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Quality of life after mandibulectomy: the impact of the resected subsite

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Abstract. The purpose of this study was to identify the factors that impact the quality of life (QOL) scores of patients undergoing mandibulectomy.

All patients with a diagnosis of an oral cavity neoplasm involving the mandible who underwent a mandibulectomy between January 1, 2000 and December 31, 2015 and completed a University of Washington QOL questionnaire (UW-QOL) were included in the study.

Fifty-eight patients fulfilled all inclusion criteria and completed the UW-QOL questionnaire. Forty patients (69%) underwent a segmental mandibulectomy and 18 patients underwent a marginal mandibulectomy. Forty-eight patients (82.7%) had a free flap reconstruction. There was no significant difference in the QOL scores between patients who underwent a marginal or a segmental mandibulectomy. In contrast, patients who underwent symphysial resection reported significantly worse scores in various domains compared to patients with body or ramus segmental mandibulectomy.

Patients who underwent a segmental mandibulectomy that included the symphysis had worse outcomes in chewing, recreation, health-related and social QOL domains compared to those whose mandibulectomy did not include the symphysis.

Key words: quality of life; mandibulectomy; segmental; symphysis.

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Quality of life (QOL) is a multi-dimensional construct of an individual's subjective assessment of the impact of an illness or treatment on physical, psychological, social, and general well-being[1]. QOL evaluation has been enriched by more precise and validated measurement instruments consisting of self-reported questionnaires designed to evaluate the impact of a pathology and its treatment on the patient's QOL[2]. The University of Washington QOL (UW-QOL) questionnaire is a well-established tool for assessing head and neck (H&N) cancer patients' QOL[3]. Recent studies that used the UW-QOL have demonstrated that QOL scores are influenced by various factors, such as comorbidities, tumor staging, treatment modalities, and postoperative complications[4]. Some of these factors were tested in a recent study of H&N patients undergoing segmental mandibulectomy (SM) with osseous free flap

reconstruction, and the patient's QOL scores were unexpectedly high after such a difficult surgical procedure[2].

Despite having similarly complex procedures and postoperative courses, two different patients will often have quite divergent QOL scores. In order to better understand these discrepancies, we differentiated between the types of mandibulectomies that have a detrimental effect on QOL and searched for other operative variables that affect the patient's QOL. The specific aim of this study was to identify the factors that impact the QOL scores of patients undergoing mandibulectomies with different resection types, resection locations, and reconstruction types.

Methodology

The protocol of this study was approved by the Tel-Aviv Sourasky Medical Center's Committee on Human Research (TLV- 0254-16). All of the patients gave their consent to participate and were interviewed by an intern in the H&N department. The medical records of all individuals who had undergone mandibular resection with or without reconstruction were reviewed. This study included patients with a diagnosis of an oral cavity neoplasm involving the mandible that required a mandibulectomy between January 1, 2000 and December 31, 2015. Patients operated on for recurrent disease, second primary disease, or for other reasons (e.g., trauma cases), as well as those whose medical records lacked relevant data or who did not complete the questionnaire were excluded. The medical charts were reviewed retrospectively for patient demographics, clinical data, surgical interventions, operative time, length of stay in the intensive care unit, and length of hospitalization. Additionally, immediate complications (those occurring during the hospital stay) and delayed complications were recorded.

