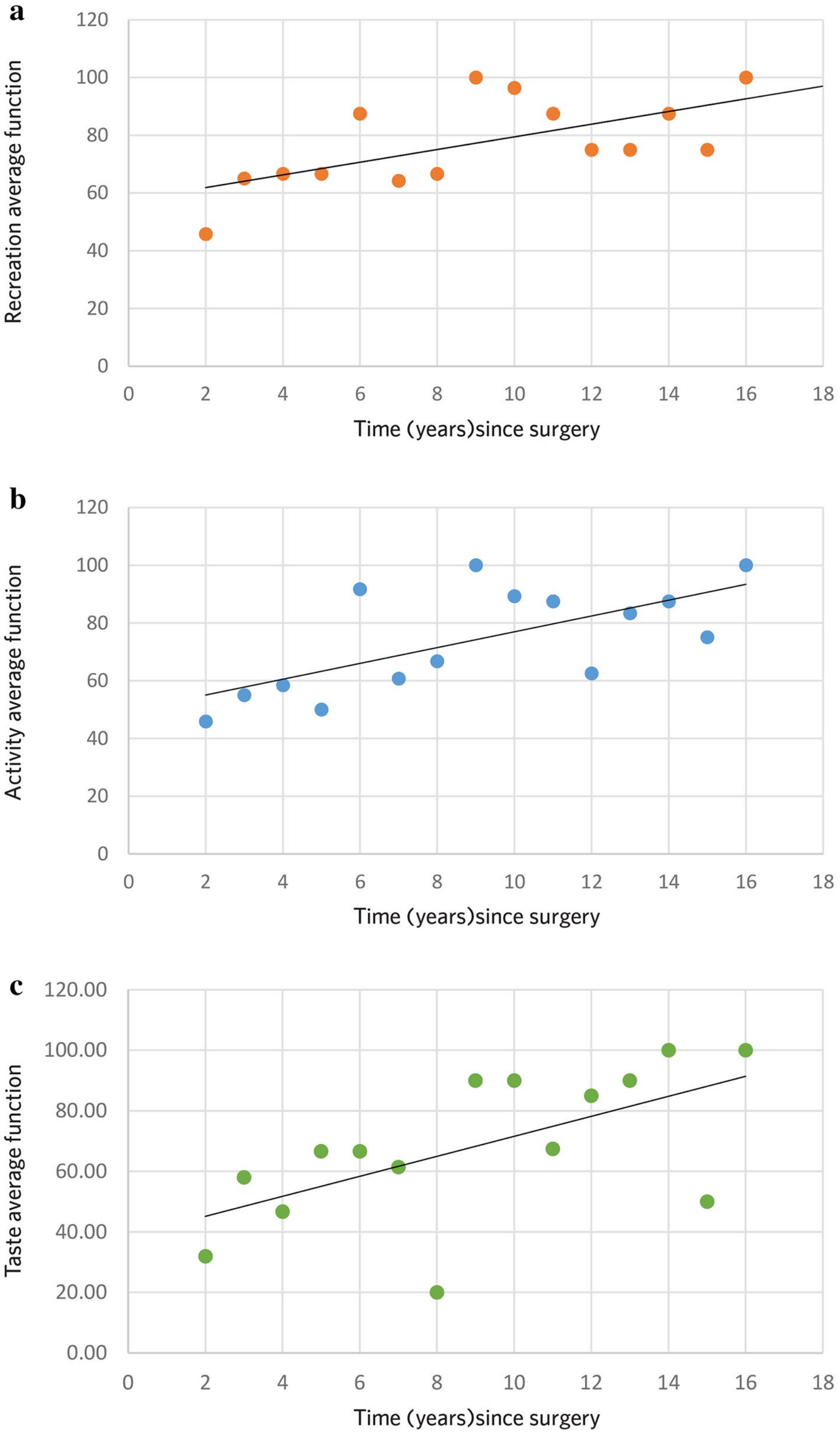

Fig. 1 **a** Recreation average score as a function of time since surgery. **b** Activity average score as a function of time since surgery. **c** Taste average score as a function of time since surgery

various domains [22]. The two domains that were found to represent more significant problems in the short-term follow-up group compared to the long-term follow-up group were activity (criterion definition scores of 0 or 25 or 50 and important) and pain (criterion definition scores of 0 or 25 or 50 and important). A similar difference was also seen in the recreation domain, however, not to a level of significance (23.5% vs 4.9%, respectively, $p = 0.055$).

These differences similarly attest to some form of ongoing changes. It is our impression that patients attribute less importance to these domains over time, although not tested as a continuum. We also consider that the shift may imply that the patients may be better adjusted to their post-treatment situation with time.

The group differences in the physical function subscale score and the social–emotional scores reached levels of significance in our study. These scores are a simple average and were obviously altered by the change in the taste domain for the physical function subscale and the activity and recreation domains for the social–emotional function subscale (see Online Appendix). The better average scores in the long-term follow-up group raise the possibility of there being a continuing effect of healing that is not limited to the first years following treatment. Rogers et al. showed similar ongoing effects on QOL scores among patients treated by primary resection for oral and oropharyngeal squamous cell carcinoma [23]. Another paper that demonstrated improvement in QOL scores over a 6-year period hypothesized that this effect was due to continuous healing and adaptation [24].

We are aware of several weaknesses in this study. One is the relatively small size of the groups that precludes assessment of the influence of some variables, such as sex, age, and pathology, on the patients' QOL. Another limitation is the retrospective nature of this study. In addition, the questionnaires were not repeated by the same patients over time. The fact that these questionnaires do not represent the prospective progression of an individual's QOL but rather that of a group, precludes the arrival at firm conclusions with regard to 'improvement' over time. With that being said, this is one of a handful of papers studying long-term QOL scores and the only one focusing on patients undergoing resection and reconstruction of the mandible.

In conclusion, this study reports the long-term QOL results of patients undergoing mandibular resection and reconstruction. To the best of our knowledge, this is the first report of long-term QOL findings specifically on this group of patients. We conclude that long-term QOL scores are better than short-term ones in several domains of the UW-QOL questionnaire. We suggest that there might be a positive ongoing effect on those patients' QOL, even many years post-treatment.

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Compliance with ethical standards

Conflict of interest None declared.

Ethical approval The study was approved by the institutional ethics committee board.

Informed consent Informed consent was obtained from all individual participants included in the study.

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