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ORIGINAL RESEARCH

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A prospective study of patient-reported xerostomia-related outcomes after parotidectomy

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Abstract

Objective: There is a paucity of data on patient-reported outcome measures regarding xerostomia after parotidectomy surgery. Although salivary flow rates after parotidectomy have been previously studied, they do not correlate with subjective xerostomia. This study was designed to evaluate if unilateral parotidectomy increases patient-reported xerostomia.

Methods: A prospective cohort of patients undergoing unilateral partial, superficial, or total parotidectomy for benign or low-grade malignant pathology without postoperative radiation at a tertiary care academic center was studied. We analyzed patient-reported outcome measures of xerostomia using the Xerostomia Questionnaire (XQ) preoperatively and postoperatively. We compared pre- and postoperative cumulative and individual XQ scores using Wilcoxon signed-rank tests. We stratified patients by the weight in grams (g) of the parotid tissue excised, pathology, smoking status, and xerostomia-related medication use.

Results: Twenty-two adults with benign or low grade malignant unilateral parotid tumors were included. Postoperative questionnaires were completed at a median of 10.2 months (interquartile range [IQR] 8.6-11.9) after unilateral parotidectomy. Mean preoperative and postoperative cumulative XQ scores, on a 100-point scale, with higher scores representing worse symptoms, were 10.33 (95% CI: 4.46-16.20) and 10.54 (95% CI: 5.10-15.98), respectively, with a mean change of +0.21 ($p = 0.472$). There were no statistically significant changes in individual XQ symptom scores. Neither type of parotidectomy, resection specimens weighing over 10 g, smoking habits, xerostomia-related medication use, nor malignant pathology were associated with worse symptom scores.

Conclusion: Based on these data, unilateral parotidectomy does not appear to definitely, or at least consistently, increase xerostomia per patient reporting. More extensive parotid resections are not associated with worse symptom scores. These data

can help guide preoperative counseling and postoperative expectations for parotidectomy.

Level of Evidence: 2b.

KEYWORDS
parotidectomy, patient reported outcome measures, xerostomia

1 | INTRODUCTION

There is a paucity of data regarding patient-reported outcome measures (PROM) of xerostomia following parotidectomy. Xerostomia is known to have significant impact not only on oral health and caries development, but also quality of life (QOL) related to comfort, speaking, swallowing, denture wearing, sleeping, and social interaction. The parotid glands together account for approximately 26% of unstimulated saliva production. When stimulated, the parotid glands together produce about 50% of total saliva.[1] Previous studies have investigated salivary flow rates after parotidectomy, finding both a decrease in salivary production as well as a compensatory increase in production from the contralateral side.[2,3] However, it is unclear if these changes in salivary secretion result in clinically significant impact on patient's perception of QOL related to xerostomia.

Objective salivary flow rates do not correlate well with subjective xerostomia symptoms.[1,4-7] Beyond evidence of objective changes in salivary flow, there are limited studies evaluating the specific functional or QOL implications of xerostomia following parotidectomy. Previous studies have analyzed results of the *Parotidectomy Outcomes Index*, a survey evaluating several different sequelae and complications of parotidectomy that includes a global xerostomia score.[8-10] These studies found no significant change in postoperative symptom score when patients were asked to grade the "dryness of mouth as impact of the operation" on a 1 to 7 point scale; however, none of these studies performed preoperative evaluation to determine the patients' baselines. Additionally, this specific survey did not evaluate the impact of parotidectomy on specific xerostomia-related symptoms regarding functional impact.

Given these gaps in the medical literature on parotidectomy, this study investigates whether there is a correlation between parotidectomy and postoperative xerostomia, in relation to preoperative scores, using the University of Michigan Xerostomia Questionnaire (XQ) survey to better evaluate the impact of parotidectomy on QOL symptoms.

2 | MATERIALS AND METHODS

We conducted a prospective, non-randomized study evaluating the PROM of xerostomia using the XQ preoperatively and postoperatively, at least 6 months after parotidectomy surgery, at a tertiary academic cancer center over a 15-month period. This study was approved by the UCSF Institutional Review Board. All patients provided consent at the beginning of the study.