The questionnaire

Each patient's QOL was measured at least 1 year after surgery (range, 12–189 months, median 83.5 months). QOL assessment was performed using the UW-QOL version 4 questionnaire. The UW-QOL is a self-administered scale that provides a broad measure of QOL for patients with H&N cancer with good acceptability, practicality, validity, reliability and responsiveness[5]. This questionnaire has a validated Hebrew version[6]. It consists of 12 disease-specific domains (pain, appearance, activity, recreation, swallowing, chewing, speech, shoulder, taste, saliva, mood and anxiety), and three global QOL questions. Each of the 12 questions has between three and five possible options that allow patients to describe their functional state in the week prior to exam administration. Scoring is scaled from 0 (worst result) to 100 (best result). Patients were also asked to choose up to three of the 12 disease-specific domains that were most important to them in the preceding 7 days. Further analysis of the questionnaires allowed the identification of the significance of a specific domain as determined by an algorithm that combined the answers for the individual domains and the three important domains[7]. Domains that received low scores in the specific domain section and were mentioned as an important domain were categorized as 'significant' domains. We also calculated two subscale scores: Physical–Functional, which is the average of six domain scores (chewing, swallowing, speech, taste, saliva and appearance) and Social–Emotional Function, which is the average of the remaining six domain scores (anxiety, mood, pain, activity, recreation and shoulder function).

The primary comparison was between questionnaire responses of patients who had undergone a marginal mandibulectomy (MM) and those who underwent an SM. A subgroup analysis was performed to compare an SM of the symphysis to an SM that did not involve any symphysial parts.

Statistical analysis

A multivariate analysis was performed to determine the significant variables affecting QOL.

Categorical variables were reported as frequency and percentage. Continuous variables were evaluated for normal distribution using a histogram and a Q–Q plot and reported as either mean and standard deviation (SD) or median and interquartile range. Categorical variables were compared using the Chi-squared or Fisher's exact test, and continuous variables were compared using the independent samples t-test or Mann–Whitney test. Linear regression was used for multivariate analysis. All linear regressions were repeated using bootstrapping of 1000 samples to validate the results. A two-tailed value of $p < 0.05$ was considered statistically significant. The analyses were performed with IBM SPSS Statistics for Windows, version 22.0 (IBM Corp., Armonk, NY, USA).

Results

One-hundred and eighty-two patients who had undergone a mandibulectomy during the study period were identified, of whom 103 patients were alive and eligible for study entry. Fifty-eight patients agreed to participate in the QOL assessment, and they included 32 men (55.2%) and 26 women (44.8%) with a mean age $\pm$ SD of 56 $\pm$ 16 years. Their clinical characteristics are given in Table 1. Forty patients (69%) underwent an SM and 18 patients (31%) underwent an MM. Of the 40 patients that had undergone an SM, seven patients (17.5%) had a resection that included the symphysis of the mandible, and the mean length of the osseous resection was 5.66 $\pm$ 2.06 cm. Forty-eight patients (82.7%) had a free flap reconstruction and 33 of them (68.5%) had an osseous reconstruction (32 fibula free flap and one scapula free flap).

The scores for the 12 disease-specific domains, the global domains, and the important and significant domains are listed in Table 2. Most of the patients had high scores on 12 specific domains of the UW-QOL questionnaires, indicating low rates of dysfunction. In contrast, the scores on the global assessment were significantly lower. Comparison of the assessments of the global and specific QOL between the patients who underwent an MM and those who underwent an SM revealed no statistical difference in their scores (Table 3).

The next step in our analysis was to compare the QOL scores of patients who underwent an SM with lateral segment resection and those whose SM included symphysial resection. The patients who underwent symphysial resection reported significantly worse scores in the domains of recreation, chewing and taste. They also reported lower scores on global assessments of health-related QOL as well as an overall more negative change when comparing their current QOL to the preoperative QOL. This difference remained significant after excluding patients who had either permanent tracheostomy or were using a gastric tube for feeding, and further revealed significant differences in the activity, physical and social functioning domains (Table 4).

The global and specific domains which were found to be significantly lower among patients with symphysial segment resection were re-evaluated by means of multivariate analysis. The second analysis included location of resection, stage of disease, age, sex, and adjuvant therapy. All linear regressions were repeated using bootstrapping of 1000 samples to validate the results (Table 5). The difference in chewing, recreation, health-related QOL,

Table 1. Patient demographic and clinical data.