Inclusion criteria for the study included patients greater than 18 years of age undergoing a partial, superficial, or total parotidectomy for either benign or malignant pathology. Exclusion criteria included patients who underwent postoperative radiation and those with a history of autoimmune disease, sialadenitis, or sialolithiasis. We classified the parotid tumor resections as partial superficial parotidectomy or superficial parotidectomy based on the extent of facial nerve dissection. We defined a partial parotidectomy as an operation that involved a dissection of the main trunk of the facial nerve and two or fewer distal branch regions (temporal, zygomatic, buccal, and/or marginal mandibular) or no dissection of the facial nerve. We defined a superficial parotidectomy as an operation that involved dissection of three or four of the distal branch regions. We assessed possible confounding factors such as age, gender, tobacco use, use of medications known to cause xerostomia, comorbidities, type of parotidectomy, the mass of parotid tissue, benign vs malignant tumors, and length of follow up time. Patients were given the complete XQ plus an additional question regarding overall mouth dryness in the preceding week on a scale of 0-10, referred to as the global dry mouth score, both preoperatively and postoperatively.

The XQ is a self-administered survey with eight questions that provide detailed insight on how xerostomia influences QOL. The XQ evaluates severity of mouth dryness when eating, mouth dryness at rest, need for fluid intake to facilitate swallowing, oral discomfort, and difficulty with the following due to xerostomia: speaking, chewing, swallowing, and sleeping. The XQ was originally developed to assess xerostomia because of head and neck cancer radiation treatment and was found to have high internal consistency, test-retest reliability, and sensitivity for changes in dryness.[11,12] The survey has been validated against other subjective xerostomia measures with high validity and reliability in several languages.[13-17]

Cumulative XQ scores were tallied on the 11-point Likert scale, then linearly normalized to a scale of 0 to 100. Individual XQ question scores and global dry mouth scores were reported on a scale of 0-10. Higher scores reflected increased and worse xerostomia symptoms. A cumulative XQ score increase of at least 10 points (which correlates with a score of 11.36 after linear transformation) was determined to represent clinical significance. To adjust for preoperative xerostomia symptoms, a subgroup analysis of patients with low preoperative global dry mouth scores (0-1 out of 10) was performed.

To better understand the effects of potential confounding variables, patients were then stratified into one of two subgroups based

on these factors. These variables included the mass of parotid tissue excised using a 10-g cutoff, benign vs malignant lesions, smoking history, and presence of preoperative medications with the potential to cause xerostomia. When possible, a threshold was created for each of these variables that permitted approximately equal numbers of patients into each subgroup.

Continuous variables were reported in median (interquartile range [IQR]). Categorical variables were reported in frequency (%). All XQ scores were reported in mean (95% confidence interval [CI]). We compared pre- and postoperative cumulative and individual-question scores using Wilcoxon signed-rank tests for paired, nonparametric data. Significance was determined using one-tailed probability values to detect an increase in postoperative scores. To detect any differences in XQ scores after stratifying by potential confounders, we used Mann-Whitney U-tests for non-paired, nonparametric data and two-tailed probability values. All statistical analyses were performed using RStudio software, R v4.0.2 (The R Foundation for Statistical Computing, Vienna, Austria).

3 | RESULTS

A total of 22 patients who underwent unilateral parotidectomy completed the preoperative and postoperative surveys. Table 1 shows the demographics of the patient sample. Most patients were women, over 50 years old, never smokers, who underwent superficial parotidectomy for benign tumors, most commonly pleomorphic adenoma. The median time to follow-up survey completion was 10.2 months (IQR: 8.6-11.9). Three patients in the sample were taking medications with moderate risk of xerostomia, including: selective serotonin reuptake inhibitors (SSRI), serotonin-norepinephrine reuptake inhibitors (SNRI), and muscarinic antagonists for overactive bladder.[18]

Table 2 shows the XQ and global dry mouth scores for the entire sample with probability values determined by Wilcoxon signed-rank tests. On a linearized scale from 0 to 100, the mean cumulative preoperative and postoperative XQ scores were 10.33 and 10.54, respectively, with a mean difference of +0.21 (95% CI: −5.66 to 6.07; $p = .472$). Only four of the 22 (18.2%) patients experienced a clinically significant cumulative XQ score increase of at least 10 points. There was no significant mean increase in any of the eight individual XQ question scores. On a scale of 0-10, the mean preoperative and postoperative global dry mouth scores were 1.73 and 1.95, respectively, with a mean change of +0.22 (95% CI: −0.72 to 1.17; $p = .318$).

We performed a subgroup analysis of 16 patients who reported low preoperative global mouth dryness scores (0-1), thereby excluding patients who had preoperative dry mouth symptoms (see Table A1). In this cohort, the mean preoperative and postoperative cumulative XQ scores on a linearized scale from 0 to 100 were 5.54 and 7.53, respectively, with a mean change of +1.99 (95% CI: −5.27 to 9.25; $p = .238$). Again, there was no significant difference in any of the individual XQ question scores in this cohort. The mean preoperative and postoperative global dry mouth scores in this same cohort, on a scale of 0-10, were 0.38 and 1.31 with a statistically significant difference of +0.94 (95% CI: −0.02 to 1.89; $p = .041$).

TABLE 1 Demographic and clinicopathologic characteristics of the patient sample

Characteristic	
Age, years, median [IQR]	54 (34.3-56.0)
Age cohorts, N (%)	
<30 years	5 (22.7)
>30 years <45 years	2 (9.1)
>45 years <60 years	11 (50.0)
>60 years <75 years	4 (18.2)
Gender, N (%)	
Male	6 (27.3)
Female	16 (72.7)
Smoking history, N (%)	
Never	14 (63.6)
Former	6 (27.3)
Current	2 (9.1)
Parotidectomy type, N (%)	
Superficial	14 (63.6)
Partial	7 (31.8)
Total	1 (4.5)
Tumor type, N (%)	
Benign	16 (72.7)
Pleomorphic adenoma	14
Warthin's tumor	1
Lipoma	1
Malignant	6 (27.3)
Squamous cell carcinoma skin/elective parotidectomy	1
Minimally invasive adenocarcinoma	1
Low grade mucoepidermoid	1
Low grade acinic cell	2
Low grade myoepithelial carcinoma	1
Specimen weight, grams, N (%)	
<10 g	12 (54.5)
>10 g	7 (31.8)
Unknown	3 (13.6)
Follow-up, months, median [QR]	10.2 (8.6-11.9)

Subgroup analyses via Mann-Whitney *U*-tests of preoperative to postoperative change in XQ score, on a linearized scale of 0-100, stratified by potential confounding variables are displayed in Table 3. There was no significant difference in the change of XQ scores between patients undergoing partial vs superficial or total parotidectomies (mean change −1.62 vs +1.06, respectively; $p = .524$). Confidence intervals and further details are included in Table 3. There was also no difference with resections of less than 10 g and greater than 10 g (mean change +4.55 vs −7.63, respectively; $p = .216$). Likewise, benign vs malignant pathology displayed no significant difference in XQ score change

TABLE 2 A comparison of preoperative and postoperative University of Michigan Xerostomia Questionnaire scores and global mouth dryness scores in relation to unilateral parotidectomy

	Pre-op mean (95% CI)	Post-op mean (95% CI)	Mean difference (95% CI)	*P*
Xerostomia Questionnaire[a]				
1. Difficulty in speaking due to dryness of your mouth and tongue	1.00 (0.10-1.90)	0.50 (0.08-0.92)	−0.50 (−1.37-0.37)	.857
2. Difficulty in chewing food due to dryness	0.86 (−0.02-1.75)	0.41 (0.01-0.81)	−0.45 (−1.37-0.46)	.692
3. Difficulty in swallowing food due to dryness	1.05 (0.11-1.98)	0.77 (0.07-1.48)	−0.27 (−1.33-0.78)	.595
4. Dryness when eating a meal	0.45 (0.07-0.84)	0.68 (0.10-1.26)	+0.23 (−0.25-0.71)	.229
5. Dryness while not eating or chewing	1.68 (0.72-2.64)	1.77 (0.90-2.65)	+0.09 (−1.00-1.16)	.482
6. Frequency of sipping liquids to aid swallowing food	1.32 (0.61-2.03)	1.73 (0.59-2.87)	+0.41 (−0.67-1.49)	.361
7. Frequency of fluid intake for oral comfort when not eating	1.59 (0.55-2.64)	2.64 (1.34-3.93)	+1.05 (−0.34-2.43)	.128
8. Frequency of sleeping problems due to dryness	1.14 (0.28-1.99)	0.77 (−0.06-1.61)	−0.36 (−1.03-0.30)	.910
Cumulative score (linear transformation, 0-100)	10.33 (4.46-16.20)	10.54 (5.10-15.98)	+0.21 (−5.66-6.07)	.472
Global dry mouth questionnaire				
1. Overall, rate the dryness of your mouth on a scale of 0-10	1.73 (0.69-2.76)	1.95 (1.04-2.87)	+0.2 (−0.72-1.17)	.318

[a]Questions have been summarized from the original survey for brevity and ease of understanding.