	Age (mean)	56.24 (SD 16.02)
Gender	Male	32 (55.2%)
	Female	26 (44.8%)
Pathology	Oral cavity SCC	41 (70.7%)
	Sarcoma	2 (3.4%)
	Ameloblastoma	10 (17.2%)
	Other	5 (8.6%)
T	T1	3 (5.2%)
	T2	14 (24.1%)
	T3	10 (17.2%)
	T4	31 (50%)
N	N0	45 (77.5%)
	N1	4 (6.9%)
	N2	8 (13.7%)
	N3	1 (1.7%)
Stage	Stage1	3 (5.2%)
	Stage 2	10 (17.2%)
	Stage 3	11 (19.0%)
	Stage 4	34 (58.6%)
Resection type	Marginal	18 (31.0%)
	Segmental	40 (69.0%)
Resection segment length		5.66 cm (SD 2.08)
Resection location	Lateral	50 (86.2%)
	Symphisis	8 (13.8%)
Reconstruction type	Soft tissue	25 (43.1%)
	Osseous	33 (56.9%)
Adjuvant therapy	Radiotherapy	26 (44.8%)
	Chemotherapy	13 (22.4%)
Gastric tube		3 (5.1%)
Permanent tracheostomy		2 (3.4%)

SCC, squamous cell carcinoma; SD, standard deviation.

and social functioning remained significant after the multivariate analysis.

Discussion

Quality of life is described as the 'gap between one's actual functional level and one's ideal standard'[8] but it is important to keep in mind that a patient's assessment of their QOL is dynamic and often changing over time[9]. This subjective assessment is highly influenced by bio-psychosocial factors and is, therefore, problematic to compare between individuals. However, using QOL scores for analysis may reveal important data on variables that influence them, such as the oncological staging, type of surgery, postoperative complications, and need for rehabilitation.

Terrell et al.[10] studied factors affecting the H&N cancer patient's QOL and found as many as 13 factors with significant decrements in QOL domains. In descending order of severity, the presence of a feeding tube, comorbid medical conditions, permanent tracheotomy, chemotherapy and neck dissection were found to correlate with significantly lower reported measures of QOL. We therefore excluded patients with permanent tracheotomies and gastrostomy tubes from our current analysis in order to overcome the inherent biases introduced by those factors. We also excluded all patients who were operated on less than 1 year before questionnaire completion. We did not exclude patients with benign pathologies or those not undergoing neck dissection since our analysis was focused on the type and part of the mandible resected rather than the extent of surgery.

Rogers et al.[11] reported worse scores in the SM group compared to the MM group in the domains of appearance, swallowing, recreation, and chewing. However, the difference between rim and segment was only seen in smaller resections without adjuvant radiotherapy[11]. Similarly, our results showed no significant difference in QOL between patients who underwent MM and those who underwent SM. However, a subgroup analysis produced significantly lower scores in the symphysial resection group compared to the non-symphysis resection group in the domains of recreation, chewing and taste, social functioning, and health. This key difference may explain the major

Table 2. University of Washington quality of life (QOL) scores of the entire cohort.

	Mean (SD)	Important (%)	Significant (%)	Best score 100 (%)
Pain	77.59 (26.36)	19	17.2	44.8
Appearance	66.23(26.5)	17.2	22.4	24.6
Activity	72.8 (30.1)	5.2	13.8	44.8
Recreation	75.86 (27.3)	5.2	10.3	43.1
Swallowing	74.14(39.78)	5.2	20.7	62.1
Chewing	60.34 (37.18)	15.5	19	39.7
Speech	80.17 (27.75)	1.7	12.1	55.2
Shoulder	83.28 (29.4)	3.4	1.7	74.1
Taste	66.49 (37.49)	25.9	20.7	47.4
Saliva	66.43 (38.83)	6.9	15.5	50
Mood	73.27 (28.81)	6.9	15.5	39.7
Anxiety	72.32 (34.06)	5.3	29.3	53.6
Health-related QOL compared to month before cancer diagnosis	26.09 (26.09)			
Health-related QOL during the past 7 days	51.93 (29.48)			
Overall QOL during the past 7 days	59.28 (26.14)			
Physical average function	68.71 (24.28)			
Social average function	75.73 (22.00)			

Table 3. University of Washington quality of life (QOL) scores by resection type of mandible.

	Marginal		Segmental		*p*
	Mean	SD	Mean	SD	
Pain	75	24.25	78.75	27.47	0.377
Appearance	66.67	24.25	66.03	27.8	0.823
Activity	72.22	28.3	73.13	31.21	0.789
Recreation	70.83	32.37	78.13	24.8	0.532
Swallowing	68.89	44.97	76.5	37.59	0.726
Chewing	58.33	35.36	61.25	38.38	0.724
Speech	80.56	28.17	80	27.92	0.947
Shoulder	76.67	33.96	86.25	27.05	0.321
Taste	53.33	37.42	72.56	36.4	0.056
Saliva	52.35	41.61	72.56	36.4	0.084
Mood	75	25.72	72.5	30.38	0.922
Anxiety	68.24	35.4	74.1	33.77	0.531
Health-related QOL compared to month before cancer diagnosis	25	27.12	27.03	25.94	0.698
Health-related QOL during the past 7 days	50	30.87	52.82	29.2	0.635
Overall QOL during the past 7 days	60	26.57	58.95	26.28	>0.999
Physical average function	63.41	25.1	71.11	23.84	0.256
Social average function	72.78	21.57	77.07	22.34	0.464

SD, standard deviation.

Table 4. University of Washington quality of life (QOL) scores after segmental mandibulectomy by resection location.

	Lateral segment (*n* = 33)		Symphysial segment (*n* = 7)		*p*
	Mean	SD	Mean	SD	
Pain	81.06	25.79	67.86	34.5	0.363
Appearance	66.41	25.09	64.29	40.46	0.849
Activity	77.27	29.56	53.57	33.63	0.057
Recreation	82.58	23.79	57.14	18.9	0.004
Swallowing	79.39	35.96	62.86	44.99	0.239
Chewing	68.18	37.12	28.57	26.73	0.011
Speech	81.82	27.32	71.43	31.32	0.36
Shoulder	89.7	23.65	70	37.42	0.123
Taste	79.38	31.82	41.43	42.2	0.028
Saliva	73.64	35.78	66.67	42.74	0.681
Mood	75.76	27.59	57.14	40.09	0.253
Anxiety	78.13	30.84	55.71	42.76	0.192
Health-related QOL compared to month before cancer diagnosis	30.47	25.98	5	11.18	0.031
Health-related QOL during the past 7 days	59.38	26.14	22.86	24.3	0.004
Overall QOL during the past 7 days	61.88	25.07	43.33	29.44	0.166
Physical average function	74.29	22.28	56.1	27.01	0.117
Social average function	80.64	19.19	60.24	29.65	0.054

SD, standard deviation.

discrepancies encountered in the long-term follow-up of patients undergoing resection and reconstruction of the mandible. It is apparently not the fact that the patient had undergone a mandibulectomy, but rather which segment was resected. Notably, Rogers et al. did hypothesize that resections involving the symphysis will have greater impact on QOL compared to other segments of the mandible, but no supportive evidence was provided[11].

In general, any mandibular reconstruction will have a complex impact on the forces acting on the neo-mandible during chewing[12]. There are a number of theories that may explain the deleterious effect on QOL when resecting and reconstructing the symphysis as opposed to the body and ramus of the mandible. The closure alignment is rarely perfect in symphysial reconstruction and that will often affect the relationship between the upper and lower bites even with the use of the most modern three-dimensional technologies for preoperative planning. It has been shown that the tooth-to-tooth occlusion (stops) has a linear effect on the ability to chew and to triturate or grind a bolus of food. Tooth-to-tooth occlusion has also been strongly correlated with masticatory performance[13]. Moreover, adhesions of the anterior tongue and floor of mouth could account for greater difficulty in chewing by impairing tongue movement and bolus formation and also affect the ability to clean the teeth. Adhesions of the tongue and the floor of mouth are often encountered since symphysial resection often entails resection of the anterior floor of mouth and some form of glossectomy[14].