TABLE 3 Subgroup analysis of mean preoperative to postoperative change in University of Michigan Xerostomia Questionnaire scores in relation to unilateral parotidectomy stratified by potential confounding variables

Subgroup	Group total, N (%)	Mean change of preop to postop cumulative XQ scores (95% CI)	*P*
Type of parotidectomy			.524
Partial	7 (31.8)	−1.62 (−9.18-5.93)	
Superficial or total	15 (68.2)	+1.06 (−17.94-20.07)	
Mass of parotid specimen excised			.216
<10 g	12 (54.5)	+4.55 (−2.00-11.09)	
≥10 g	7 (31.8)	−7.63 (−16.20-0.94)	
Lesion type			.221
Benign lesion	16 (72.7)	−1.85 (−9.26-5.57)	
Malignant lesion	6 (27.3)	+5.68 (−6.43-17.79)	
Smoking status			.320
Never smoker	14 (63.6)	+3.73 (−2.25-9.72)	
Current or former smoker	8 (36.4)	−5.97 (−13.88-1.95)	
Preoperative medication with a risk of xerostomia			.387
Positive	3 (13.6)	−3.79 (−11.95-4.38)	
Negative	19 (86.4)	+0.84 (−2.41-4.08)	

(−1.85 vs +5.68, respectively; $p = .221$). Smoking status also did not reveal a difference in XQ change (+3.73 for never-smokers vs −5.97 for current or former smokers; $p = .320$). Lastly, patients on preoperative medications with a risk of xerostomia experienced no significant difference in XQ score change from those not on these medications (−3.79 vs +0.84, respectively; $p = .387$).

4 | DISCUSSION

This study found no evidence of a statistically significant worsening in XQ scores or global dry mouth scores in a prospective cohort of 22 patients after unilateral parotidectomy. There was a statistically significant mean increase of 0.94 points, on a scale of 0-10, for the global dry mouth score in the subset population who reported little to no preoperative xerostomia. However, this 0-10 global xerostomia question is not a part of the validated XQ questionnaire; also, we believe this likely does not reflect a clinically significant impact. There was wide variation of reported scores across the sample; still, on an individual basis, less than one quarter of the patients reported a 10-point increase in cumulative XQ score between preoperative and postoperative survey.

The lack of definite consistent xerostomia effect from a unilateral parotidectomy may be due to several phenomena. There may be compensation from other remaining salivary glands, as has been suggested by other studies.[2] Also, the parotid glands, which together secrete approximately a quarter of unstimulated saliva production, or one eighth of saliva from one gland, may have limited noticeable contribution to the patient perception of normal salivation.[1] Additionally, because over a third of the sample reported some degree of preoperative xerostomia, any changes brought by loss of partial unilateral parotid gland may have been disguised by ongoing baseline xerostomia. This proportion of baseline xerostomia in our study mirrors that of the greater population in which 14% to 46% reports dry mouth symptoms, which can be due multiple etiologies including medications, iatrogenic, autoimmune conditions, or idiopathic.[19] There could also be underlying differences in salivary production between normal and pathologic parotid glands prior to parotidectomy that would explain the lack of postoperative changes; however, studies have shown no difference in salivary production in pathologic compared to individual's non-diseased gland.[20]

We acknowledge that there are several limitations with this study. First, the sample size may limit the ability to detect subtle differences. While the XQ has high validity, reliability and internal consistency with a test-retest correlation of 0.84, there is not a well-defined clinically significant difference in patient-reported scores. A previous study used a 10-point difference in the XQ questionnaire to reflect a clinically meaningful difference[21]; however, there is not a robust source of evidence evaluating the normative distribution of scores to determine a clinically significant difference in scores. With this 10-point difference representing meaningful change, we performed a power calculation. For a one-tailed probability value, with 80% power, 5% type I error, the sample size needed to detect a 10-point difference in XQ scores is 14 patients, assuming the SD of the population reflects the SD of 15 seen in our population. If the true SD of the population were to range from 10 to 25, the minimal detectable difference in scores would range from 5.4 to 13.4. Therefore, we believe our sample of 22 patients should be able to detect a clinically significant difference. We did not identify a trend towards this 10-point difference; however, smaller differences may not be detectable with this sample size. As ongoing research continues to evaluate xerostomia PROM using the XQ, it will be important to gather more data to define a meaningful difference in symptom scores.