Previous publications have demonstrated that oral function, as measured by masticatory performance and bite force, is negatively affected after resection of the floor of mouth and tongue[15]. Surgical alterations often result in uncoordinated mandibular movements due to loss of mandibular continuity, loss of masticatory muscles, and changes in tongue status[16,17].

Table 5. Multivariate analysis: bootstrap[a] of statistically significant domains.

	Social average function	Physical average function	Taste	Chewing	Recreation	Activity	Health-related QOL compared to month before cancer diagnosis	Health-related QOL during the past 7 days	Overall QOL during the past 7 days
Lateral segment vs symphysial segment	0.037[b]	0.064[b]	0.066[b]	0.007	0.008[b]	0.066	0.085[b]	0.006	0.247[b]
Stage (1–3) vs Stage 4	0.045[b]	0.036[b]	0.435[b]	0.059	0.304[b]	0.546	0.200[b]	0.264	0.403[b]
Age	0.052[b]	0.800[b]	0.513[b]	0.715	0.574[b]	0.461	0.234[b]	0.439	0.897[b]
Sex	0.438[b]	0.950[b]	0.339[b]	0.934	0.938[b]	0.677	0.574[b]	0.782	0.696[b]
Adjuvant radiotherapy	0.580[b]	0.320[b]	0.251[b]	0.527	0.657[b]	0.444	0.223[b]	0.208	0.161[b]
Adjuvant chemotherapy	0.394[b]	0.430[b]	0.613[b]	0.456	0.703[b]	0.93	0.918[b]	0.646	0.833[b]

QOL, quality of life; SD, standard deviation.
[a]Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples.
[b]Based on 997 samples.

This is true for any kind of mandibulectomy, but it may prove worse in cases of symphysial resection. Furthermore, lower QOL scores in the chewing domain could be due to the increased complexity of reconstruction during a symphysial resection that will usually require the use of at least two to three segments. Studies on the patterns of stress and deformation at the mandibular symphysis have shown that jaw deformation during mastication occurs in three separate axes (medial convergence, corporal rotation, and dorsoventral shear)[18]. Multiple segments are prone to torque deformities and may provide lower chewing force and, therefore, explain the worse QOL results in the symphysial resection group.

Notably, the recreation domain received significantly lower scores in the SM group and thus deserves specific attention. Because this domain focuses mainly on 'going out' and 'enjoying life' (see UW-QOL v4 questionnaire), it may be subjectively impacted by the patient's ability to chew in an acceptable manner in public. Specifically, patients may be apprehensive of chewing in public due to drooling, bite issues, and lack of oral control. As a result, they may tend to withdraw from social situations that include dining.

Health-related QOL was also significantly impacted in this study after multivariate analysis. A review of the literature did not yield any results to corroborate that finding, although a recent study found that male patients undergoing resections involving the parasymphysis and symphysis had lower health-related QOL scores on multivariate analysis[19].

The limitations of this study include relatively small study groups, our inability to account for all the variables in the multivariate analysis, not performing repeated questionnaires, and the retrospective nature of this study.

In conclusion, comparison of UW-QOL questionnaire scores of patients who underwent MMs and various types of SMs revealed that patients who had undergone an SM that included the symphysis have worse outcomes in the domains of chewing, recreation, health-related issues and social functioning.

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Competing interests

No competing interests.

Ethical approval

Ethical approval was provided by the Tel-Aviv Sourasky Medical Center's Committee on Human Research (TLV-0254-16).

Patient consent

Patient consent was obtained from all participants.

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