Other sources of bias include the presence of other confounding factors contributing to xerostomia such as medications, comorbidities, or smoking status. In our sample, three (13.6%) of the patients were taking medications with a known risk of xerostomia. However, our subgroup analysis demonstrated no difference in either preoperative or postoperative xerostomia scores compared to the rest of the sample. None of the patients in this study had any comorbidities known to cause xerostomia. Over one-third of the patients in this study had a history of current or past smoking which may have contributed to their symptoms; however, the analysis revealed no difference in their preoperative or postoperative scores compared to the never-smoker population. Surveys of any kind are subject to expectation bias regarding expected symptoms post-parotidectomy which may have influenced survey results toward worse scores. Lastly, while we stratified the data based on tumor size for our analysis, we did not standardize the surgical resection size given the natural variation in tumor size. This study did not analyze salivary flow rates or objective measures of saliva production. While these are important, we believe the patient's perceptual experience with dry mouth is an equally, if not more important outcome requiring evaluation.

5 | CONCLUSION

This study suggests unilateral parotidectomy does not result in a consistent clinically significant increase in patient-reported xerostomia. This study also found no differences in the xerostomia-related functions of speaking, chewing, eating, drinking, swallowing and sleeping. More extensive resections were not associated with worse xerostomia symptom scores. These data can help guide preoperative counseling and postoperative expectations for parotidectomy. Future studies on larger scale are warranted to test for subtle differences in xerostomia symptoms as well as defining clinically significant changes.

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CONFLICT OF INTEREST

William R. Ryan is on the scientific advisory boards for Olympus, Medtronic, and Rakuten. The department receives educational funding from Stryker, Synthes, and Medtronic.

AUTHOR CONTRIBUTIONS

Kara D. Brodie involved in study design, data collection, data analysis, and manuscript preparation. Aaron L. Zebolsky involved in data analysis and manuscript preparation. Edgar Ochoa involved in study design, data collection, and data analysis. Patrick K. Ha, Chase M. Heaton, and Ivan H. El-Sayed involved in study conduct and manuscript

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APPENDIX A.

TABLE A1 Subgroup analysis of patients with low preoperative global mouth dryness scores comparing preoperative and postoperative University of Michigan Xerostomia Questionnaire and global dry mouth scores in relation to unilateral parotidectomy

	Pre-op mean (95% CI)	Post-op mean (95% CI)	Mean difference (95% CI)	*p*
Xerostomia Questionnaire[a]				
1. Difficulty in speaking due to dryness	0.69 (−0.41-1.79)	0.19 (−0.10-0.45)	−0.50 (−1.63-0.63)	.715
2. Difficulty in chewing food due to dryness	0.63 (−0.48-1.73)	0.25 (−0.03-0.53)	−0.38 (−1.55-0.80)	.500
3. Difficulty in swallowing food due to dryness	0.63 (−0.48-1.73)	0.44 (−0.07-0.94)	−0.19 (−1.46-1.08)	.446
4. Dryness when eating a meal	0.13 (−0.12-0.37)	0.44 (0.04-0.84)	+0.31 (−0.12-0.74)	.102
5. Dryness while not eating or chewing	0.63 (−0.02-1.27)	1.25 (0.23-2.27)	+0.63 (−0.63-1.88)	.223
6. Frequency of sipping liquids to aid swallowing food	1.00 (0.26-1.74)	1.50 (0.07-2.93)	+0.50 (−0.74-1.74)	.287
7. Frequency of fluid intake for oral comfort when not eating	0.81 (0.21-1.41)	2.25 (0.71-3.79)	+1.44 (−0.15-3.03)	.070
8. Frequency of sleeping problems due to dryness	0.38 (0.02-0.73)	0.31 (−0.30-0.93)	−0.06 (−0.69-0.57)	.710
Cumulative score (linear transformation, 0-100)	5.54 (0.72-10.36)	7.53 (2.13-12.93)	+1.99 (−5.27-9.25)	.238
Global dry mouth questionnaire, n = 15				
1. Overall mouth dryness (0-10)	0.38 (0.13-0.62)	1.31 (0.34-2.29)	+0.94 (−0.02-1.89)	.041

[a]Questions have been summarized from the original survey for brevity and ease of understanding.